

Bridge Rail Rating Guide

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Bridge Rail Rating Guide

Glossary

Instructions:

1. Begin with the bridge railing section of the bridge rail you are inspecting.
2. Fill in the information at the top of the Bridge Railing Criteria Checklist.
3. Find the bridge railing that best represents the inspected railing in the Bridge Railing Glossary.
4. Go through each of the lettered criteria and check the box on the Criteria Checklist if the inspected railing meets the standards.
5. Since it is not possible to list all the types of railings in the glossary, one must use proper judgment and use the glossary as a guide if the inspected bridge element is not exactly like one in the glossary.
6. Give the bridge railing a rating of 1 if all the boxes on the Criteria Checklist are checked.
7. Give the bridge railing a rating of 0 if not all the boxes on the Criteria Checklist are checked.

Note: If there are no hazards or miscellaneous criteria listed in the glossary for a particular bridge rail element, those boxes should receive a check mark on the Criteria Checklist.

8. Repeat steps 1 through 7 for the three remaining bridge rail elements in the following order: approach rail, transition, and end terminal.

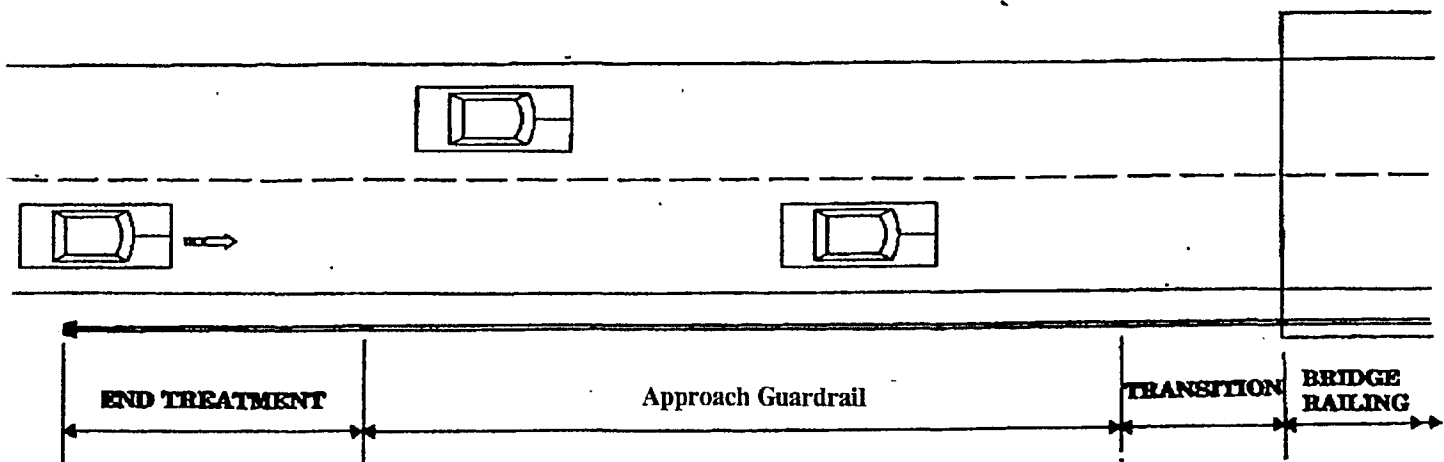


Diagram of the Four Main Bridge Rail Elements

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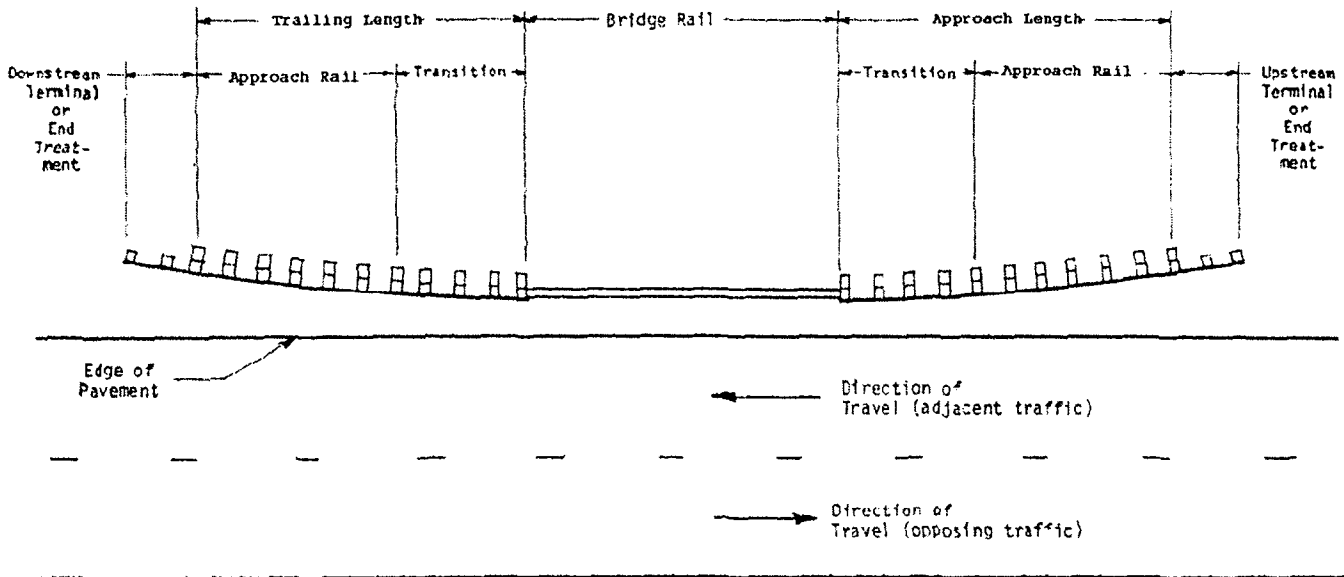
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Definitions and Abbreviations

➤ Bridge Rail Elements



➤ TL-2 Crash Test Level: (Also known as Performance Level 1: PL-1)

Consists of two full-scale crash tests:

- 17) 1800 pound passenger car impacting the structure at 50 MPH and 20 degrees
- 16) 5400 pound pickup truck impacting the structure at 45 MPH and 20 degrees

➤ TL-4 Crash Test Level: (Also known as Performance Level 2 : PL-2)

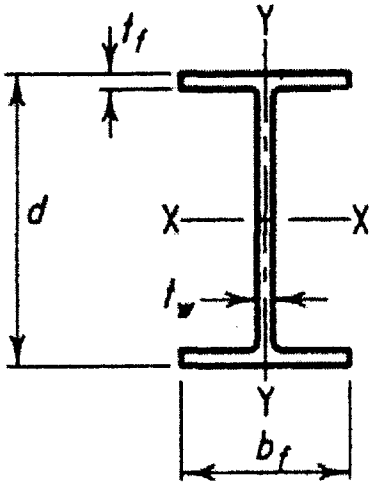
Consists of three full-scale crash tests:

- 1) 1800 pound passenger car impacting the structure at 60 MPH and 20 degrees
- 2) 5400 pound pickup truck impacting the structure at 60 MPH and 20 degrees
- 3) 18000 pound single-unit truck impacting the structure at 50 MPH and 15 degrees

➤ Post Sizes:

➤ Post Sizes:

W-Shape

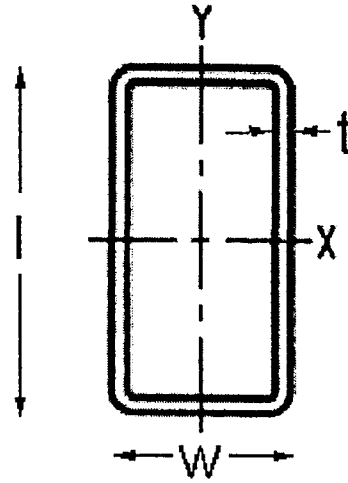


W6x9:
 $d = 5.9''$
 $t_w = 0.17''$
 $t_f = 0.22''$
 $b_f = 3.94''$

W8x24:
 $d = 7.93''$
 $t_w = 0.25''$
 $t_f = 0.40''$
 $b_f = 6.50''$

W6x25:
 $d = 6.38''$
 $t_w = 0.32''$
 $t_f = 0.46''$
 $b_f = 6.08''$

TS-Shape



TS6x3x0.25
 $l = 6''$
 $w = 3''$
 $t = 0.25''$

TS5x5x0.25
 $l = 5''$
 $w = 5''$
 $t = 0.25''$

TS8x4x0.1875
 $l = 8''$
 $w = 4''$
 $t = 0.1875''$

Section 1

Bridge Railings

Bridge Railing Criteria Checklist

County_____

Bridge No._____

Type of Bridge Railing (as named in glossary)_____



A. Does the bridge railing meet the minimum post spacing?



B. Is the bridge railing on a road with less than the allowable traffic volume and/or design speed?



C. Is the distance from the top of rail to the bridge deck approximately the standard distance?



D. Do the post sizes correspond to the standard?



E. Is the rail size approximately the same as the standard?



F. Is the bridge railing safe from all possible hazards?



G. Does the bridge railing meet the miscellaneous standards?*

* If applicable

If all criteria were met, this bridge railing should be given a rating of 1. If not all criteria were met, it should be given a rating of 0.

Rating_____

W-Beam Guardrail (over culverts)

- A. Post spacing:
- For single W-beam spans, spacing is 6'-3"
 - For nested W-beam spans, spacing may be up to 18'-9" if adjacent to nested spans of 6'-3"
- B. Maximum Traffic Speed: 60 MPH
- C. Distance of top of rail to bridge deck: 27"
- D. Post sizes: see "M-Shaped Approach Guardrail"
- E. Rail size: see "M-Shaped Approach Guardrail"
- F. Hazards:
- Should only be used over low-fill culverts where side post mounting is not possible
 - W-beam should be overlapped in the direction of traffic flow (see Figure 1.1)
 - Free from corrosion and collision damage
 - Loose bolts
- G. Miscellaneous: Does not need a transition

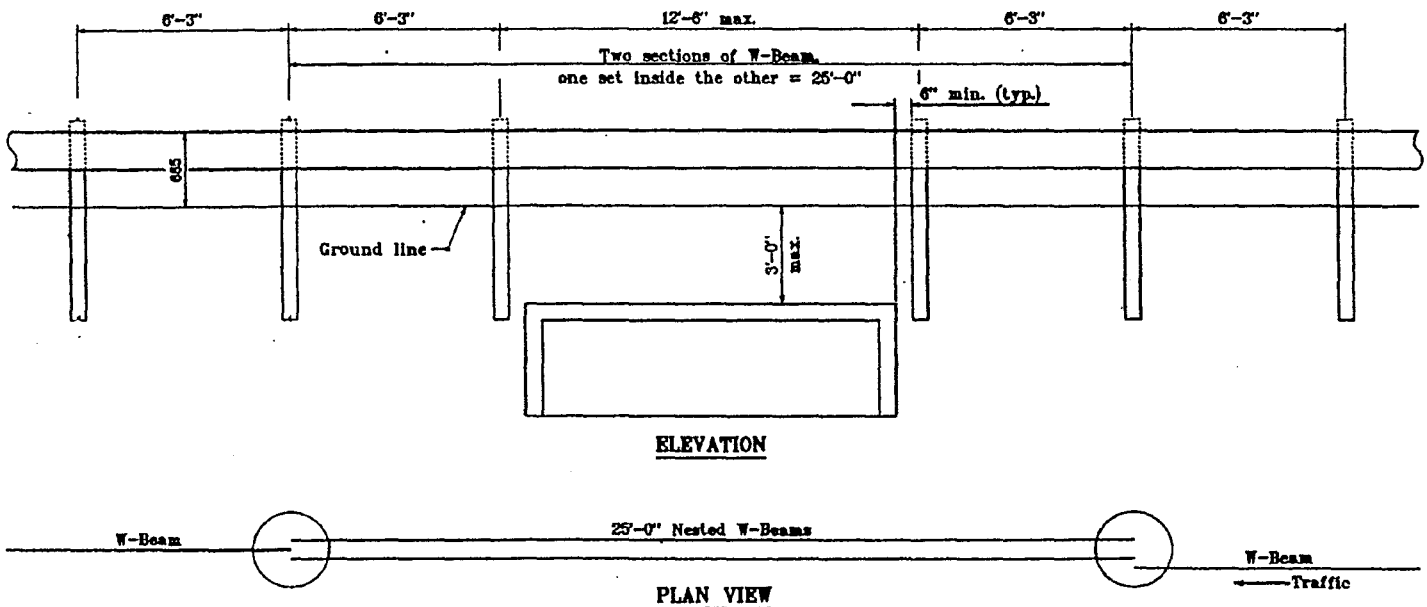


Figure 1.1: Nested Guardrail Over Culverts

Service Level 1 (SL-1) Bridge Railing

(Thrie Beam Rail)

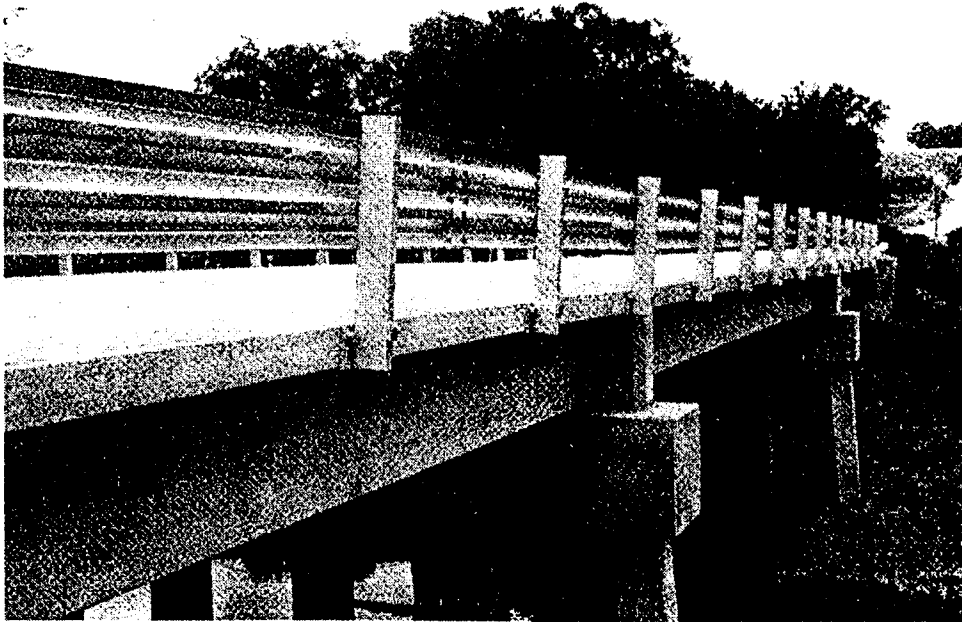


Figure 1.2: Example of SL-1 Type Bridge Railing

- A. Post Spacing: 8'-4"
- B. Maximum design speed and traffic volume: See Table 1.1
- C. Top of Rail to Bridge Deck Distance: 31"
- D. Post Size:
 - Steel: W6x9 or TS 6x3x0.25
- E. Rail Size: Width = 20"
- F. Hazards:
 - Should be firmly side mounted to deck
 - Thrie beam should be overlapped in the direction of traffic flow
 - Free from corrosion and collision damage
 - Loose bolts
- G. Miscellaneous:

Crash Test Data:

Redirected full-sized auto impact at 60mph and 15 degrees

Redirected 20,000 pound school bus at 45mph and 7 degrees

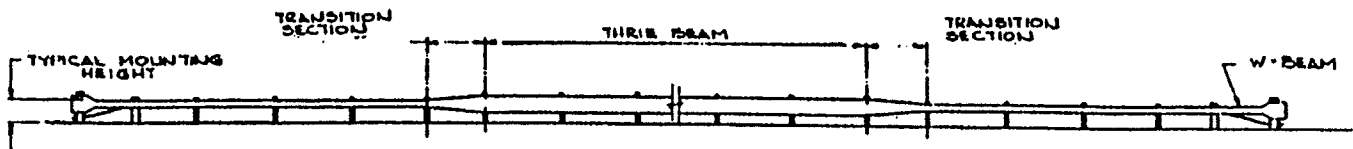


Figure 1.3: Typical Type SL-1 Bridge Rail System

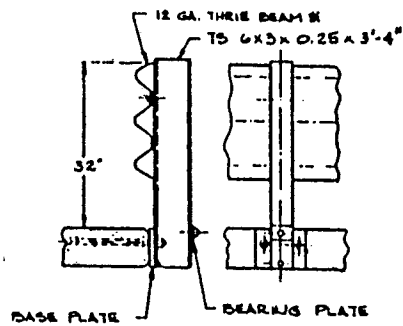


Figure 1.4: Thrie Beam Standard Drawings

New Jersey Parapet



Figure 1.5: Example of New Jersey Type Barrier

- A. No posts (N/A)
- B. Maximum design speed and traffic volume: See Table 1.2
- C. Typical distance from top of rail to bridge deck: 2'-10"
- D. No posts (N/A)
- E. Rail Size: see Figure 1.6
- F. Hazards:
 - Damaged or cracked concrete
 - Uneven barrier segments causing a potential for snagging
- G. Miscellaneous: Delineators should be mounted on the side of bridge railing

Crash Test Level: TL-4

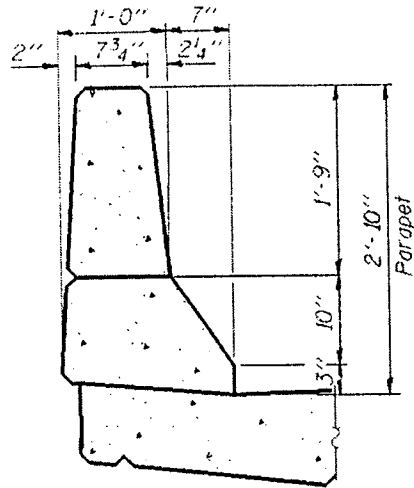


Figure 1.6: New Jersey Type Barrier Cross-Section

Indiana Common 2'-9" Height Concrete Bridge Railing (Type CBR)

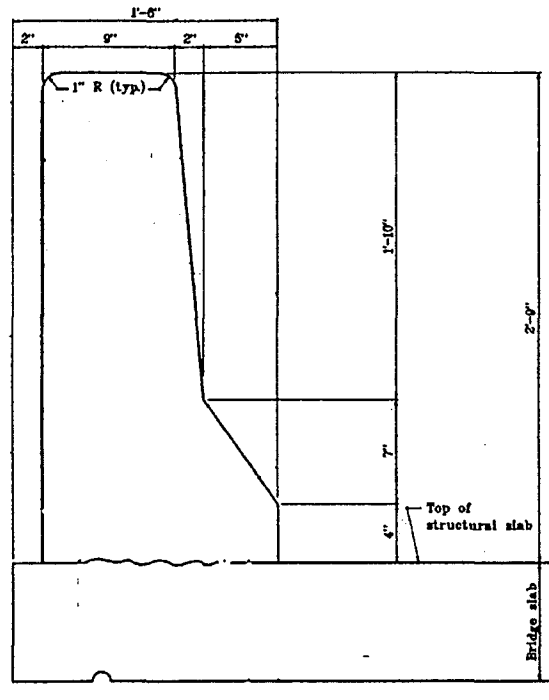


Figure 1.7: Indiana 2'-9" Concrete Bridge Railing Cross-Section

- A. Post Spacing: no posts (N/A)
- B. Maximum design speed and traffic volume: See Table 1.2
- C. Distance from top of rail to bridge deck: 2'-9"
- D. Post Sizes: no posts (N/A)
- E. Rail Size: (see Figure 1.7)
- F. Hazards:
 - Damaged or cracked concrete
 - Uneven barrier segments causing a potential for snagging
- G. Miscellaneous: Delineators should be mounted on the side of bridge railing

Crash Test Level: TL-4

Texas Concrete Traffic Rail (Type TX)

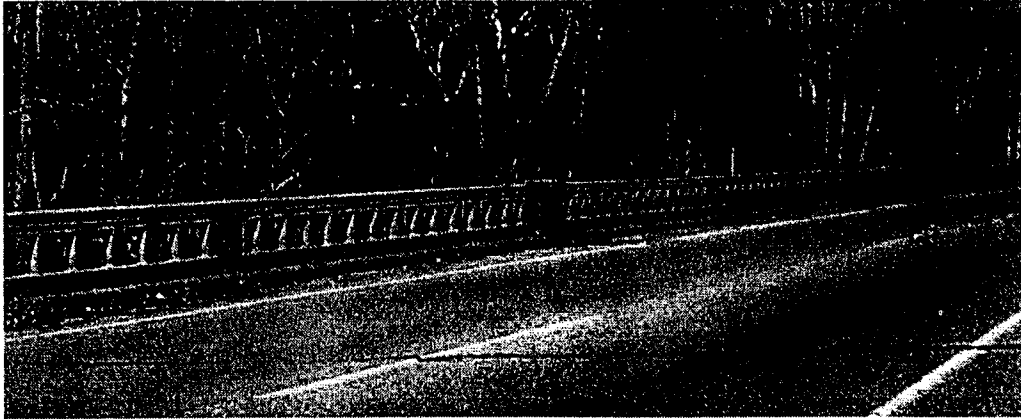


Figure 1.8: Example of Texas Classic Concrete Traffic Rail

- A. Post Spacing: Typically 8" wide openings between concrete columns
Maximum of 30' between span pilasters (See Figure 1.9)
- B. Maximum design speed and traffic volume: see Table 1.1
- C. Distance from top of rail to bridge deck: 2'-8"
- D. Post Size: Typically 10" wide (See Figure 1.9)
- E. Rail Size: Minimum barrier depth = 10"
- F. Hazards:
 - Bridge rails or parapets with abrupt vertical faces at right angles to the direction of traffic can result in vehicle snagging.
 - Severely damaged or cracking concrete
- G. Miscellaneous: A sidewalk of 5 ft. minimum width is required with this railing.

Crash Test Level: TL-2

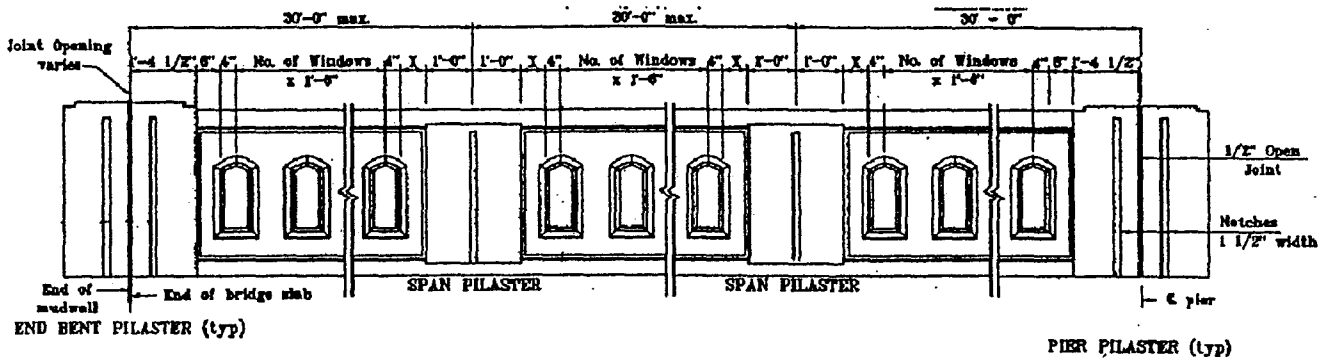


Figure 1.9: Texas Concrete Traffic Railing (Elevation View)

North Carolina Standard 1 Bar Metal Rail

(Aluminum or Galvanized Steel Railing on Vertical Faced Concrete Parapet)



Figure 1.10: Example of North Carolina 1 Bar Metal Railing

- A. Post Spacing: 8' for metal posts
- B. Maximum design speed and traffic volume: see Table 1.1
- C. Distance from top of rail to bridge deck: 32"
- D. Post Sizes: Height of metal post = approximately 1'
Height of concrete parapet = approximately 1'-6" (See Figure 1.11)
- E. Rail Size: Concrete parapet thickness = 1'
- F. Hazards: Metal rail should be continuous and gradually flare down at the ends
(See Figure 1.10)
- G. Miscellaneous:

Crash Test Level: TL-2

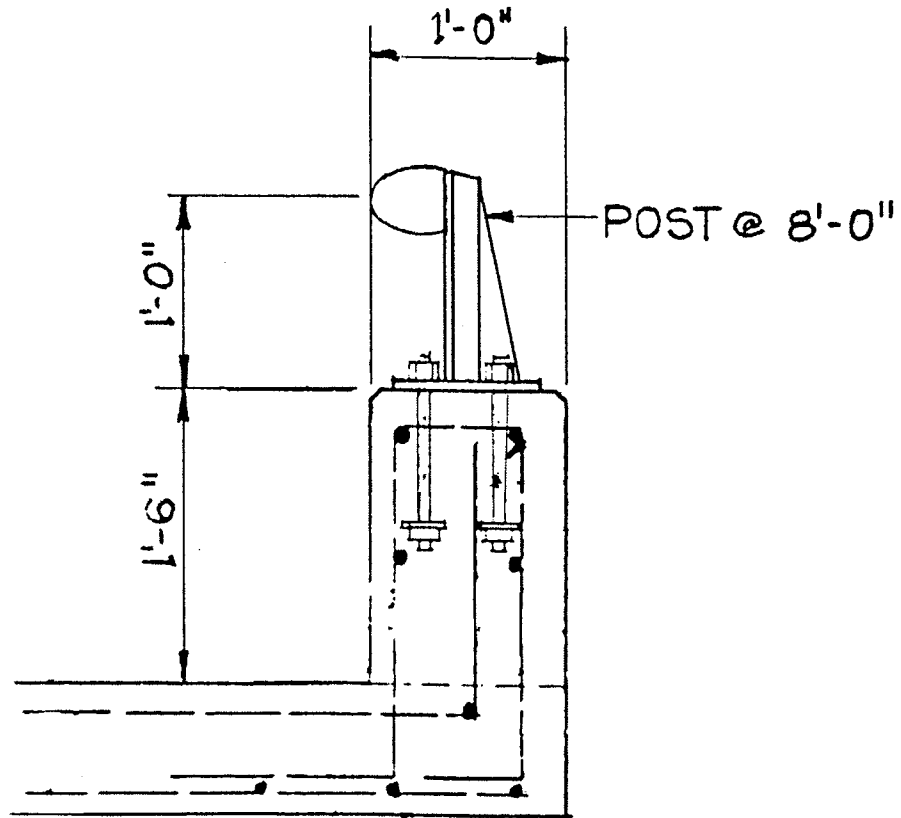


Figure 1.11: N.C. Standard 1 Bar Metal Rail Cross-Section

Indiana Type 5 or 6 Aluminum Bridge Railing

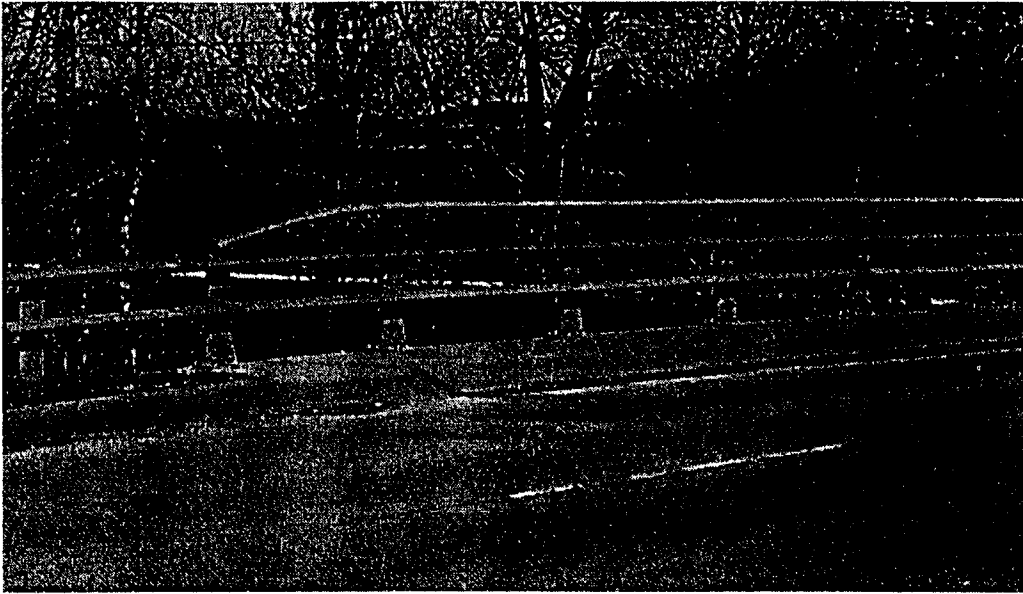


Figure 1.12: Example of Type 6 Aluminum Bridge Railing

- A. Post Spacing: 6'-6" maximum
- B. Maximum design speed and traffic volume: see Table 1.1
- C. Distance from top of rail to bridge deck:
 - For 2 rails (type 5): approximately 2'-3"
 - For 3 rails (type 6): approximately 3'-6.5" (See Figure 1.13)
- D. Post Size: Type D post or approximately W8x24 (see Figure 1.13 for relative size)
- E. Rail Size: 4.75" x 3.75" semi-ellipse aluminum rail
- F. Hazards:
 - Bridge rail splice bars should be placed at rail joints to maintain continuity
 - If curb is present, face of curb should be less than 9" from railing
 - Posts should be firmly anchored into the bridge deck
- G. Miscellaneous:

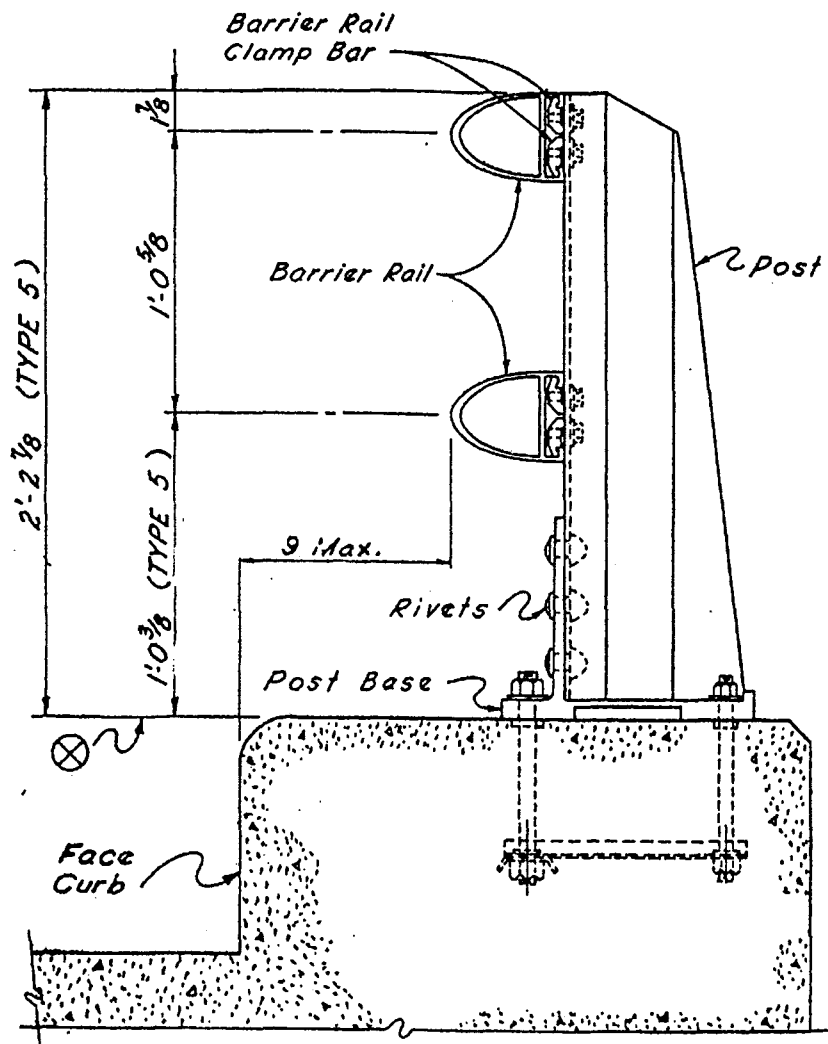


Figure 1.13: Type 5 Aluminum Bridge Railing Cross-Section

Indiana Type C or D Steel Bridge Railing



Figure 1.14: Example of Type C Steel Tube Bridge Railing

- A. Spacing: 6'-6" maximum
- B. Maximum design speed and traffic volume: See Table 1.1
- C. Distance from top of rail to bridge deck:
 - For 2 rails (type 5): approximately 2'-3" to 2'-8"
 - For 3 rails (type 6): approximately 3'-6.5" (See Figure 1.15)
- D. Post Size: type D post or approximately W8x24 (see Figure 1.15 for relative size)
- E. Rail Size: 4 x 3 x 1/4 rectangular steel tubing
- F. Hazards:
 - Bridge rail splice bars should be placed at rail joints to maintain continuity
 - If curb is present, face of curb should be less than 9" from railing
- G. Miscellaneous:

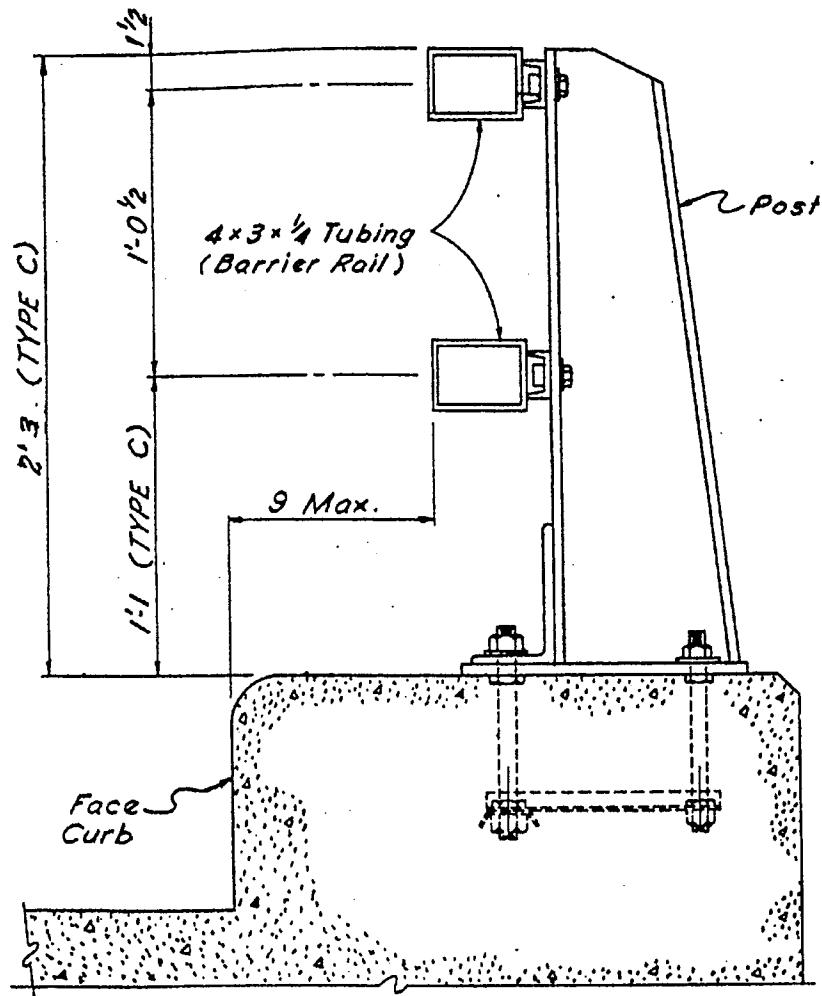


Figure 1.15: Type C Steel Tube Bridge Railing Cross-Section

CF-1 Type Bridge Railing

(Curb, Flush Mount)

- A. Post spacing: 10'
- B. Maximum design speed and traffic volume: See Table 1.1
- C. Distance from top of railing to bridge deck: approximately 35"
- D. Post Sizes: W8x24 steel
- E. Rail Size: Two TS 5x5x0.25 tubes spaced 14" apart
- F. Hazards: No sidewalks are to be placed adjacent to this bridge railing.
- G. Miscellaneous: Steel posts are mounted on 10" raised concrete slab

Crash Test Level: TL-4

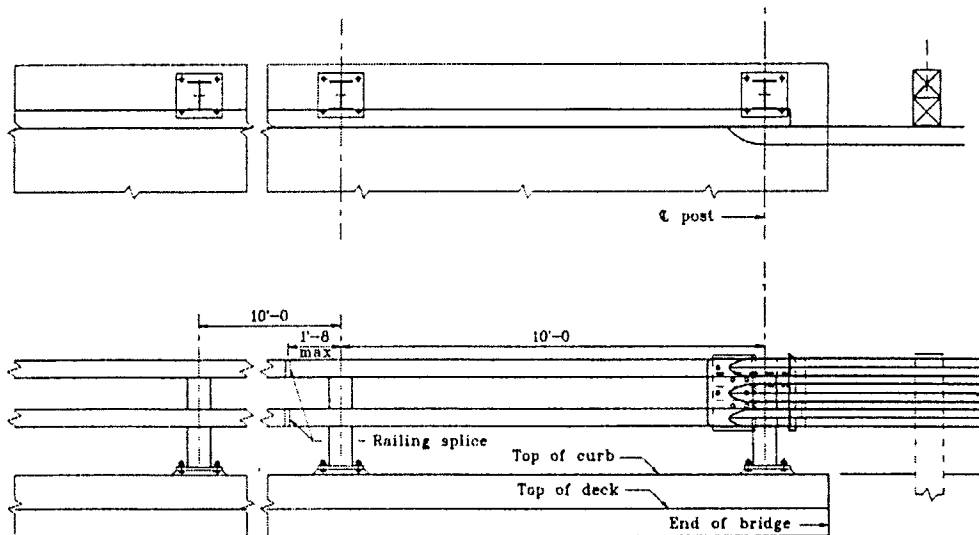


Figure 1.16: Type CF-1 Bridge Railing (Elevation View)

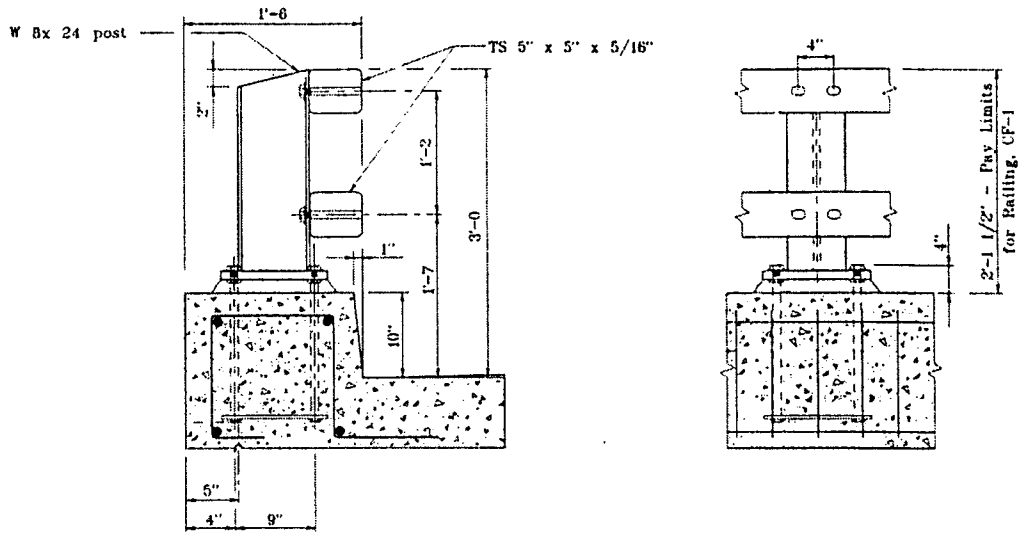


Figure 1.17: Type CF-1 Bridge Railing Curb and Post Detail

Texas Type T6 Bridge Railing

- A. Post Spacing: 6'-3"
 - B. Maximum design speed and traffic volume: See Table 1.1
 - C. Distance from top of rail to bridge deck: approximately 27"
 - D. Post sizes: steel W6x9 or W6x8.5
 - E. Rail Size: Two W-Beam members welded together to form a tubular shape (see "M-Shaped Approach Guardrail")
 - F. Hazards:
 - Free from corrosion and collision damage
 - Loose bolts
 - G. Miscellaneous: No transition is needed if M-shaped approach rail is used
- Crash Test Data: redirected 4500 pound vehicle at 62 MPH and 27.5 degrees

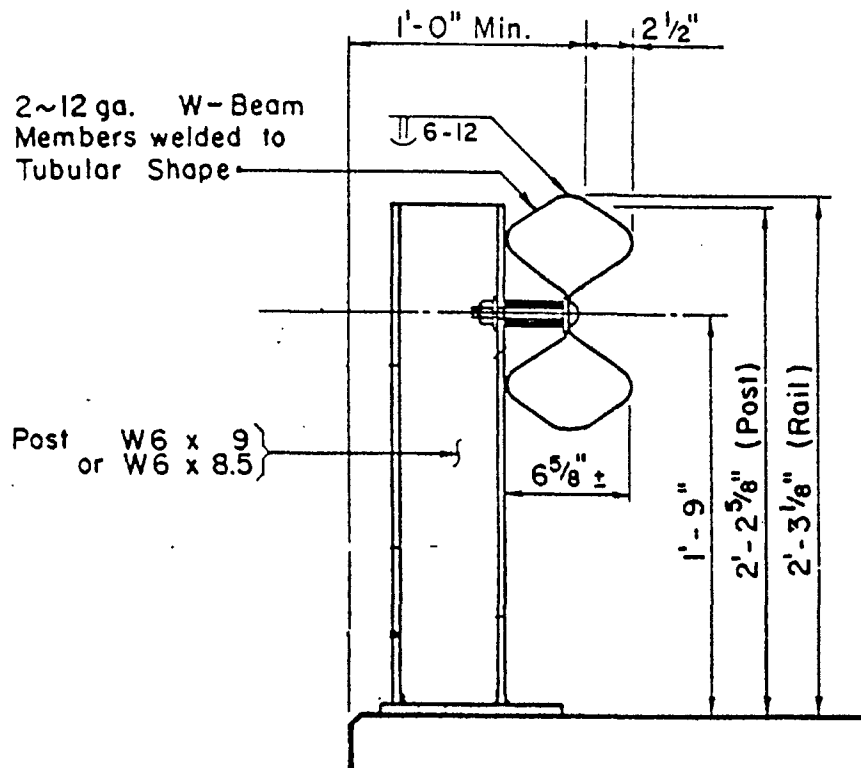


Figure 1.18: Texas Type T6 Bridge Railing Cross-Section

Ohio Box Beam Railing

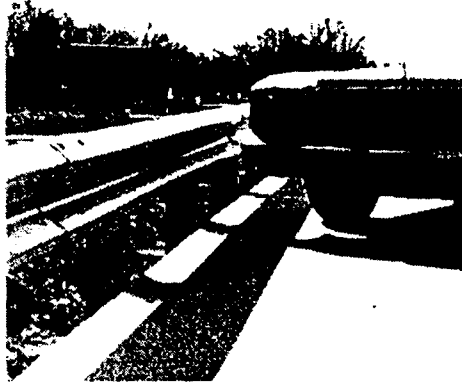


Figure 1.19: Example of Ohio Box Beam Bridge Railing

- A. Post Spacing: 6'-3"
- B. Maximum design speed and traffic volume: See Table 1.1
- C. Distance from top of rail to bridge deck: approximately 27"
- D. Post Size: Steel W6x25
- E. Rail Size: Standard W-Beam rail (see "M-Shaped Approach Guardrail") backed by TS 8x4 steel tubing (6" long) on each post (See Figure 1.20)
- F. Hazards:
 - Damage to anchors and/or concrete where posts are attached to deck
 - W-beam should be overlapped in the direction of traffic flow
 - Free from corrosion and collision damage
 - Loose bolts
- G. Miscellaneous:
 - Railing should be side mounted to bridge deck
 - No transition is needed if M-shaped approach rail is used

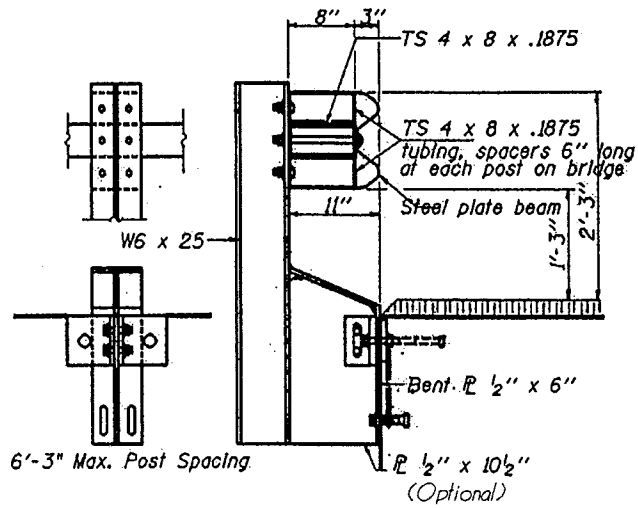


Figure 1.20: Ohio Box Beam Bridge Railing Cross-Section

Table 1.1 Threshold Warrants for TL-2 Bridge Railings

INSTRUCTIONS:

To find if the bridge railing falls within the design speed and traffic limits:

1. Find the appropriate table for your bridge (divided or undivided).
2. Find where your design speed, % trucks in AADT, and barrier offset intersect on the table.
3. If the average daily truck volume on your bridge is less than that on the table, your bridge railing meets the requirements.
4. If the average daily truck volume on your bridge is greater than that on the table, your bridge railing does not meet the traffic speed/volume standards.

Divided (Rural/Urban) Non-Freeway

Average Daily Truck Volume in Design Year							
Percent Trucks in Total AADT	Barrier Offset from Edge of Travelway	Design Speed (MPH)					
		31	37	43	50	56	62
5% or less	1 - 6.9 ft.	5,900	2,700	950	450	300	200
	6.9 - 11.8 ft.	9,700	4,150	1,350	600	400	250
	>11.8 ft.	20,550	8,200	2,100	850	500	300
>5% but <10%	1 - 6.9 ft.	4,850	2,700	1,450	800	550	400
	6.9 - 11.8 ft.	7,400	4,000	1,900	1,050	750	500
	>11.8 ft.	13,300	6,600	2,850	1,400	950	600
10% or more	1 - 6.9 ft.	4,600	2,700	1,700	1,050	750	550
	6.9 - 11.8 ft.	6,900	4,000	2,250	1,350	1,000	700
	>11.8 ft.	11,950	6,500	3,300	1,850	1,300	900

Undivided (Rural/Urban) Arterials, Collectors, and Locals

Average Daily Truck Volume in Design Year						
Percent Trucks in Total AADT	Barrier Offset from Edge of Travelway	Design Speed (MPH)				
		31	37	43	50	56
5% or less	1 - 6.9 ft.	4,850	2,150	700	300	200
	6.9 - 11.8 ft.	8,400	3,500	1,050	450	250
	>11.8 ft.	18,000	7,100	1,700	600	350
>5% but <10%	1 - 6.9 ft.	3,800	2,100	1,000	550	350
	6.9 - 11.8 ft.	6,150	3,150	1,450	750	500
	>11.8 ft.	11,150	5,400	2,200	1,000	650
10% or more	1 - 6.9 ft.	3,600	2,100	1,200	700	500
	6.9 - 11.8 ft.	5,650	3,150	1,650	950	650
	>11.8 ft.	9,900	5,200	2,450	1,300	850

INSTRUCTIONS:

To find if the bridge railing falls within the design speed and traffic limits:

1. Find the appropriate table for your bridge (divided or undivided).
2. Find where your design speed, % trucks in AADT, and barrier offset intersect on the table.
3. If the average daily truck volume on your bridge is less than that on the table, your bridge railing meets the requirements.
4. If the average daily truck volume on your bridge is greater than that on the table, your bridge railing does not meet the traffic speed/volume standards.

Undivided Rural Arterials

Average Daily Truck Volume in Design Year						
Percent Trucks in Total AADT	Barrier Offset from Edge of Travelway	Design Speed (MPH)				
		43	50	56	62	68
15% or less	1 - 6.9 ft.	7,400	5,500	4,400	3,800	3,200
	6.9 - 11.8 ft.	10,600	6,400	5,100	4,200	3,800
	>11.8 ft.	15,700	8,800	6,800	5,400	4,600
More than 15%	1 - 6.9 ft.	6,700	4,900	4,100	3,500	3,200
	6.9 - 11.8 ft.	9,300	5,700	4,500	3,800	3,500
	>11.8 ft.	13,600	7,800	6,100	4,900	4,400

Rural/Urban Freeways

Average Daily Truck Volume in Design Year					
Percent Trucks in Total AADT	Barrier Offset from Edge of Travelway	Design Speed (MPH)			
		50	56	62	68
15% or less	1 - 6.9 ft.	8,600	7,500	6,600	6,000
	6.9 - 11.8 ft.	9,900	8,300	7,200	6,400
	>11.8 ft.	12,400	10,500	9,100	8,200
More than 15%	1 - 6.9 ft.	7,900	6,900	6,300	5,800
	6.9 - 11.8 ft.	8,800	7,500	6,600	6,300
	>11.8 ft.	11,000	9,400	8,300	7,500

Undivided Rural Collectors/Locals

Average Daily Truck Volume in Design Year						
Percent Trucks in Total AADT	Barrier Offset from Edge of Travelway	Design Speed (MPH)				
		43	50	56	62	68
15% or less	1 - 6.9 ft.	7,700	5,800	4,600	3,900	3,300
	6.9 - 11.8 ft.	11,100	6,700	5,300	4,400	3,900
	>11.8 ft.	16,400	9,300	7,100	5,600	4,900
More than 15%	1 - 6.9 ft.	7,000	5,200	4,300	3,600	3,300
	6.9 - 11.8 ft.	9,700	5,900	4,700	3,900	3,600
	>11.8 ft.	14,300	8,200	6,400	5,200	4,600

Rural Non-Freeways

Average Daily Truck Volume in Design Year					
Percent Trucks in Total AADT	Barrier Offset from Edge of Travelway	Design Speed (MPH)			
		50	56	62	68
15% or less	1 - 6.9 ft.	8,000	7,000	6,100	5,500
	6.9 - 11.8 ft.	9,100	7,700	6,700	5,900
	>11.8 ft.	11,500	9,700	8,400	7,500
More than 15%	1 - 6.9 ft.	7,300	6,400	5,800	5,400
	6.9 - 11.8 ft.	8,100	7,000	6,100	5,800
	>11.8 ft.	10,200	8,700	7,700	7,000

Undivided Urban Facilities

Average Daily Truck Volume in Design Year						
Percent Trucks in Total AADT	Barrier Offset from Edge of Travelway	Design Speed (MPH)				
		43	50	56	62	68
15% or less	1 - 6.9 ft.	7,300	5,500	4,300	3,700	3,200
	6.9 - 11.8 ft.	10,500	6,300	5,000	4,200	3,700
	>11.8 ft.	15,500	8,800	6,800	5,300	4,600
More than 15%	1 - 6.9 ft.	6,600	4,900	4,000	3,400	3,200
	6.9 - 11.8 ft.	9,200	5,600	4,500	3,700	3,400
	>11.8 ft.	13,500	7,800	6,000	4,900	4,300

Urban Non-Freeways

Average Daily Truck Volume in Design Year						
Percent Trucks in Total AADT	Barrier Offset from Edge of Travelway	Design Speed (MPH)				
		43	50	56	62	68
15% or less	1 - 6.9 ft.	10,000	7,900	6,900	6,000	5,500
	6.9 - 11.8 ft.	14,000	9,100	7,600	6,600	5,900
	>11.8 ft.	18,600	11,400	9,600	8,300	7,500
More than 15%	1 - 6.9 ft.	8,700	7,200	6,300	5,700	5,300
	6.9 - 11.8 ft.	12,100	8,000	6,900	6,000	5,700
	>11.8 ft.	15,900	10,100	8,600	7,600	69,000

Section 2

Approach Rail

Approach Guardrail Criteria Checklist

County_____

Bridge No._____

Type of Approach Guardrail (as named in glossary)_____



A. Does the approach guardrail meet the minimum post spacing?



B. Does the approach guardrail approximately meet the minimum length for approaching traffic?



C. Does the approach guardrail approximately meet the minimum length for trailing traffic?



D. Does the approach guardrail have a flare rate less than the maximum?



E. Is the distance from the top of rail to the ground approximately the standard distance?



F. Do the post (and block) sizes correspond to the standard?



G. Is the rail size approximately the same as the standard?



H. Is the approach rail safe from all possible hazards?

If all criteria were met, this approach guardrail should be given a rating of 1. If not all criteria were met, it should be given a rating of 0.

Rating_____

M-Shaped Approach Guardrail (Blocked Out W-Beam)



Figure 2.1: Example of Blocked Out W-Beam Approach Rail

A. Post Spacing: 6'-3"

[A maximum post spacing of 12'-6" may be used if two sections of W-beam guardrail is used, one set inside the other (nested)]

B. Approach Length: for approaching traffic (applies to most bridges)

Design Speed (MPH)	Design Year ADT		Current Year ADT	
	Over 2000	1001 - 2000	400 - 1000	Under 400
70	262'	262'	262'	224'
60	212'	212'	187'	162'
50	124'	124'	100'	100'
40	62'	50'	50'	50'

C. Trailing Length: for trailing traffic (applies to most bridges)

Design Speed (MPH)	Design Year ADT		Current Year ADT	
	Over 2000	1001 - 2000	400 - 1000	Under 400
70	87'	87'	62'	50'
60	62'	50'	50'	50'
50	50'	50'	50'	50'
40	50'	50'	50'	50'

D. Maximum Flare Rate: (it is acceptable not to have a flared approach rail)

Design Speed	70 MPH		60 MPH		50 MPH		40 MPH		30 MPH	
Rail Offset from Edge of Lane	<10'	≥10'	<8'	≥8'	<6'	≥6'	<5'	≥5'	<4'	≥4'
Flare Rate	30:1	15:1	26:1	13:1	21:1	11:1	17:1	9:1	13:1	8:1

E. Recommended ground to top of railing distance: 27"

F. Post Size:

- Timber: 6" x 8"
- Steel: W 6 x 8.5

Block Size:

- Timber: Height = 14", Width = 6", Depth = 8"
- Steel: I-shaped, Height = 19", Depth = 6"

G. Rail Size: Width = 12.25" (See Figure 2.2)

H. Hazards:

- W-Beam should be overlapped in the direction of traffic flow
- Deterioration and collision damage
- Loose bolts
- Lack of continuity (snagging potential)

Crash Test Data: Upper performance limit is a 4650 pound impact at 59 MPH at 21 degrees.

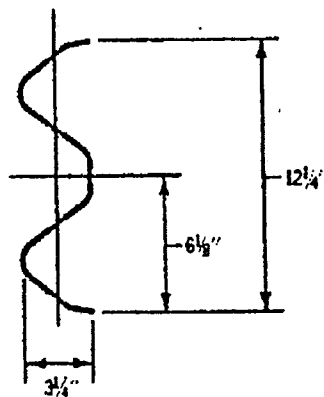


Figure 2.2: M-Shape Rail (W-Beam) Detail

Steel-Backed Timber Rail

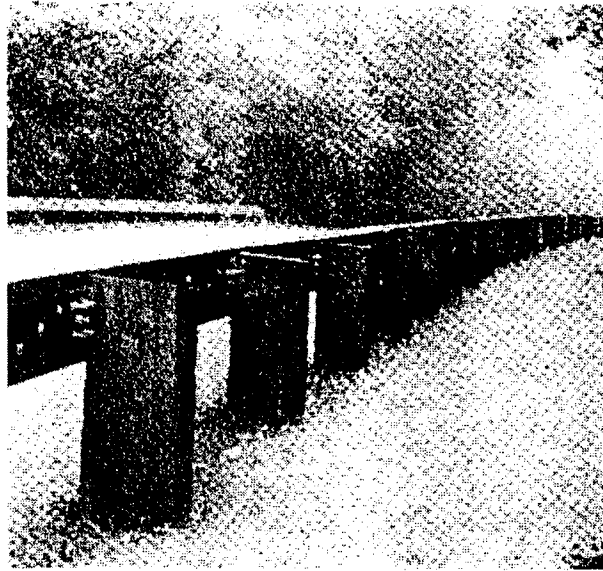


Figure 2.3: Example of Steel-Back Timber Approach Rail

- A. Post Spacing: Maximum = 9'-9"
- B. Approach Length: see "M-Shaped Approach Guardrail"
- C. Trailing Length: see "M-Shaped Approach Guardrail"
- D. Maximum Flare Rate: see "M-Shaped Approach Guardrail"
- E. Recommended ground to top of rail distance: 27"
- F. Post Size:
 - Timber: 10" x 12" (orientation to the road is not important)
- G. Rail Size: 10" x 6" with reinforcing steel plate placed behind rail
- H. Hazards:
 - Should not be used on roads with design speeds exceeding 50 mph
 - Lack of continuity (snagging potential)

Crash Test Data:

- Redirects a 1800 pound vehicle at 50 MPH and 20 degrees
- Redirects a 4500 pound vehicle at 50 MPH and 25 degrees

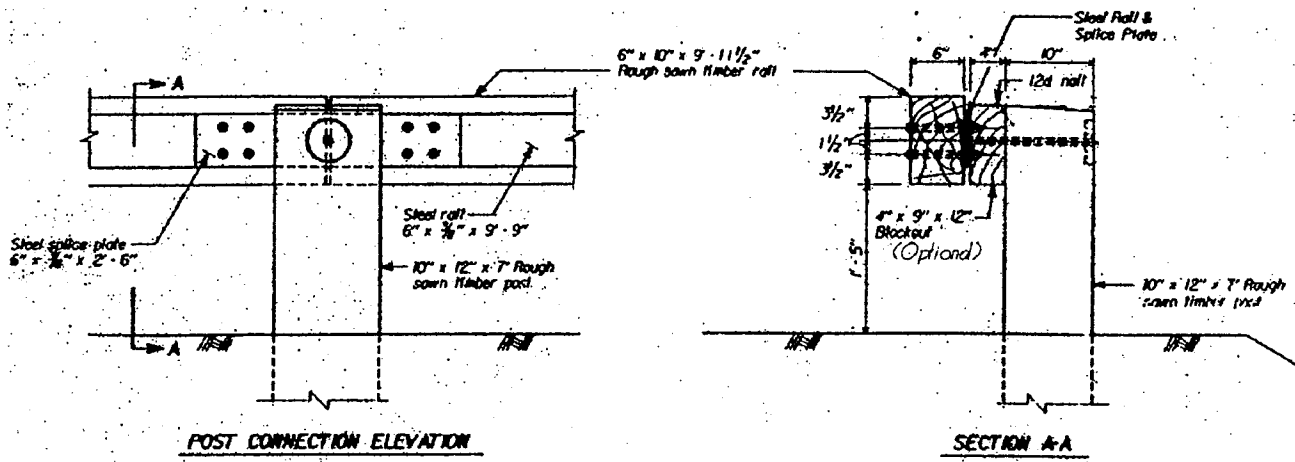


Figure 2.4: Steel-Backed Timber Approach Rail Standard Drawings

Section 3

Transitions

Rail Transition Criteria Checklist

County_____

Bridge No._____

Type of Transition (as named in glossary)_____



A. Does the transition meet the minimum post spacing?



B. Do the post sizes correspond to the standard?



C. Is the rail size approximately the same as the standard?



D. Does the transition connect the correct type of railing and approach?



E. Is the bridge railing safe from all possible hazards and is the transition connected to the bridge railing?



F. Does the bridge railing meet the miscellaneous standards?*

* If applicable

*If all criteria were met, this transition system should be given a rating of 1.
If not all criteria were met, it should be given a rating of 0.*

Rating_____

Type WT Transition

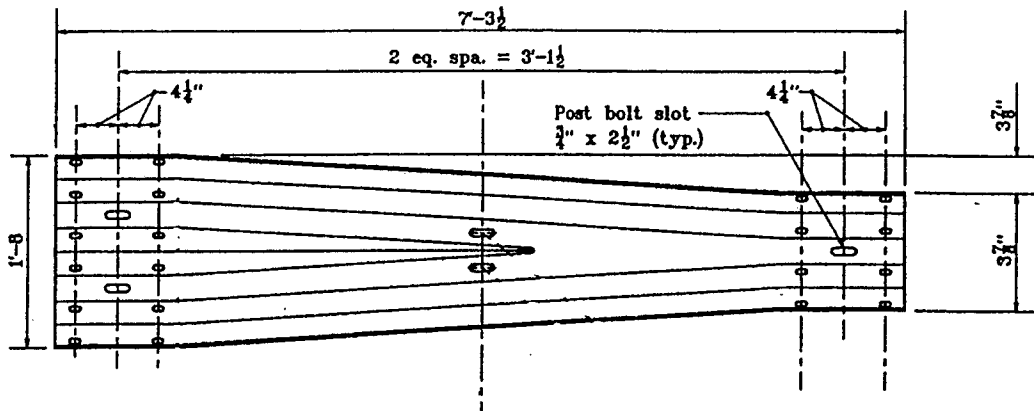


Figure 3.1: Type WT Transition Standard Drawing

- A. Post spacing: One post on both ends of the 6'-3" transition member
- B. Post sizes: Steel TS 6x3x0.25 posts with W 6x9 or W 6x8.5 steel blocks
- C. Rail size: Thrie beam width (20") tapered down to W-beam width (12.25")
- D. Connects Thrie Beam bridge rail (SL-1 Bridge Railing) to W-Beam approach guardrail
- E. Hazards: loose bolts and a non-rigid connection
- F. Miscellaneous:

Type WGB Transition

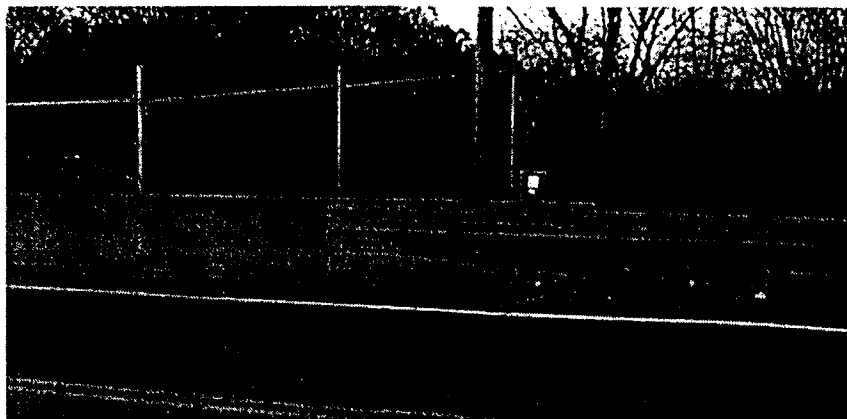


Figure 3.2: Example of Type WGB Transition (W-beam)

A. Post spacing:

- 1st section following rigid barrier: 4 spaces at 1'-6.75" (See Figure 3.5)
- 2nd section following rigid barrier: 3 spaces at 3'-1.5" (See Figure 3.5)

B. Post size:

- Timber: 6" x 8" post with block
- Steel: W 6 x 8.5 post with block

C. Rail Size:

- 1st 12'-6" after rigid barrier is two W-beam rails set inside the other
- Remaining rail is standard W-beam section (see "W-Shaped Approach Guardrail")

D. Connects rigid concrete bridge railing to W-beam approach rail

E. Hazards: loose bolts and a non-rigid connection

F. Miscellaneous

- Top of transition rail should be approximately 27" from the ground.
- W-beam terminal connector (see Figure 3.3) should be placed where transition meets concrete barrier.
- Should have a cylindrical steel spacer attached to W-beam at connection to bridge railing (See Figure 3.5)

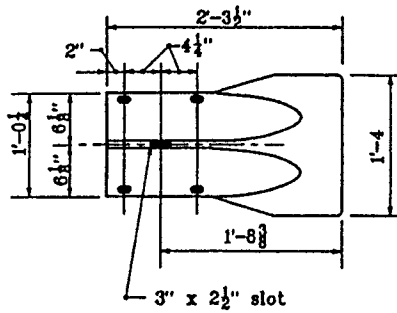


Figure 3.3: W-Beam Terminal Connector

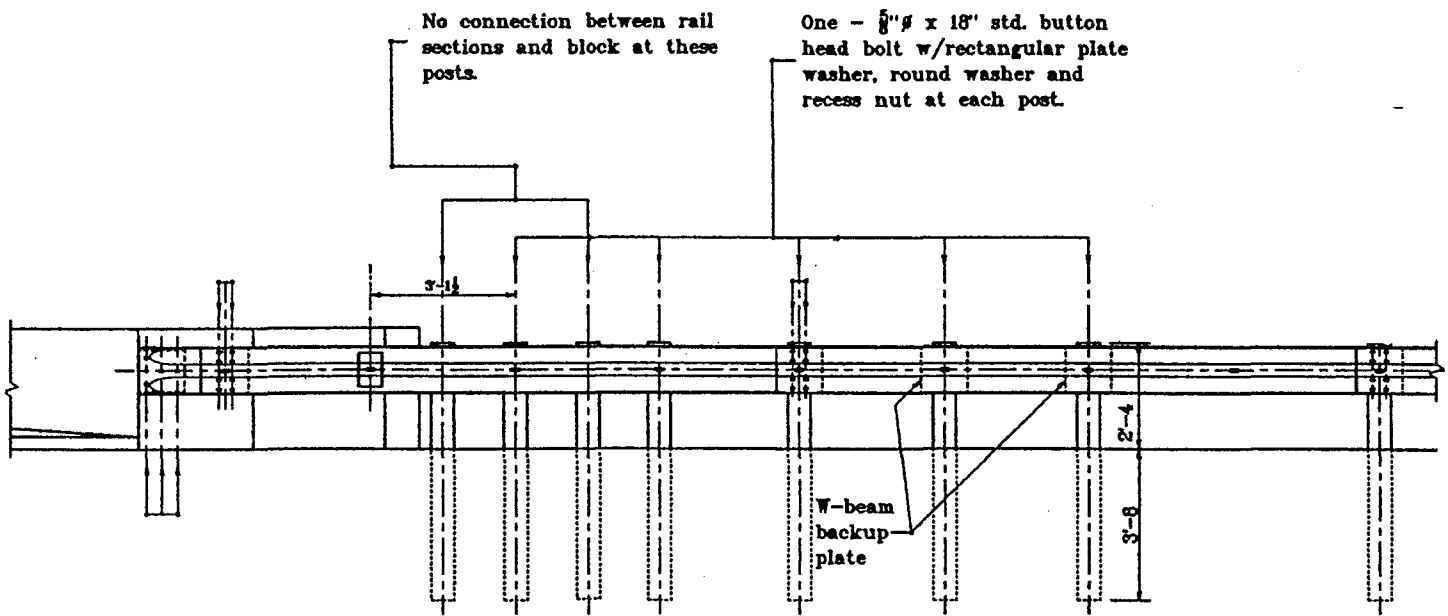


Figure 3.4: Type WGB Transition (elevation view)

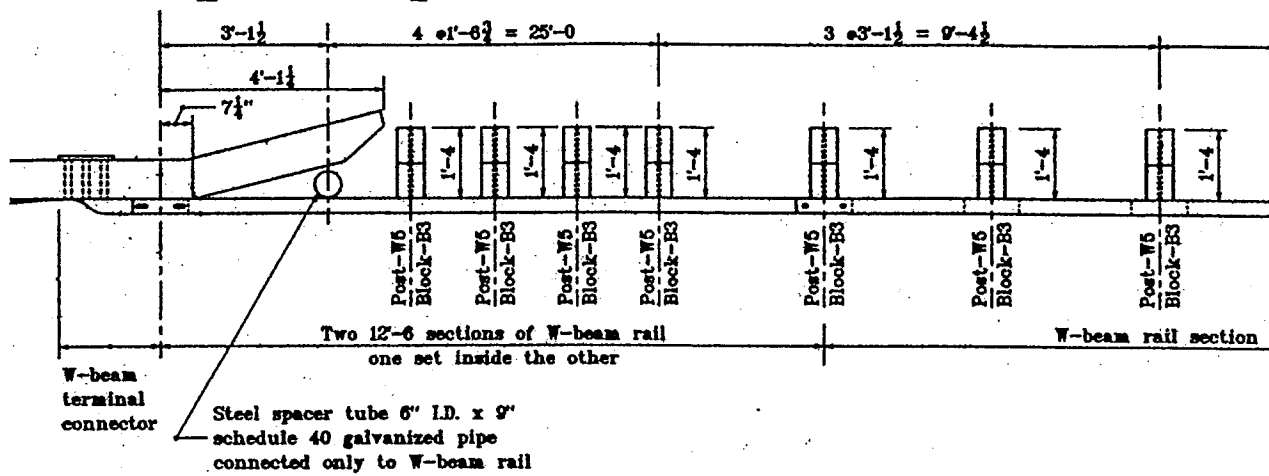


Figure 3.5: Type WGB Transition (plan view)

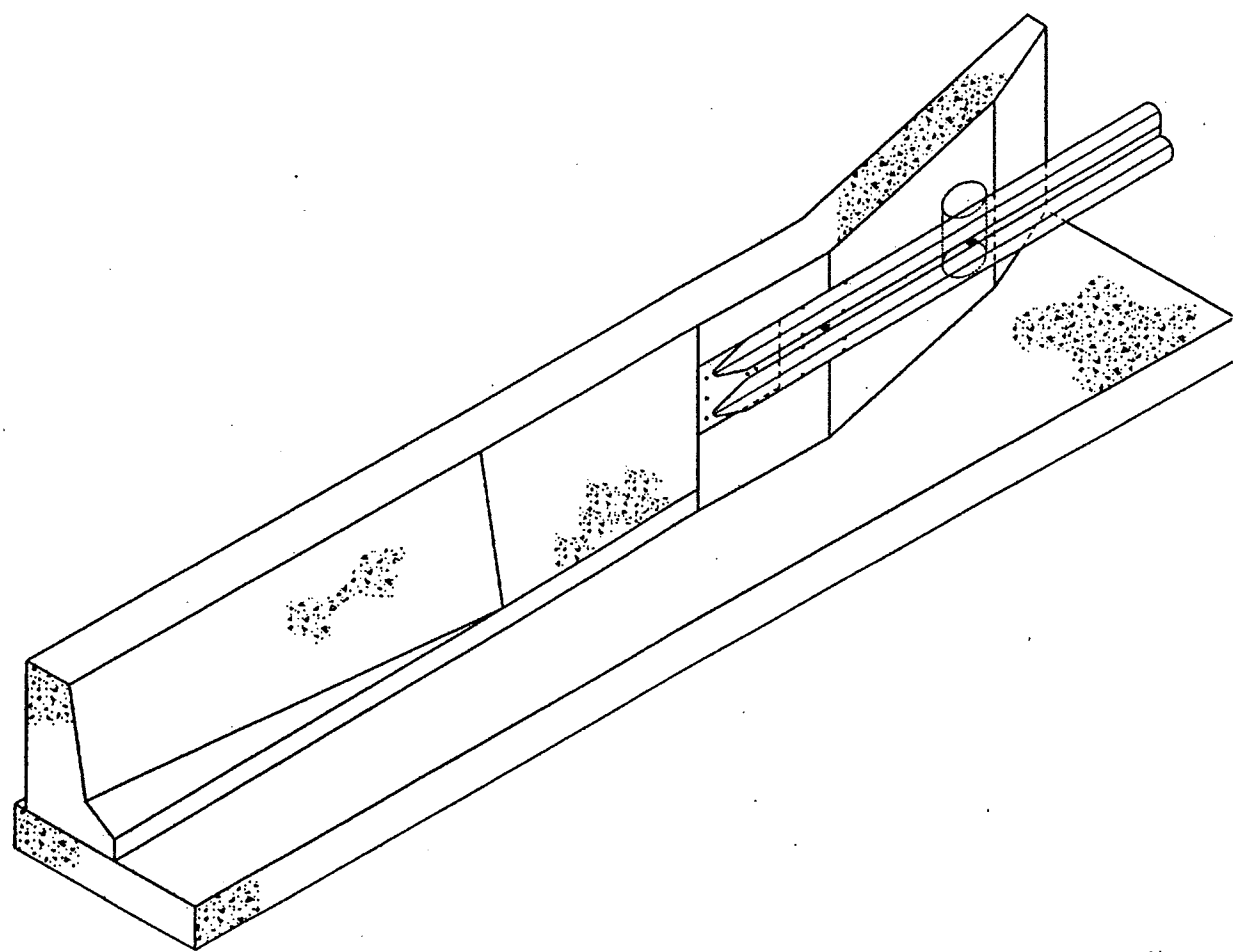


Figure 3.6: Type WGB Transition (3-dimensional view)

Type TGB Transition



Figure 3.7: Example of Type TGB Transition

A. Post spacing:

- 1st section following rigid barrier: 5 spaces at 1'-6.75"
- 2nd section following rigid barrier: 3 spaces at 3'-1.5"

B. Post size:

- Steel: W 6x9 post with block
- Timber: 6" x 8" post with block

C. Rail Size: (for thrie beam size see "Service Level 1 (SL-1) Bridge Railing")

- 1st 12'-6" after rigid barrier is two thrie beam rails set inside the other
- Next 6'-3" section is W-thrie beam transition (See figure 3.1)
- Remaining rail is standard W-beam rail (see "W-Shaped Approach Guardrail")

D. Connects rigid concrete bridge railing with W-beam approach rail

E. Hazards:

- There should be a minimum 25' of 6'-3" post spacing for W-Beam approach rail
- Loose bolts and a non-rigid connection

F. Miscellaneous:

- Thrie beam terminal connector (see Figure 3.8) should be placed where transition meets concrete barrier
- Top of thrie beam portion of transition should be approximately 31" from the ground
- Top of W-beam portion of transition should be approximately 27" from the ground

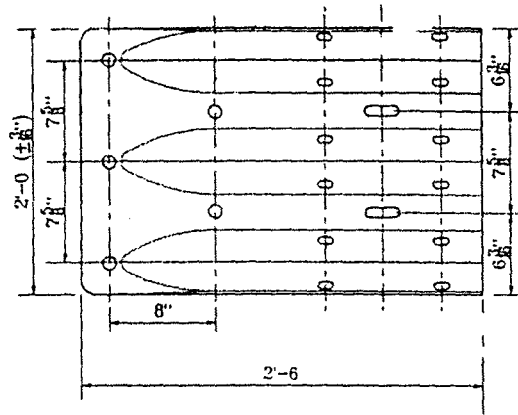


Figure 3.8: Thrie Beam Terminal Connection

Type TGT Transition

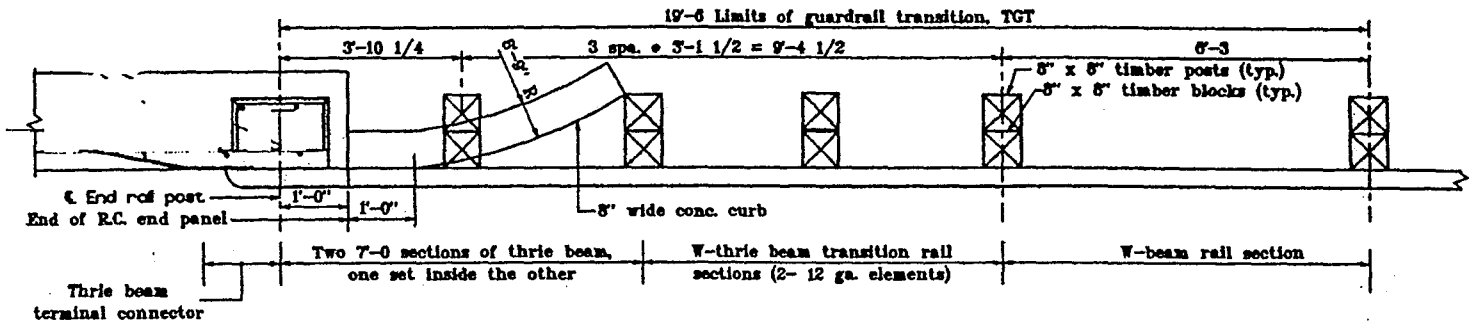


Figure 3.9: Type TGT Transition (plan view)

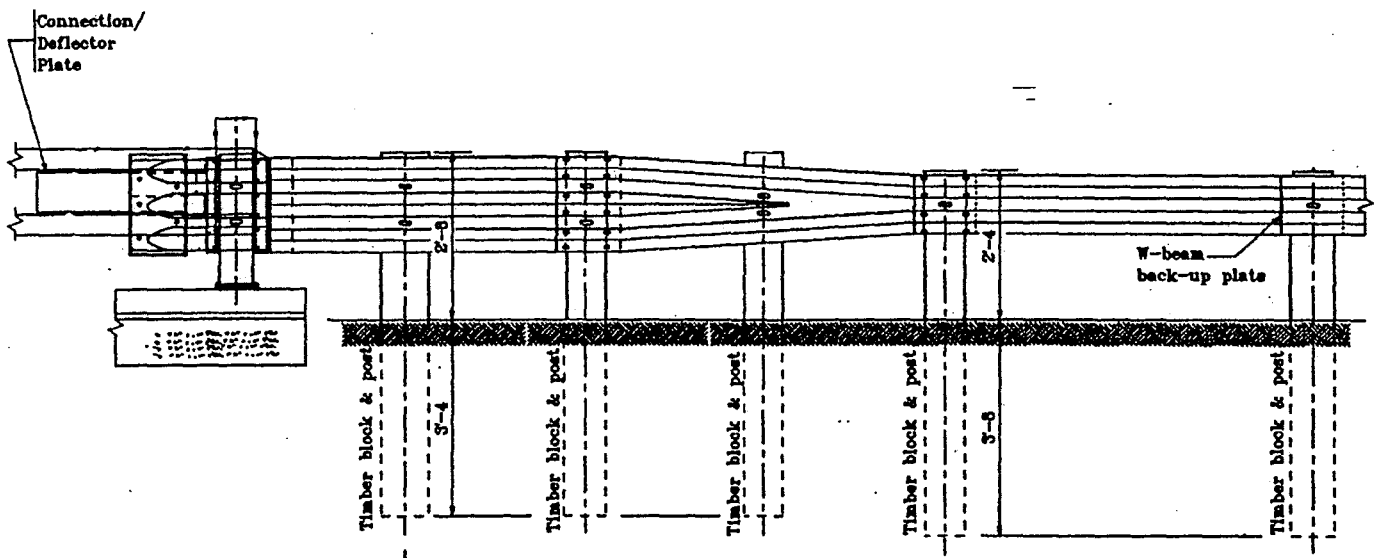


Figure 3.10: Type TGT Transition (elevation view)

A. Post spacing:

- 1st section following rigid barrier: 1 space at 3'-10.25" (See Figure 3.9)
- 2nd section following rigid barrier: 3 spaces at 3'-1.5" (See Figure 3.9)

B. Post size:

- Timber post: 8" x 8"
- Timber thrie beam block: 8" x 8", height = 1'-10.5"
- Timber W-beam block: 8" x 8", height = 1'-2.75"

- C. Rail Size: (for thrie beam size see "Service Level 1 (SL-1) Bridge Railing")
 - 1st 7' after rigid barrier is two thrie beam rails set inside the other (See Figure 3.9)
 - Next 6'-3" section is W-thrie beam transition (See Figure 3.1)
 - Remaining rail is standard W-beam rail (See "W-Shaped Approach Guardrail")

- E. Connects CF-1 (and similar) bridge railing with W-beam approach rail

- F. Hazards: loose bolts and a non-rigid connection

- G. Miscellaneous:
 - Thrie beam terminal connector (see Figure 3.8) should be placed where transition meets bridge railing
 - Top of W-beam portion of transition should be approximately 27" from the ground

Crash Test Level: TL-4

Concrete Bridge Railing Type TTTX Transition

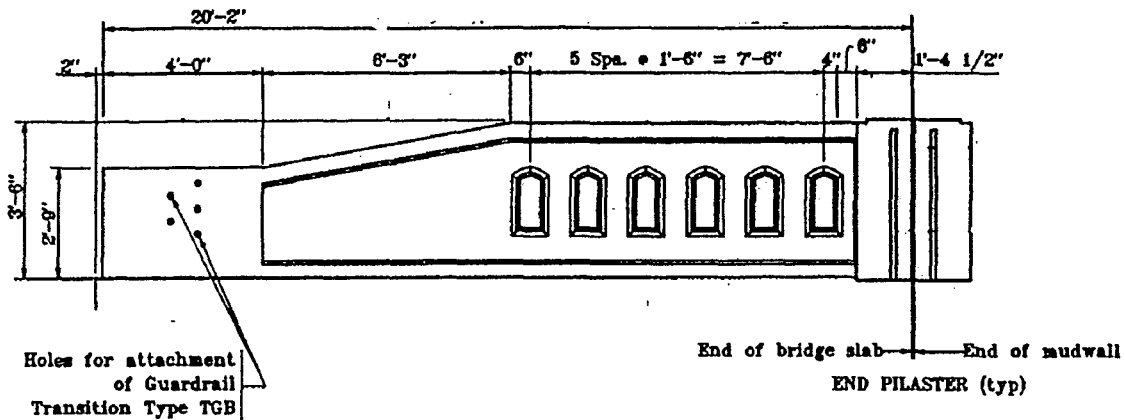


Figure 3.11: Type TTTX Transition (elevation view)

- A. Post Spacing: 5 spaces at 1'-6" (see Figure 3.11)
- B. Post Sizes: 10" columns between openings in transition
- C. Rail Size:
 - Height should be same size as "Texas Concrete Bridge Railing" (3'-6") at the end near the railing and should taper down to 2'-9" at the other end near the approach rail.
 - The length of the transition should be approximately 20'-2"
- D. Connects the "Texas Concrete Bridge Railing" to a "Type TGB Transition"
- E. Hazards:
 - Type TGB Transition must accompany this transition
 - Severely damaged or cracking concrete
- F. Miscellaneous:

Crash Test Level: TL-2

Concrete Bridge Railing Type TBC Transition

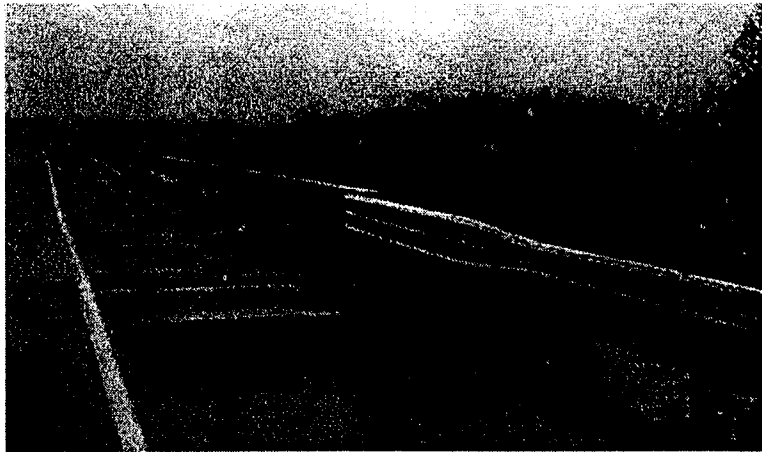


Figure 3.12: Example of Type TBC Transition

- A. Post Spacing: no posts (N/A)
- B. Post Sizes: no posts (N/A)
- C. Rail Size:
 - Height: 2'-9" throughout length of transition
 - Thickness: Same thickness as "Indiana 2'-9" Concrete Bridge Railing" at end near bridge railing. Taper down to thickness of 9" at approach rail end. (See Figure 3.13)
- D. Connects "Indiana 2'-9" Concrete Bridge Railing" with "Type TGB Transition"
- E. Hazards:
 - Type TGB Transition must accompany this transition
 - Severely damaged or cracking concrete
- F. Miscellaneous:

Crash Test Level: TL-4

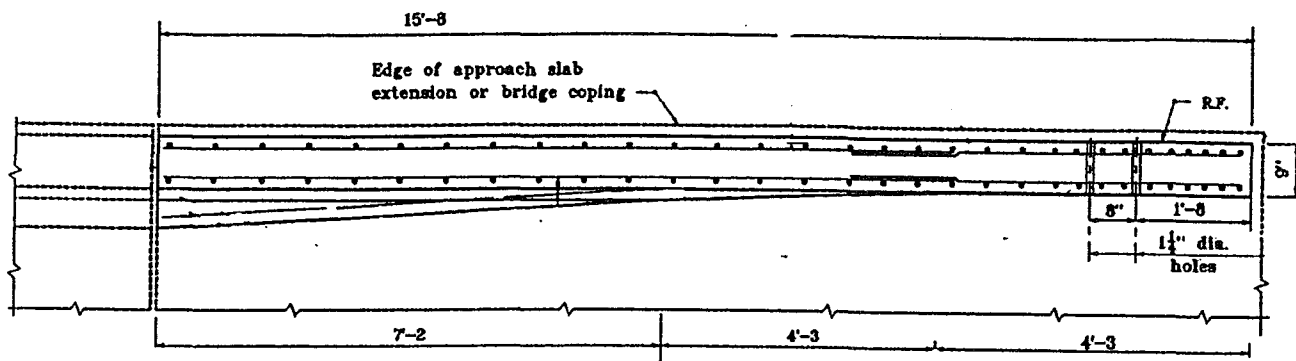


Figure 3.13: Type TBC Transition (plan view)

Section 4

End Terminals

End Terminal Criteria Checklist

County_____

Bridge No._____

Type of End Treatment (as named in glossary)_____



A. Does the end treatment fall under the maximum traffic volume and/or design speed criteria?



B. Is the end treatment connected to the correct type of approach rail?



C. Is the end treatment placed in the correct orientation/position?



D. Is the bridge railing safe from all possible hazards?



E. Does the bridge railing meet the miscellaneous standards?*

* If applicable

If all criteria were met, this end terminal should be given a rating of 1. If not all criteria were met, it should be given a rating of 0.

Rating_____

Breakaway Cable Terminal (BCT)

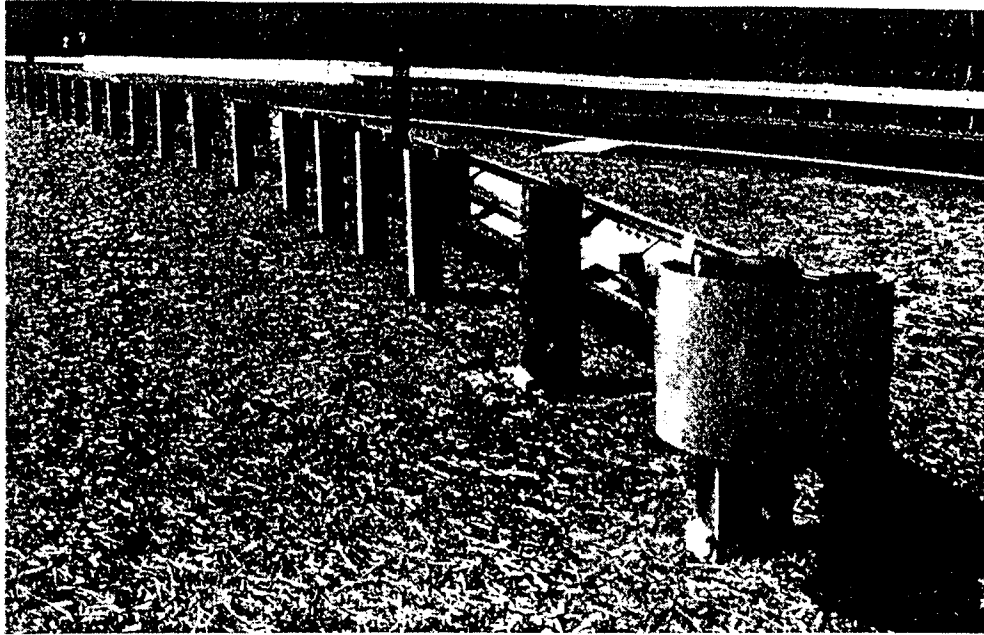


Figure 4.1: Example of Breakaway Cable Terminal

- A. Maximum design speed: 65 MPH
- B. Connects to W-Beam approach guardrail
- C. See figures 4.2 and 4.3 for correct parabolic offsets for both wood post and steel post end treatments.
- D. Hazards: No transition should be placed less than 12.5' from the end terminal
- E. Miscellaneous:
 - The first two posts on the end of the terminal should be either 6" x 8" wood posts weakened by holes drilled through them or W6x8.5 steel posts with slip base breakaway design. They should also be set in concrete footings so they break upon impact.
 - Top of end terminal should be 27" from the ground

Crash Test Data: Successfully buckles under 2250 and 4500 pound vehicles

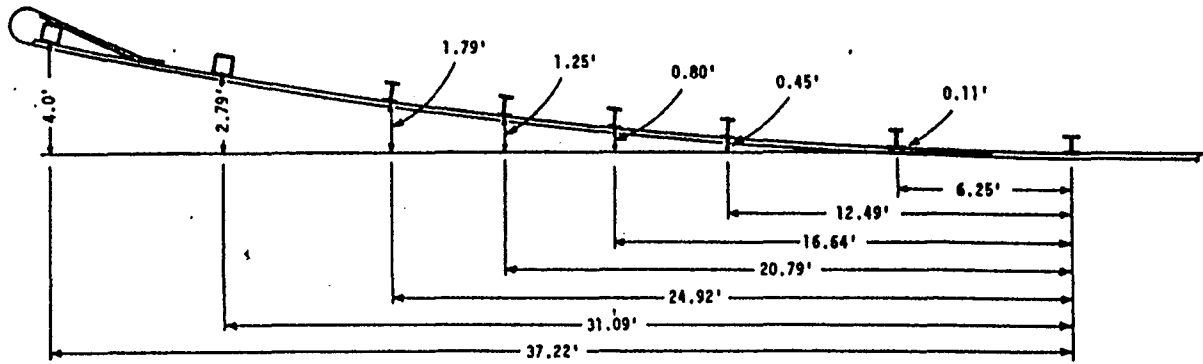


Figure 4.2: Parabolic Offsets for Steel Post BCT

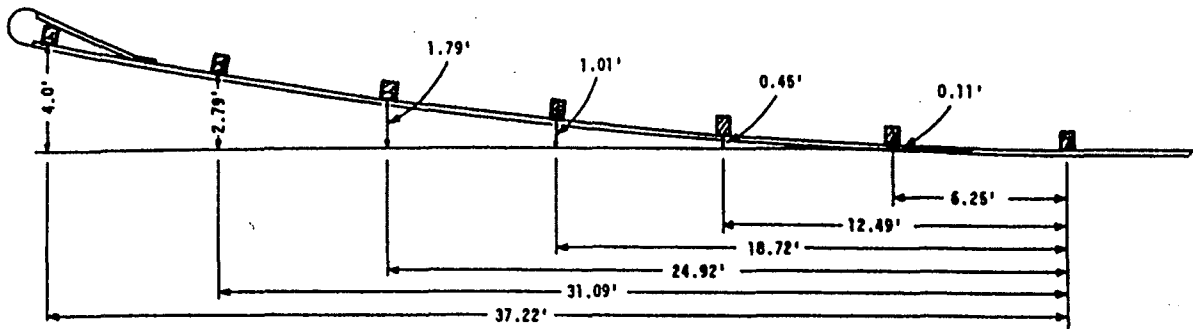


Figure 4.3: Parabolic Offsets for Wood Post BCT

Turned-Down W-Beam Guardrail End Terminal (Type 1)

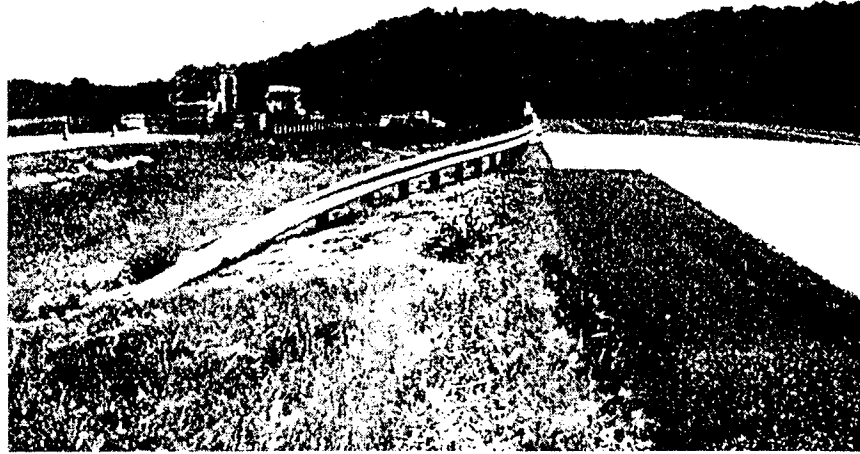


Figure 4.4: Example of Turned-Down W-Beam End Terminal (with flare)

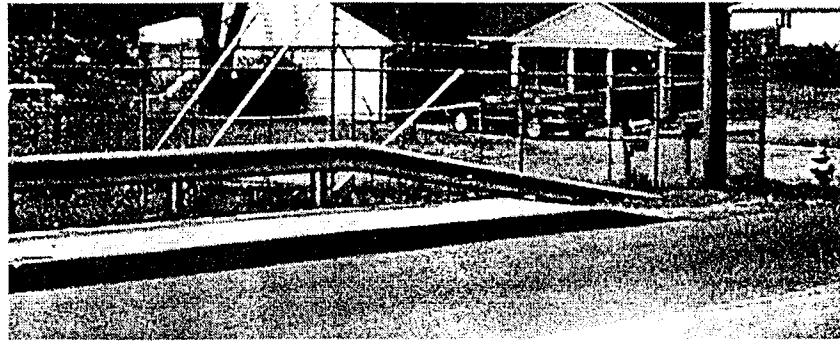


Figure 4.5: Example of Turned-Down W-Beam End Terminal (no flare)

- A. Maximum traffic volume: 6000 ADT
Maximum design speed: 50 MPH
- B. Commonly connects to W-Beam approach guardrail
- C. Typical length is 25'
Should be flared away from traffic at a rate of 15:1

D. Hazards:

- Buried end terminal should not be placed within 2' of shoulder.
- An object marker should be placed approximately 6' ahead of the end terminal.
- W-beam members should be lapped in the direction of traffic flow

E. Miscellaneous:

- Smaller 5/8" post bolts are recommended so the end terminal fails upon impact and the vehicle does not vault or roll upon impact
- End terminal should consist of one 25' or two 12'-6" W-beam sections
- Top of rail height should match that of the adjacent approach guardrail

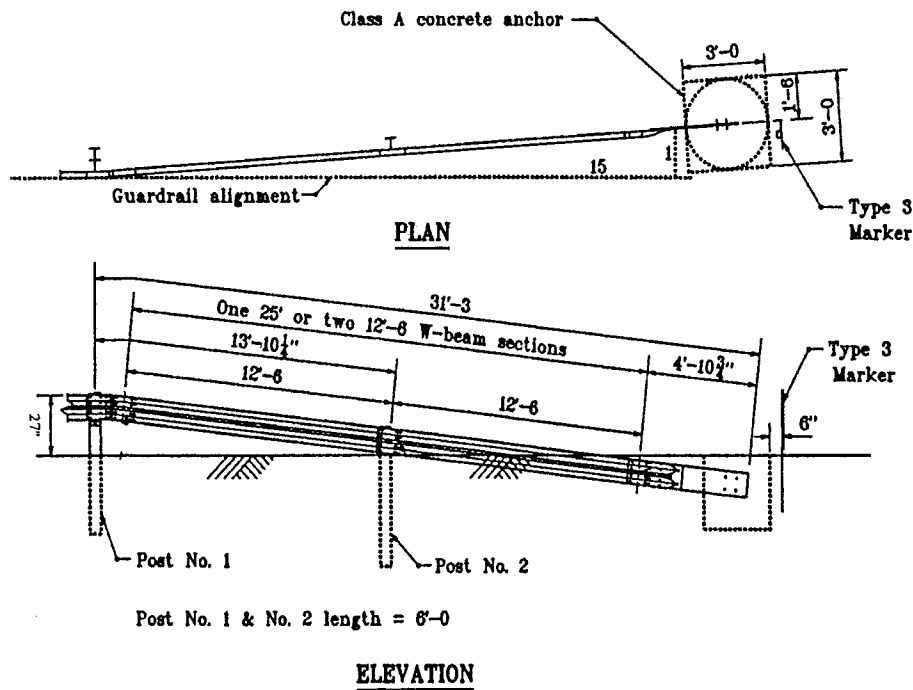


Figure 4.6: Turned-Down End Terminal Standard Drawings

SENTRE End Terminal

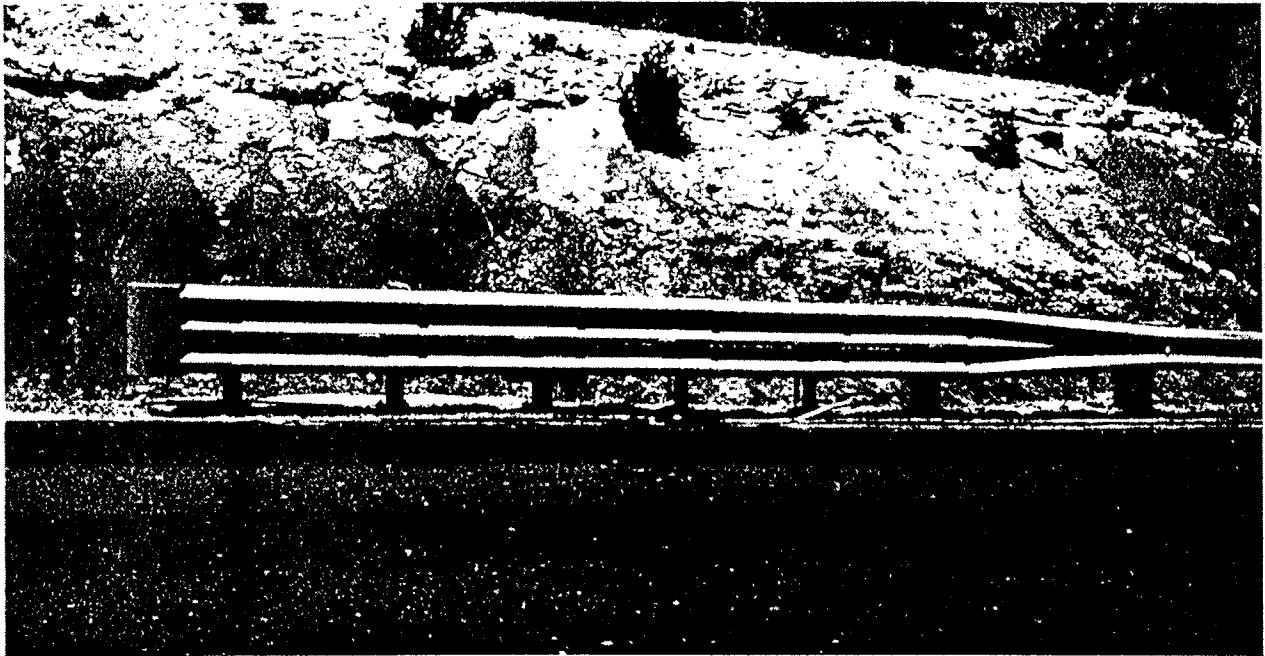


Figure 4.7: Example of SENTRE End Terminal

- A. Design Speed: 65 MPH
- B. Connects to W-Beam approach guardrail
- C. Can be installed parallel to the roadway or flared up to a 4' offset.
- D. Hazards:
 - A WT transition should be used to connect SENTRE to W-Beam approach guardrail (see "Type WT Transition").
 - Slip-based support posts should be used.
- F. Miscellaneous:
 - Posts should be mounted in concrete footings or on a concrete pad.
 - Sand-filled plastic containers should be placed behind the three beam fender panels.
 - End treatment should be approximately 23' in length and 32" in height.

Flared Energy Absorbing Terminal (FLEAT)

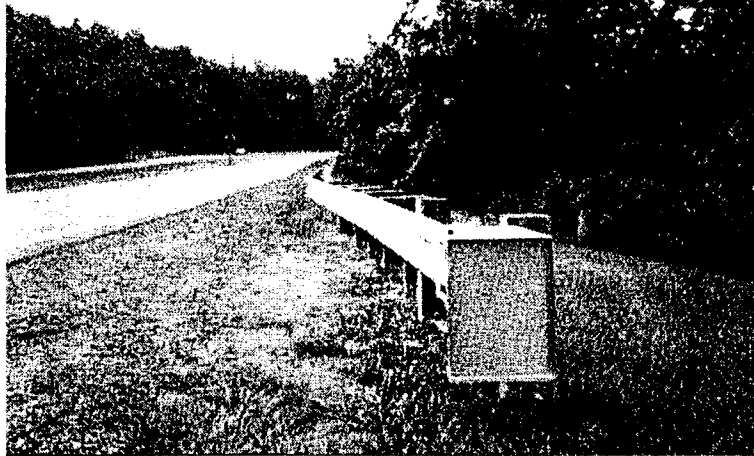


Figure 4.8: Example of a FLEAT End Terminal

- A. Maximum design speed: 65 MPH
- B. Connects to W-shaped approach guardrail
- C. The end terminal should have a flare of approximately 6 degrees and a length of 37'-6"
- D. Hazards: A yellow or orange reflector should be placed on the end of the end terminal
- E. Miscellaneous:
 - Post Spacing: (see Figure 4.9)
 - Post Type: (see Figure 4.9)

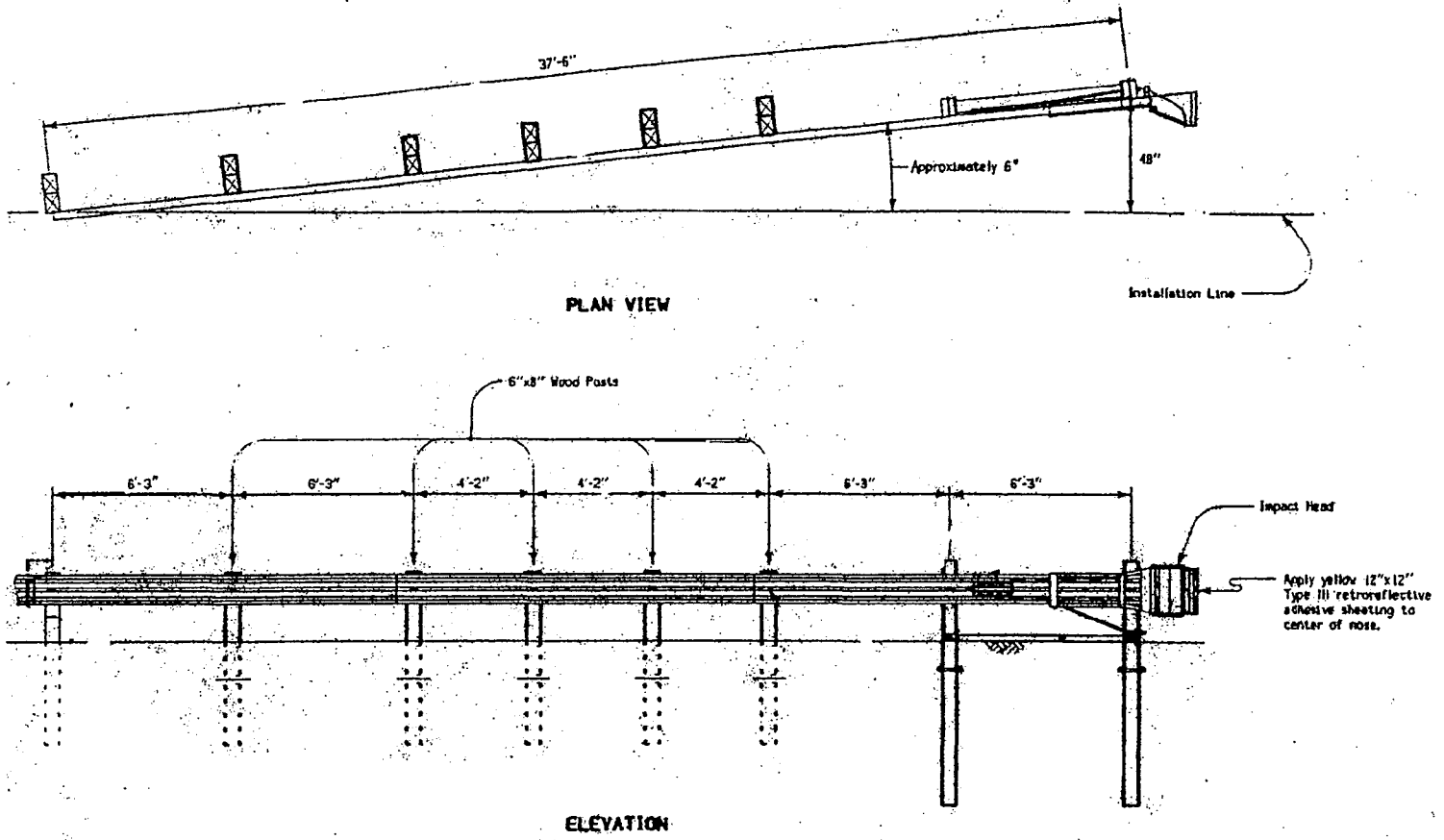


Figure 4.9: FLEAT End Terminal Standard Drawings

Steel-Backed Timber Turned-Down End Terminal

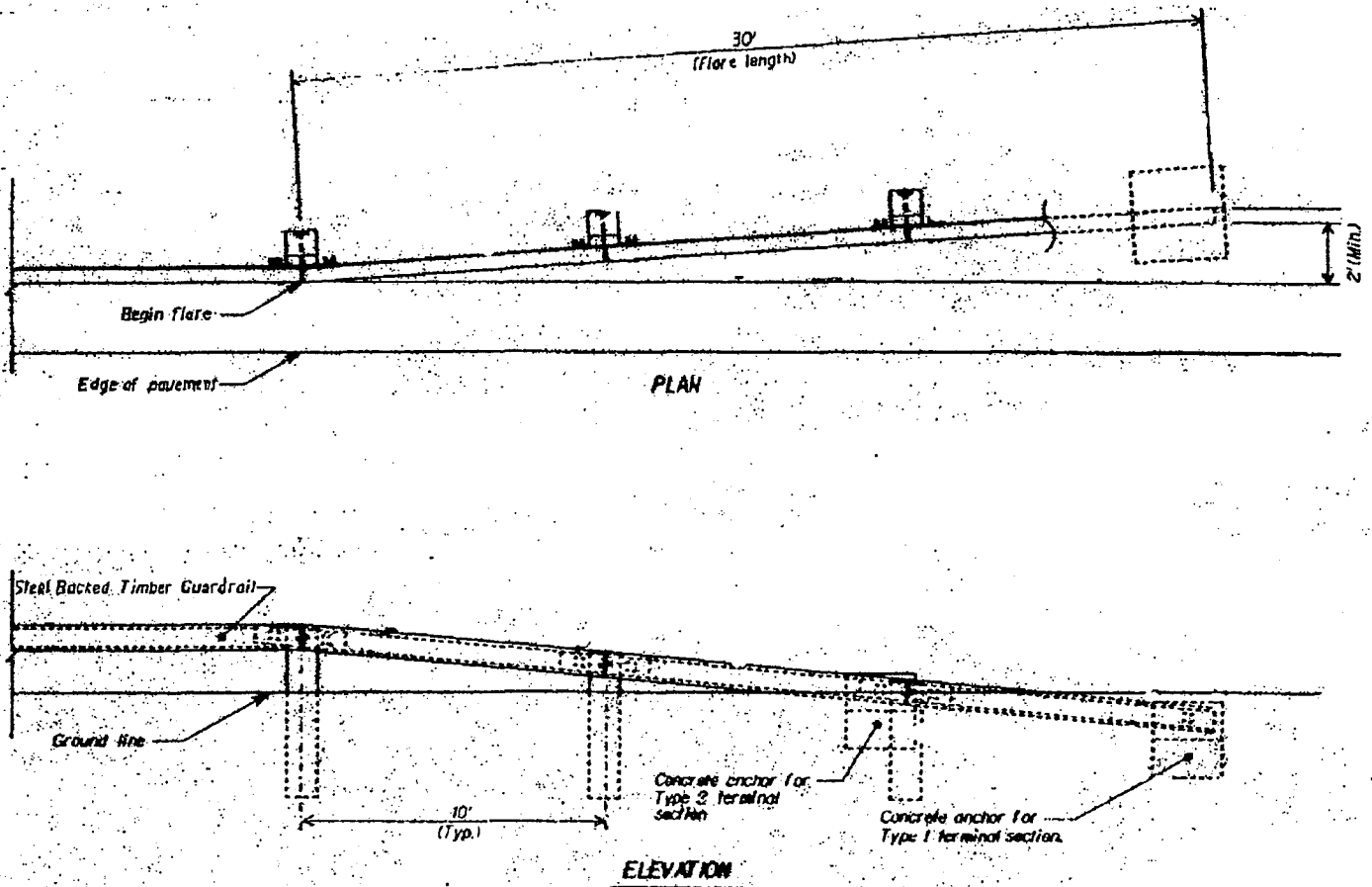


Figure 4.10: Steel-Backed Timber Turned Down End Terminal Standard Drawings

- A. Maximum design speed: 50 MPH
- B. Connects to steel-backed timber approach rail.
- C. End Treatment Positioning: See Figure 4.10
- D. Hazards: Lack of continuity
- E. Miscellaneous: Steel plate should be placed behind the timber rail.

Trend End Treatment

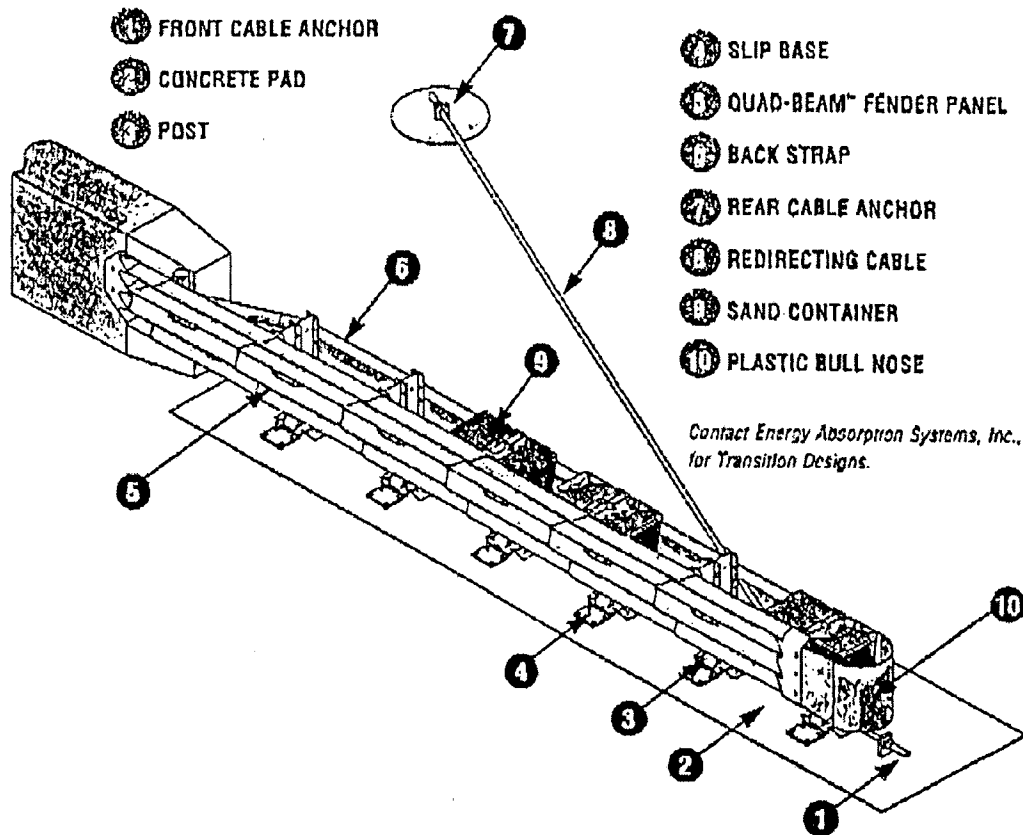


Figure 4.11: Quad Trend 350 End Treatment (3-dimensional view)

- A. Maximum design speed: 65 MPH
- B. Trend End Treatment may be connected directly to rigid concrete bridge railings without the use of transitions.
- C. End treatment positioning: (See Figure 4.11)
- D. Hazards:
 - A traversable clear zone of 75' x 20' should be kept adjacent to the end terminal in case it gates upon an angled impact.
 - End terminal should be attached firmly to bridge railing
 - Steel posts are to be slip-based
- E. Miscellaneous:
 - Standard Length: 20'
 - Standard Height: 32"
 - Standard Width: 15"
 - Sand containers should be placed inside the terminal (See Figure 4.11)

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