

# ***GUARDRAIL***



***John Mauthner, Jr., P.E.***

# ***31" Height W-beam Guardrail***

***What to expect?***



**Session hosted by: John Mauthner, Jr., P.E.**

**June 11, 2014**

# *The Benefits of Change!*

## **Outline:**

**Background**

**Benefits of 31" Height Guardrail**

**31" Height Guardrail Highlights**

**Summary:**

**Part 1 – Major Changes**

**Part 2 – Future Changes**

**Final Notes and Conclusion**

# Background

- **Review The Evolution of Crash Test Procedures:**

1962 – Highway Research Circular 482

1974 – NCHRP Report 153

1981 – NCHRP Report 230

1993 – NCHRP Report 350

FHWA Adopts NCHRP 350  
(Based on ISTEA of 1990)



# Background

- **AASHTO's Manual for Assessing Safety Hardware 2009:**

Roadside Safety Appurtenances Crash Tested after January 1, 2011 must Meet MASH 2009

Topic	NCHRP 350	MASH
Small car test vehicle	820C vehicle (1,800 lbs.)	1100C vehicle (2,420 lbs.)
Small car impact angle	20 degrees	25 degrees
Light truck test vehicle	2000P vehicle (4,400 lbs.)	2270P vehicle (5,000 lbs.)
Gating terminals and crash cushion impact angle	15 degrees	5 degrees
Variable message signs and arrow board trailers	No mention	Added to TMA crash test matrix
Support structure and work zone traffic control device testing	Only small car tested	Small car and light truck tested
Windshield damage criteria	Subjective/Qualitative	Objective/Quantitative
Vehicle rebound in crash cushion tests	None	Required

# Background

- **FHWA Memorandum May 17, 2010:**

According to FHWA; “Transportation agencies should consider adopting generic 31” high guardrail designs as standard for all new installations.”

Our new standard 31” height guardrail design meets all federal guidelines and current crash test performance criteria.

# *Benefits of 31" Height Guardrail*

- **Benefits of Change:**

- A) Improves the Safety Performance of Semi-Rigid Barriers by Reducing the Crash Severity.
- B) Redirects Larger and Higher Center-of-Gravity Vehicles.
- C) Moves the Splice Location, Increases the Guardrail's Effective Ribbon Strength and Improves its Capacity to Contain Heavier Vehicles by Reducing Penetrations.
- D) Meets FHWA Eligibility Requirements and the Latest Crash Test Performance Requirements.

# 31" Height Guardrail Highlights

- **New Installations (RDB 14-05)**

Raise Guardrail Height to 31" using an 8" Offset Block as the standard for all New Installations with the Panel Splice set to Mid-span between Posts.

Installation of 31" to the top of rail will be the nominal height and apply a - 1/2" to + 1" construction tolerance.

Maintain existing Inventories by Using same Posts, Offset Blocks, and Mounting Hardware.

New W-beam Panels can be Used to Repair both 27" and 31" Height Guardrail Inventories.

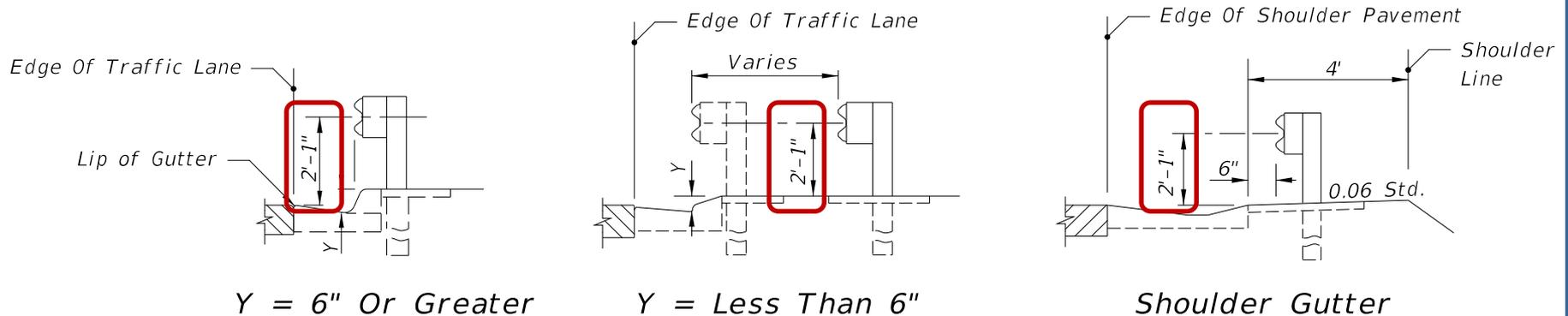
# Part 1 – Major Changes

## ■ Design Standards – Index 400 (Guardrail)

Summary of Major Changes to Guardrail			
Criteria	Existing	New	Sheet Number
Standard Guardrail Mounting Height	1'-9"	2'-1"	1, 16, 18, 23, 25, and 26
Rail to Post Attachments	Attach the Rail to the Post at the Guardrail Splice	Offset the Post 3'-1 ½" from Slot at the Guardrail Splice	2A
Index 400 Detail J	11 posts required in 43'-9" transition	15 posts required in 56'-3" transition, Posts (j) and (l) were added, Post (n) is relocated 3'-1 ½" from its previous location	13A

# Part 1 – Major Changes

## ■ Standard Guardrail Mounting Height



### NOTE:

For location of guardrail with offset behind curb and gutter refer to the Plans Preparation Manual, Volume 1, Section 4.3.5.

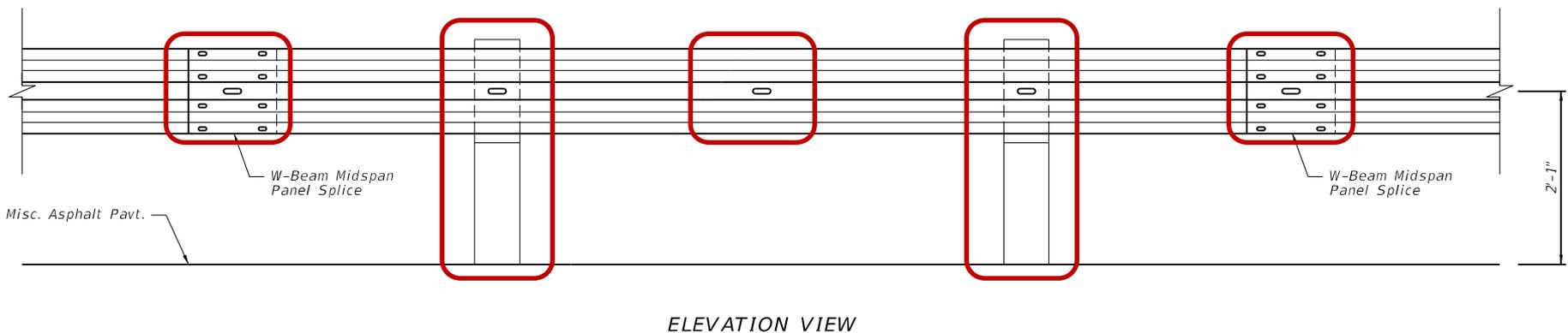
### LOCATION AT CURB & GUTTER SECTIONS DETAIL L

The Standard Guardrail Mounting Height is 2'-1" to the Center of Beam

# Part 1 – Major Changes

## ■ Rail to Post Attachments

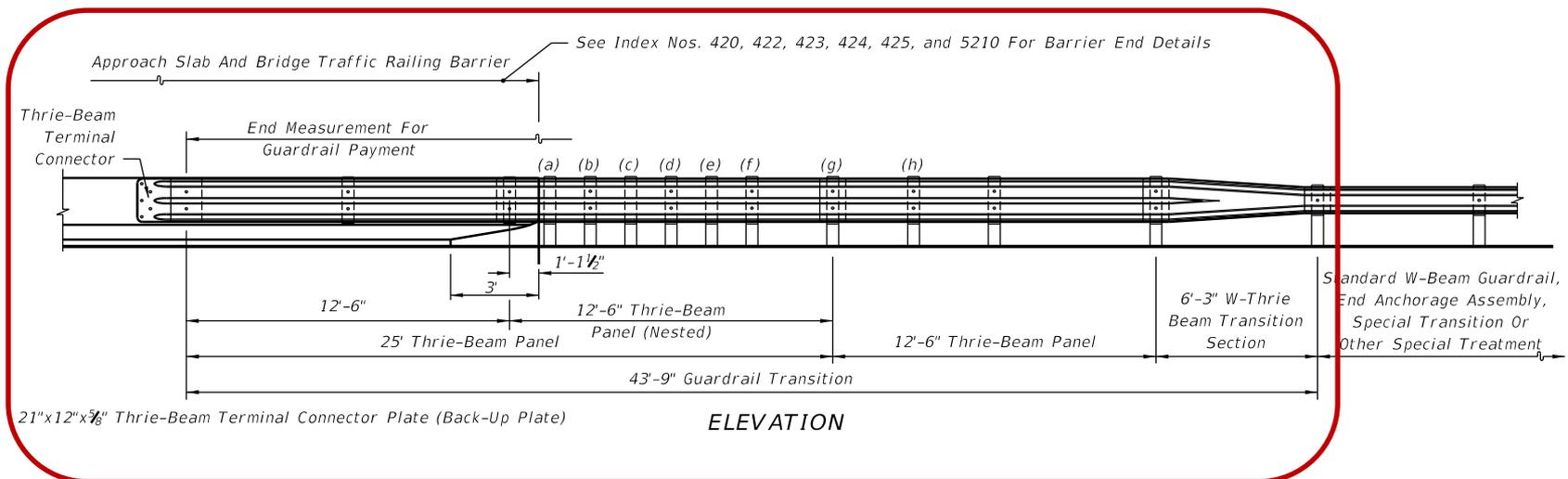
### Existing Rail to Post Attachment Locations



Proposed Rail to Post Attachment Locations  
4 Space Panel with Post Mounts Offset by 3'-1½"

# Part 1 – Major Changes

## ■ Index 400 – Detail J (Existing)

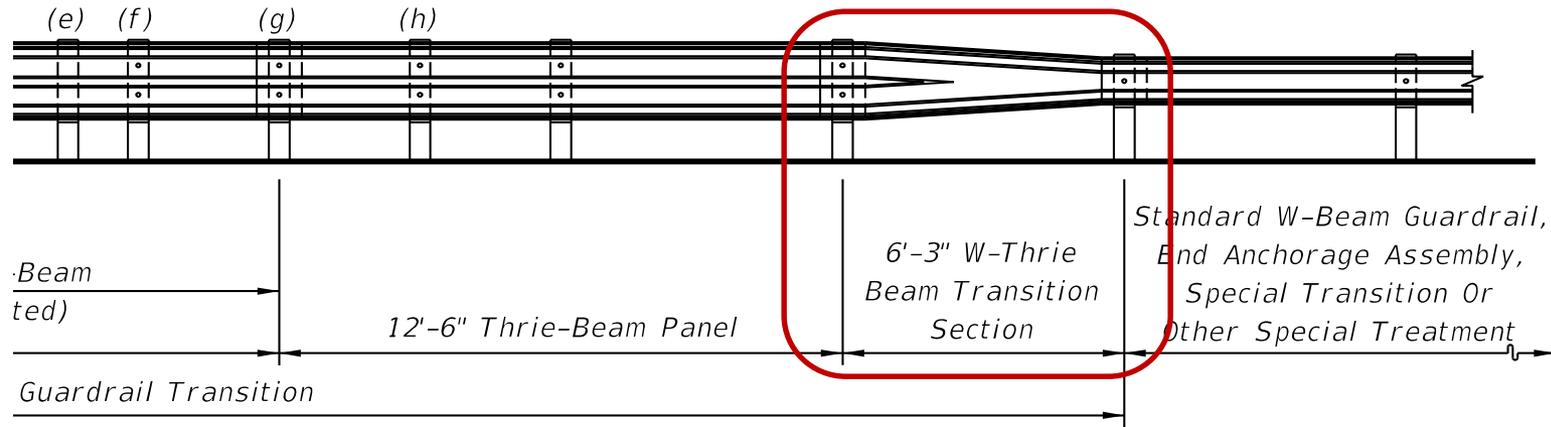


Existing 43'-9" Guardrail Transition Length

# Part 1 – Major Changes

- **Index 400 – Detail J (Existing)**

## Existing Symmetrical

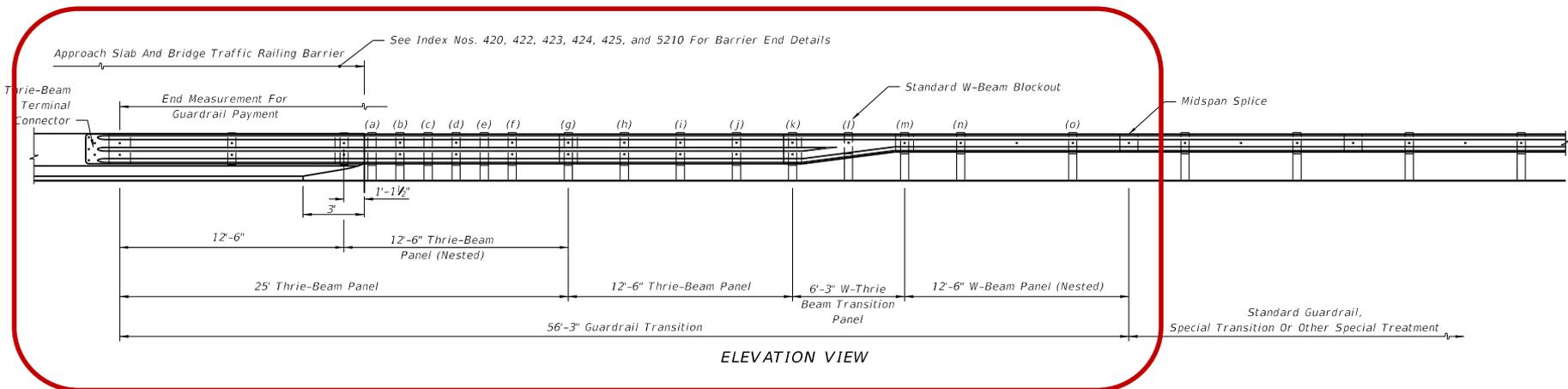


ELEVATION

## 6'-3" W-Thrie Beam Transition Section

# Part 1 – Major Changes

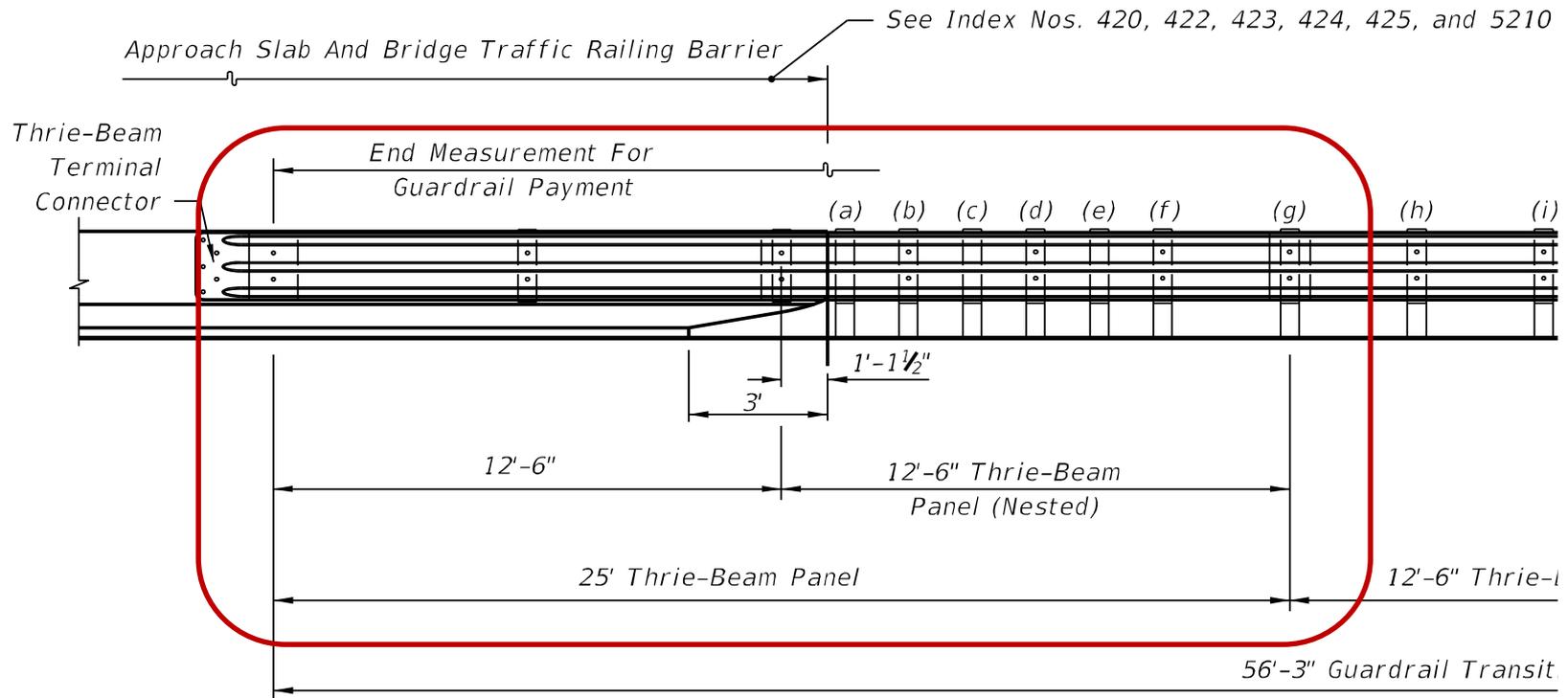
## ■ Index 400 – Detail J (Proposed)



The Proposed Guardrail Transition Length is 56'-3" which Includes a Nested 12'-6" W-Beam Guardrail Panel Upstream of the 6'-3" W-Thrie Beam Transition

# Part 1 – Major Changes

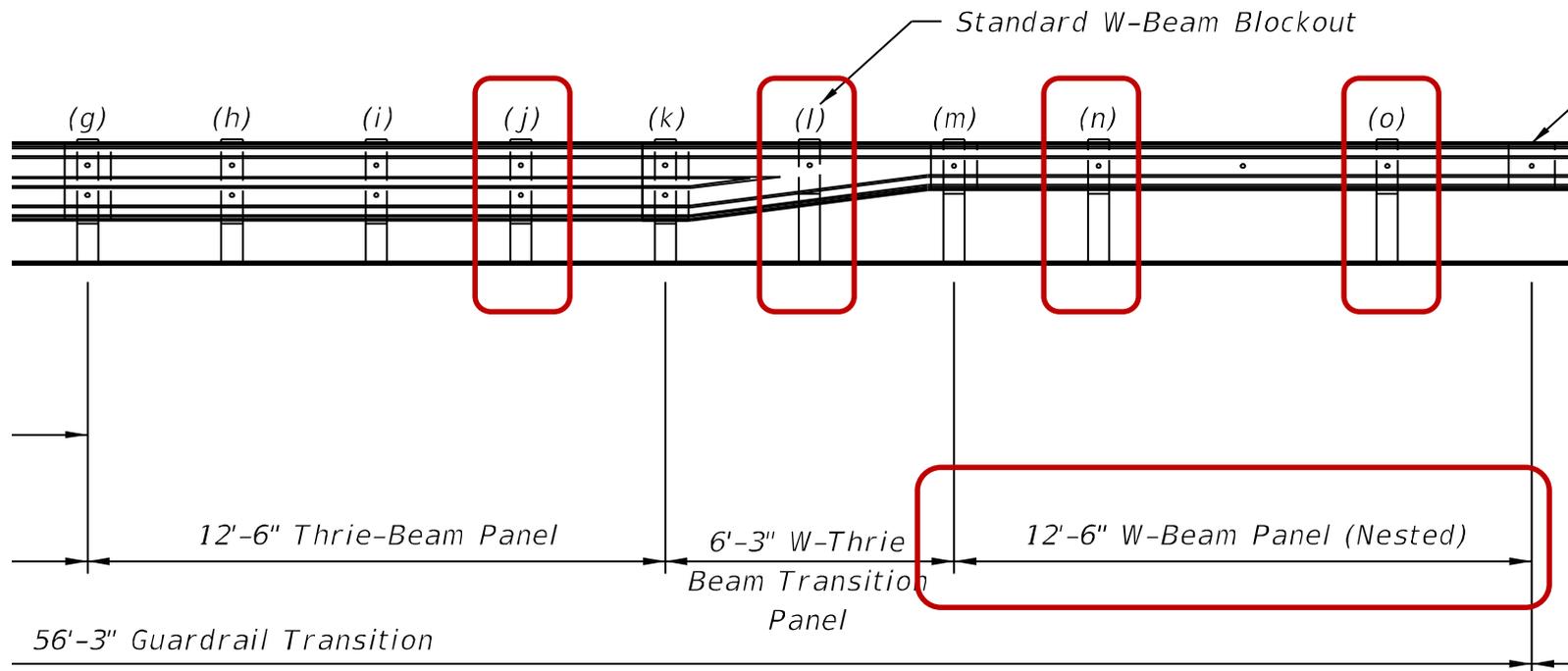
## ■ Index 400 – Detail J (Proposed)



Standard 25' Thrie-Beam Panel Remains Unchanged

# Part 1 – Major Changes

## ■ Index 400 – Detail J (Proposed)



ELEVATION VIEW

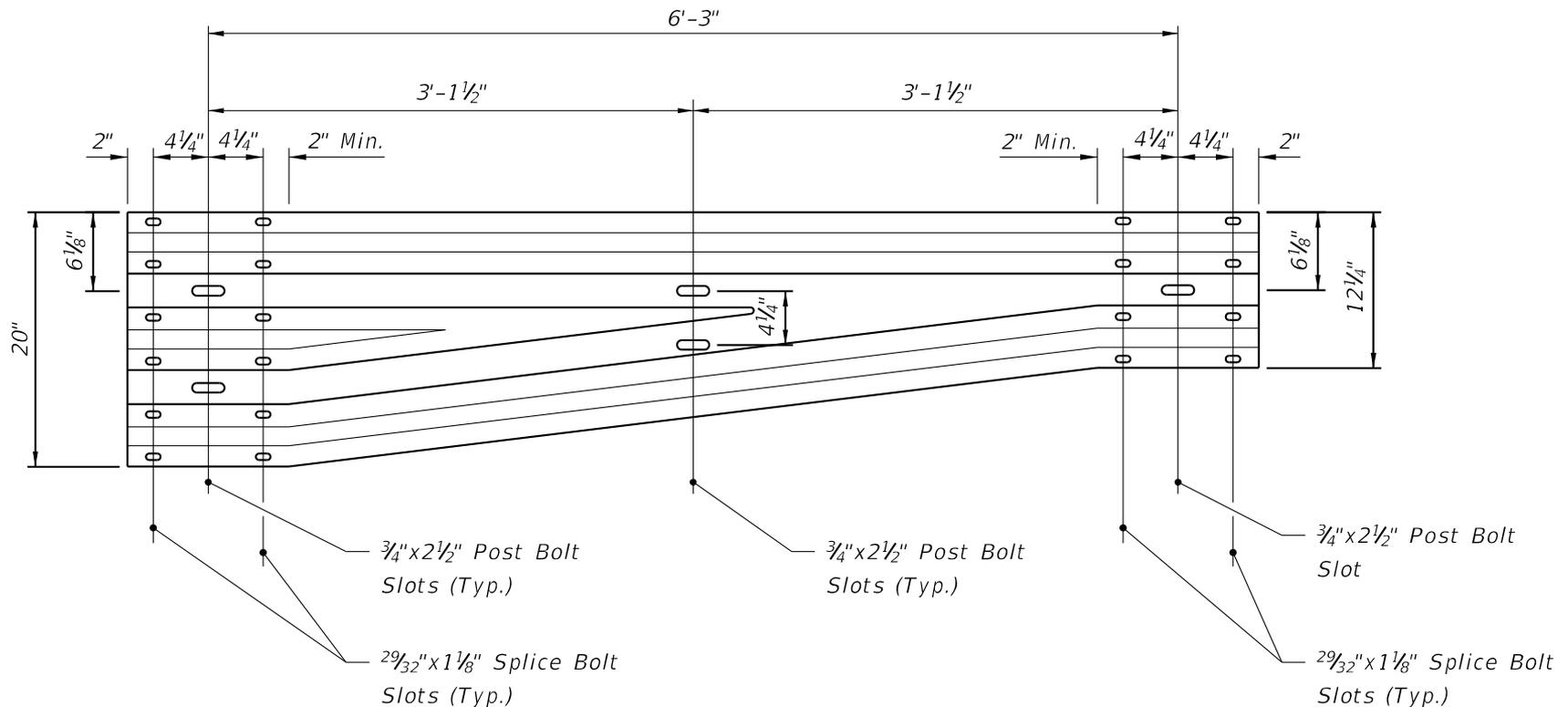
# Part 1 – Major Changes

## ■ Design Standards – Index 400

Summary of Major Changes to Guardrail			
Criteria	Existing	New	Sheet Number
W-Thrie Beam Transition Panel	Symmetric	Asymmetric	20A
Standard 12'-6" W-beam Panel	3 Slots (2 Spaces)	5 Slots (4 Spaces)	20B
Non-Standard 15'-7 ½" W-beam Panel	Not Required to Offset the Panel Splice to Mid-span	Requires a 15'-7 ½" Panel to Transition the Panel Splice to Mid-span	20C

# Part 1 – Major Changes

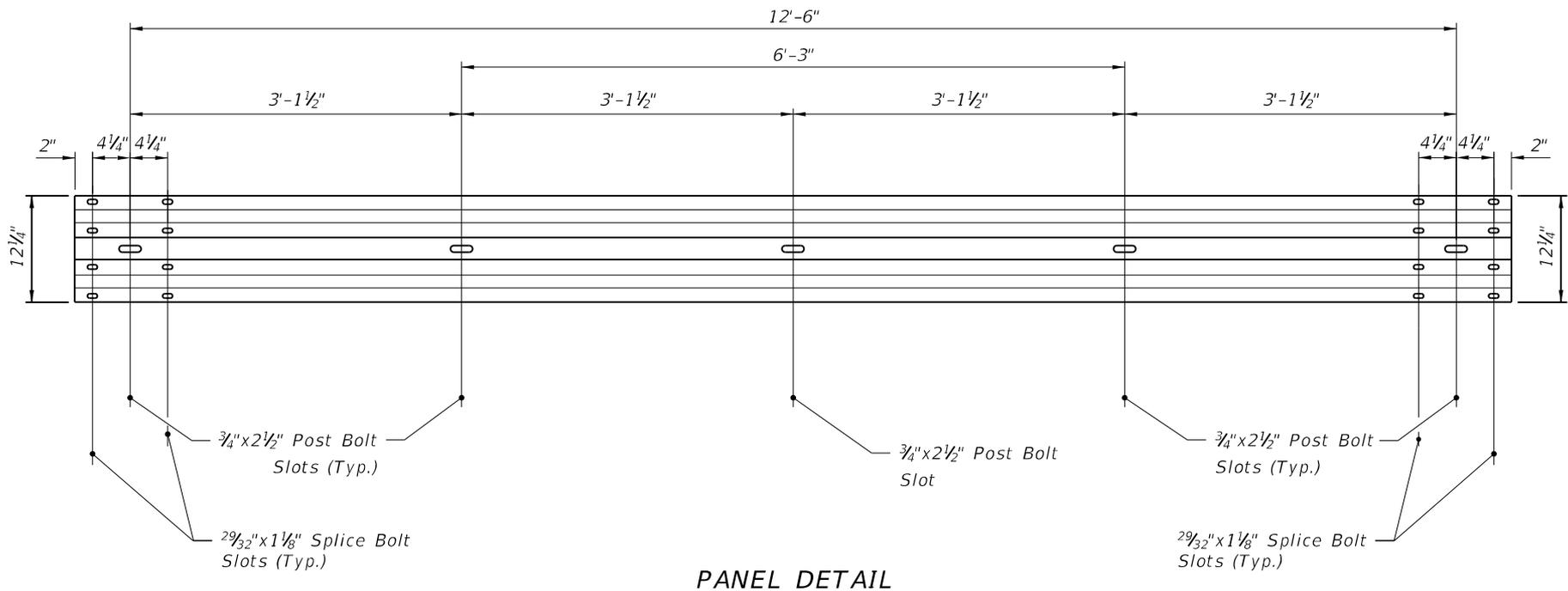
## ■ Asymmetric W-Thrie Beam Transition Panel (RWT02)



TRANSITION PANEL RIGHT

# Part 1 – Major Changes

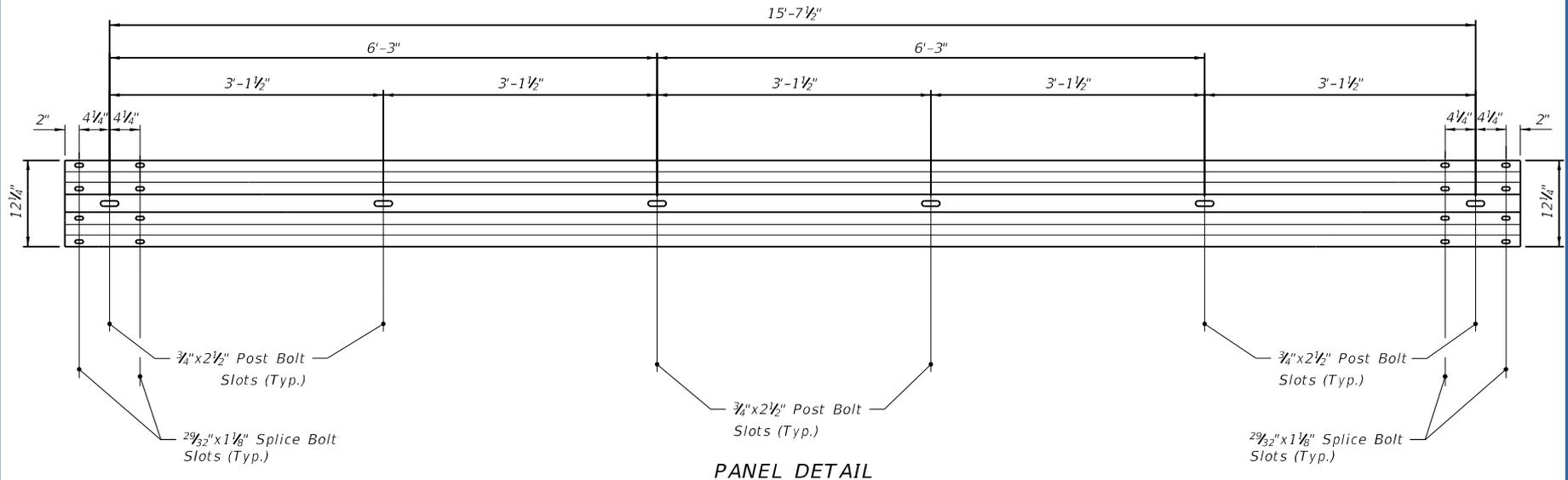
## ■ Standard 12'-6" W-Beam Panel (RWM04a)



## Standard 12'-6" W-Beam Panel with 5 Slots

# Part 1 – Major Changes

## ■ 15' - 7½" W-Beam Panel (5 Space)



Standard 15'-7½" W-Beam Panel with 6 Slots

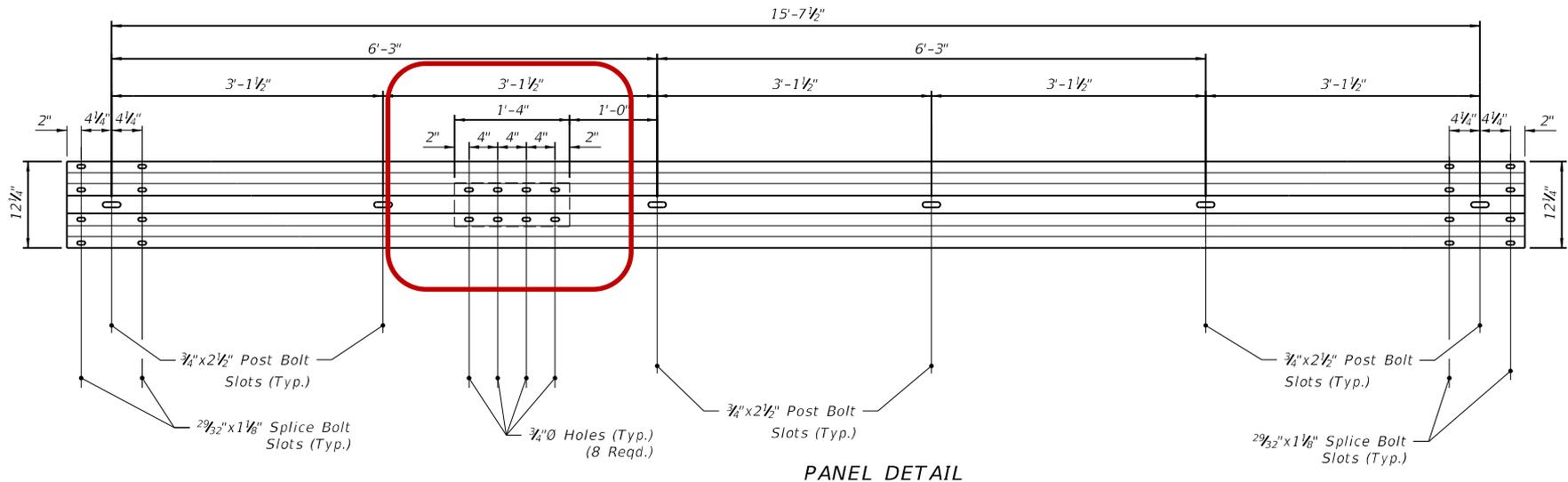
# Part 1 – Major Changes

## ■ Design Standards – Index 400

Summary of Major Changes to Guardrail			
Criteria	Existing	New	Sheet Number
End Anchorage Assembly Type II Or Type CRT	Required a 12'-6" W-Beam End Anchorage Panel with Beam Anchor Plate Attachment	Requires a 15'-7 ½" W-Beam End Anchorage Panel with Beam Anchor Plate Attachment	20D and 23A
Approach End Anchorage Assemblies Flared and Parallel	End Anchorage Assembly Flared 50'-0" Parallel 37'-6" Assembly Length	End Anchorage Assembly Flared 53'-1 ½" Parallel 53'-1 ½" Assembly Length	2
Guardrail Height Transition from 27" to 31"	1'-9" Mounting Height	2'-1" Mounting Height	13B

# Part 1 – Major Changes

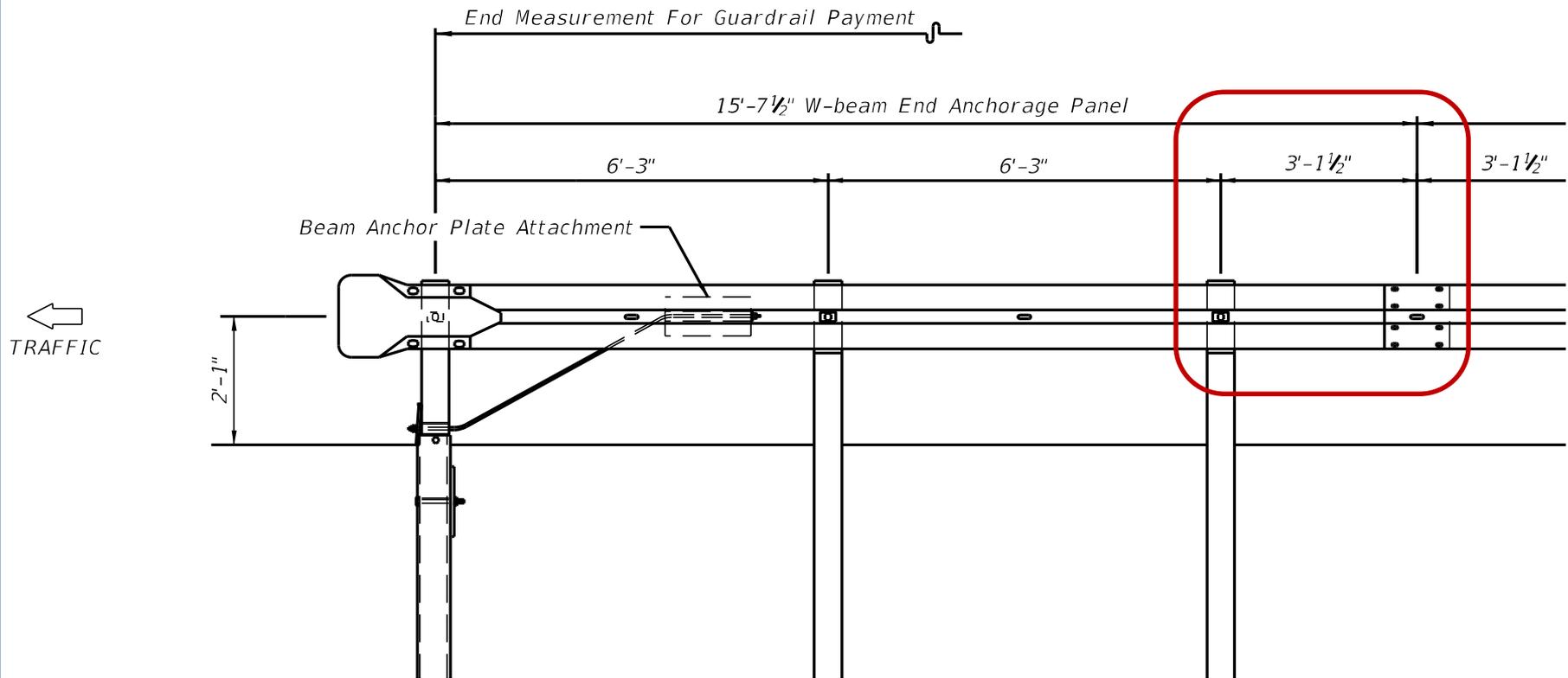
## ■ End Anchorage Assembly Type II or Type CRT



15'-7 1/2" Panel With Beam Anchor Plate Attachment

# Part 1 – Major Changes

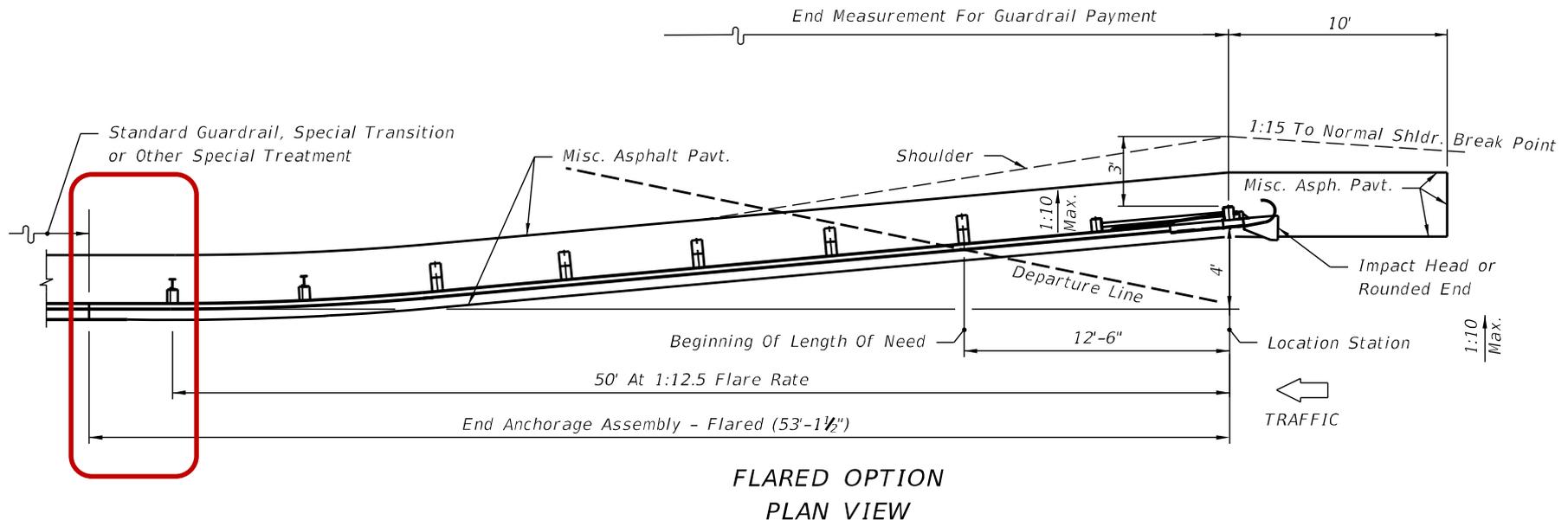
## ■ End Anchorage Assembly Type II (Elevation View)



Account for the Added 3'-1 1/2" Panel Length in your Length of Need (LON) Calculations

# Part 1 – Major Changes

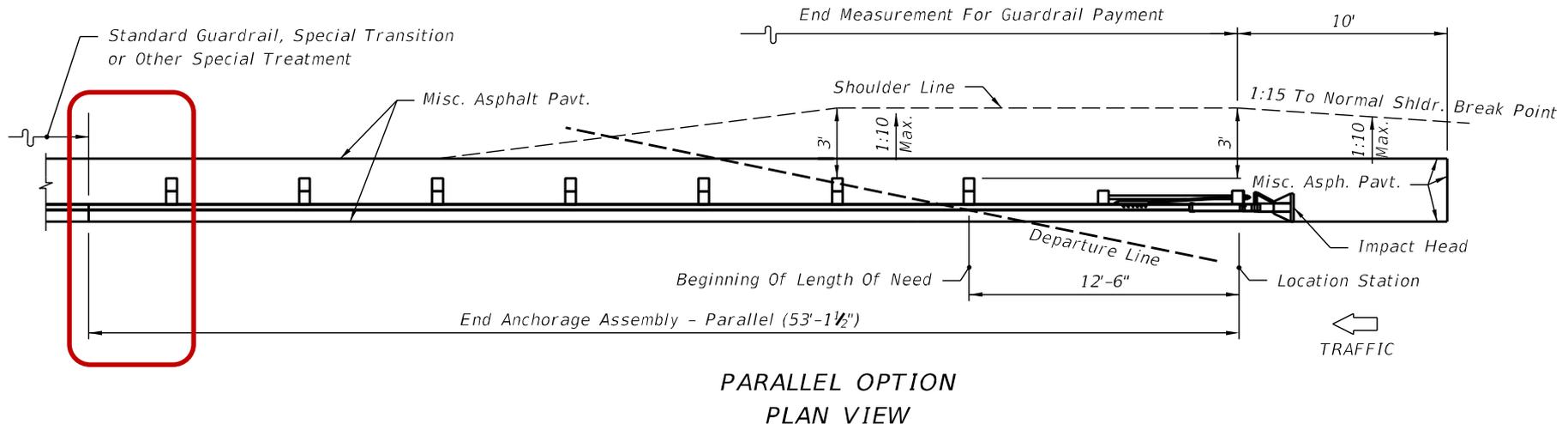
## ■ Approach End Anchorage Details (Flared 53' - 1 ½'')



Account for the Added 3'-1 ½'' Panel Length in your Length of Need (LON) Calculations

# Part 1 – Major Changes

## ■ Approach End Anchorage Details (Parallel 53' - 1½")

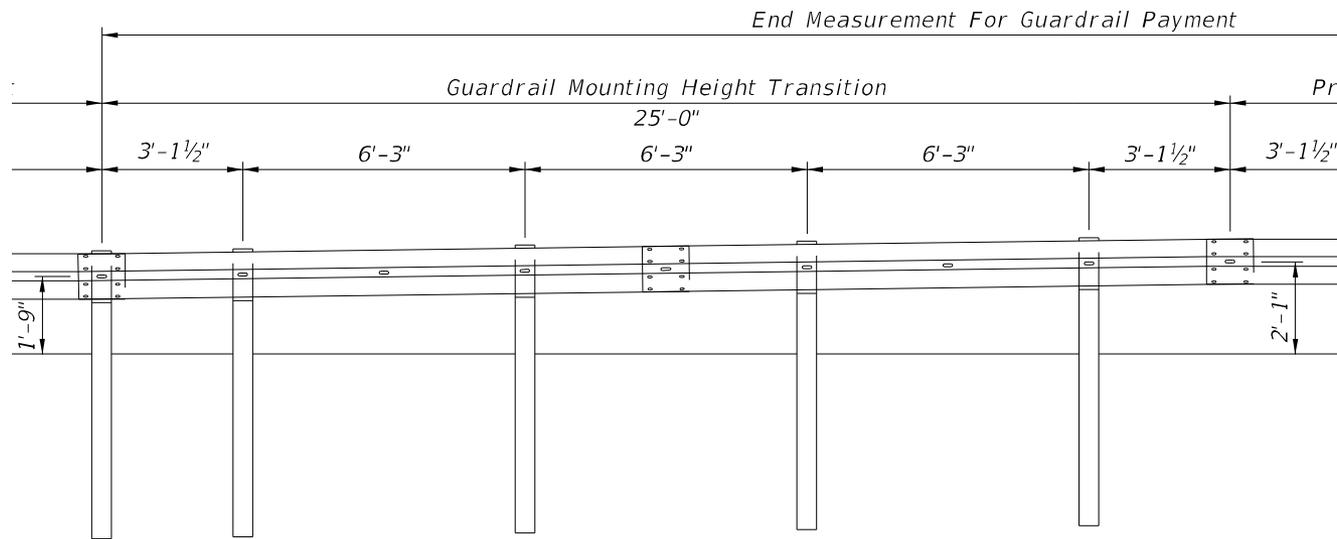


Account for the Added 3'-1½" Panel Length in your Length of Need (LON) Calculations

# Part 1 – Major Changes

## ■ Guardrail Mounting Height Transition Detail

Transition from 1'-9" to 2'-1" W-Beam Guardrail Mounting Height



Shall be Used to Transition at the Begin and End Project Limits or in Special Cases As Directed by the Engineer

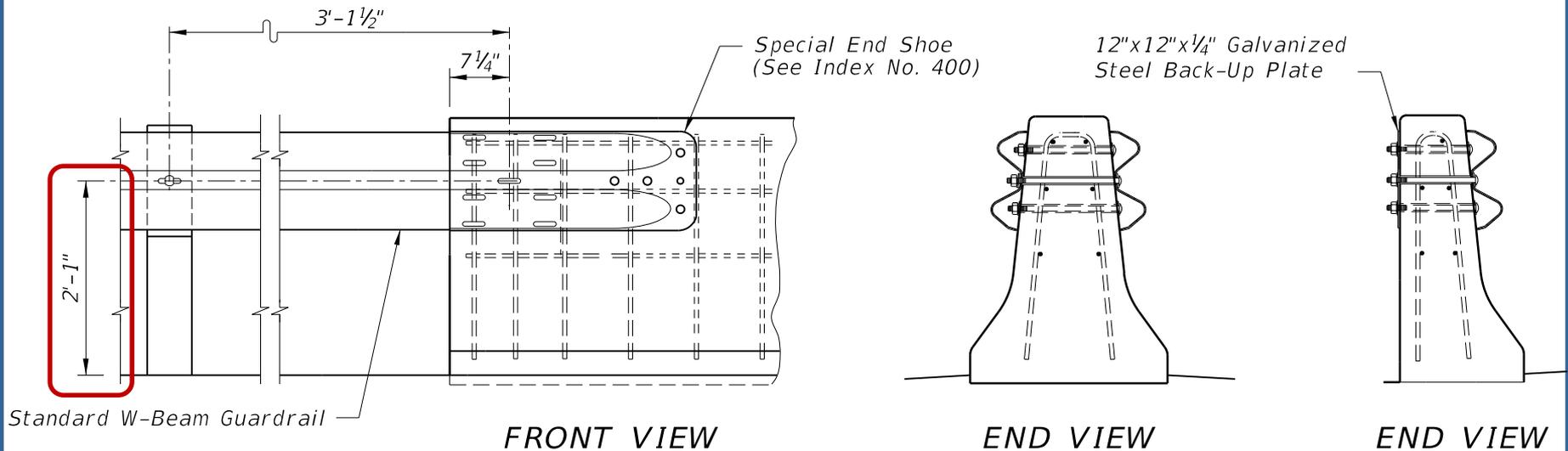
# Part 1 – Major Changes

- **Design Standards – Index 400 (Guardrail)**

Summary of Major Changes to Guardrail			
Criteria	Existing	New	Sheet Number
Index 410 W-Beam Guardrail Attachment to Concrete Barrier Wall	1'-9" Mounting Height	2'-1" Mounting Height	2
Index 430 Crash Cushion Details Standard Guardrail Transition	Symmetrical Transition Panel	Asymmetrical Transition Panel	2

# Part 1 – Major Changes

## ■ Index 410 – Concrete Barrier Wall

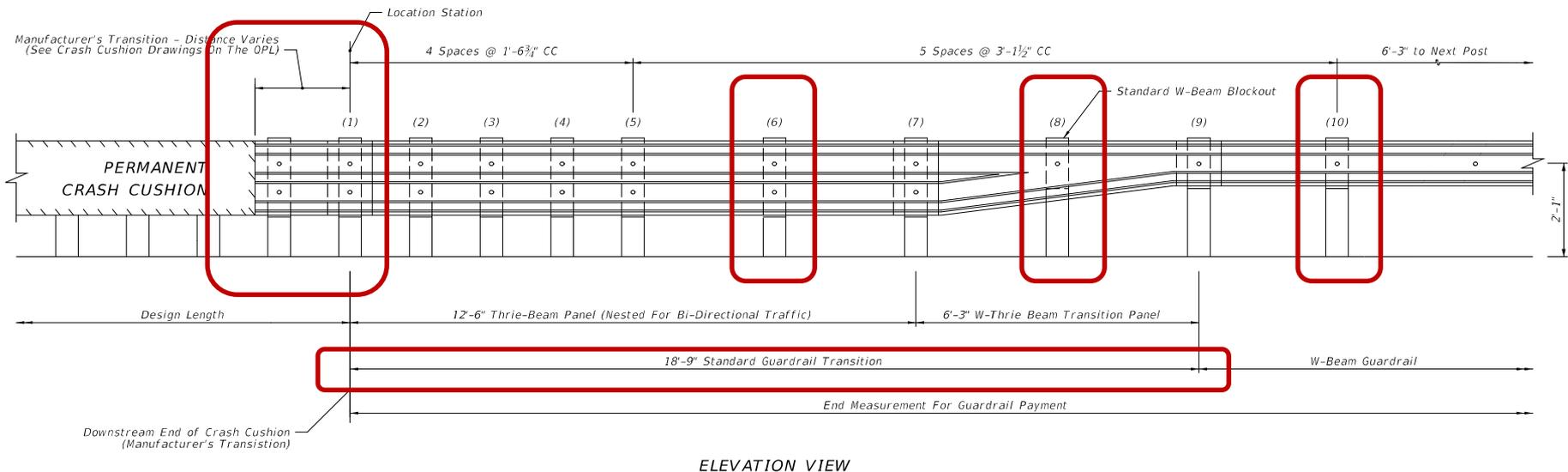


2'-1" Standard Guardrail Mounting Height

# Part 1 – Major Changes

## ■ Index 430 – Crash Cushion Details

### Manufacturer's Transition to Thrie-Beam



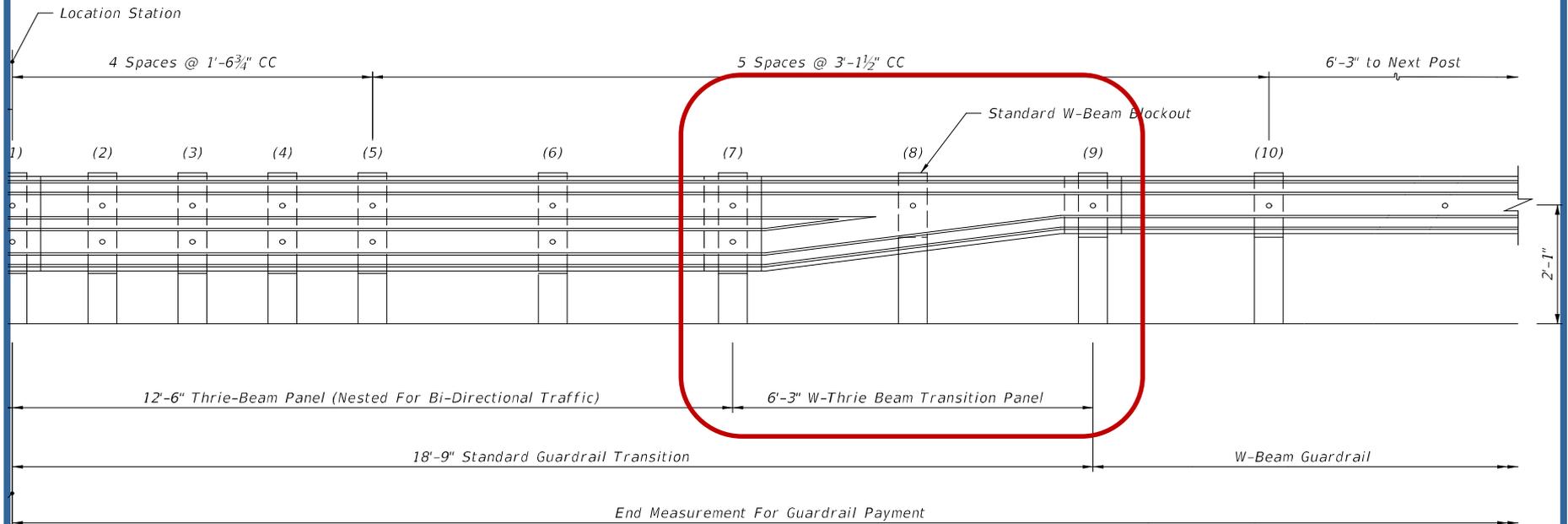
18'-9" Standard Guardrail Transition

Added Two Posts Similar to Detail J of Index 400

Located First Post 3'-1 $\frac{1}{2}$ " from Transition

# Part 1 – Major Changes

## ■ Index 430 – Crash Cushion Details



ELEVATION VIEW

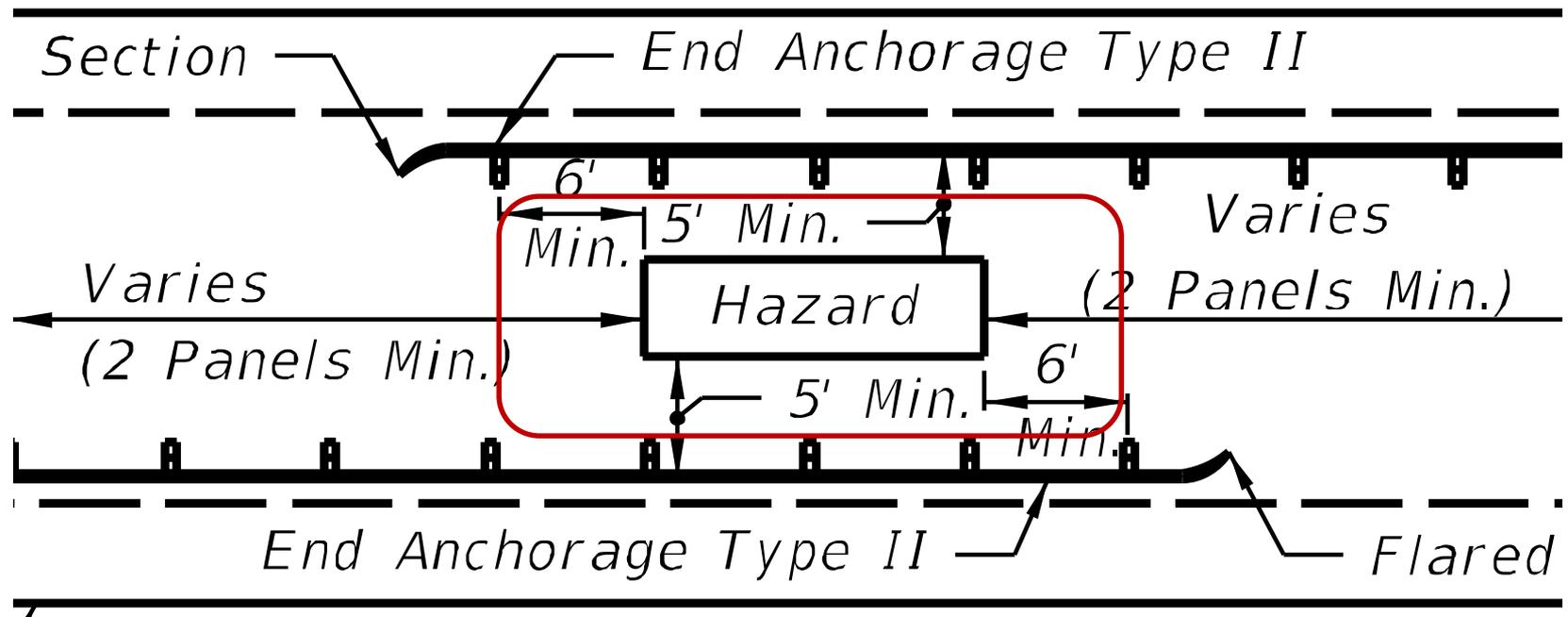
# Part 2 – Proposed Changes

## ■ Design Standards – Index 400 (Guardrail)

Summary of Future Changes to Guardrail			
Criteria	Existing	New	Sheet Number
Minimum Offset for Standard W-Beam Guardrail	4'	5'	1 and 5
Approach End Anchorage Assembly Length (TL-2)	Assembly Length Flared 40'-7½" Parallel 40'-7½"	Assembly Length Flared 53'-1½" Parallel 53'-1½"	2
Double Faced W-Beam Guardrail Median End Treatment Designation	“Crash Cushion”	“Crash Cushion or Redirective Median End Anchorage Assembly”	1, 5, 8 - 11
Table of Minimum Offsets for Single Faced Guardrail	Based on the 2006 AASHTO Roadside Design Guide, Table 5.4	Based on the 2011 AASHTO Roadside Design Guide, Table 5-4 and Table 5-6	19

# Part 2 – Proposed Changes

- Minimum Offset for Standard W-Beam Guardrail



5'-0" Minimum Hazard Offset for W-Beam Guardrail

# Part 2 – Proposed Changes

## ■ Approach End Anchorage Assembly Length (TL-2)

### Index 400, Sheet 2 of 26 General Note 8

8. Test Level 3 End Anchorage Assemblies are suitable for all design speeds. However, use a 53'-1½" long TL-3 End Anchorage Assembly shown on the QPL for Design Speeds greater than or equal to 50 mph and a 53'-1½" long TL-2 End Anchorage Assembly Shown on the APL for Design Speeds less than or equal to 45 mph.

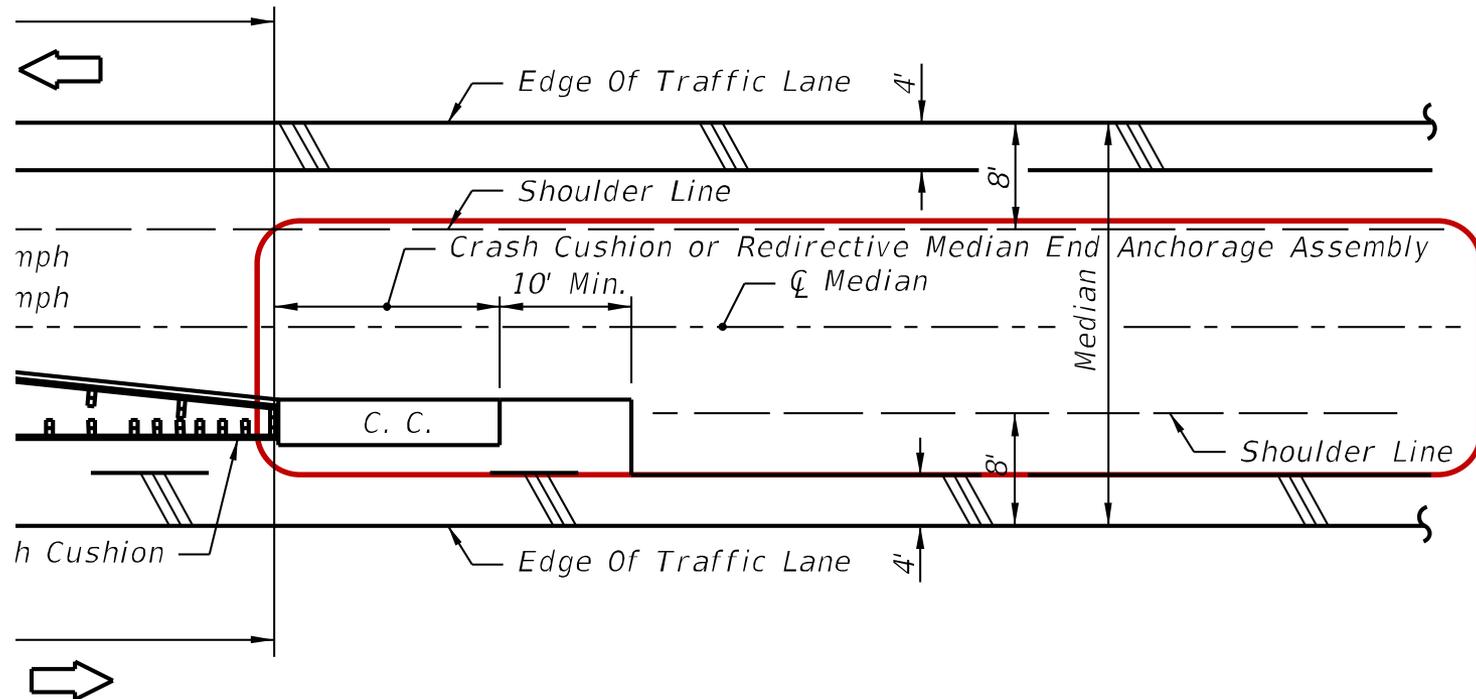
### Low Speed End Anchorage Assembly with a Design Speed Less Than 50 mph

### 53'-1½" Long Test Level 2 (TL-2) End Anchorage Assembly

# Part 2 – Proposed Changes

## ■ Double Faced W-Beam Guardrail

### Median End Treatment Designation



Use a Crash Cushion or Redirective Median End Anchorage Assembly

# Part 2 – Proposed Changes

- **Table of Minimum Offsets for Single Face Guardrail**  
Minimum Offsets Derived from Table 5-4 & Table 5-6

OFFSETS (Ft.)				
Measured From Face Of Guardrail To Front Of Above Ground Rigid Hazard				
POST SPACING (Ft.)	SINGLE BEAMS		NESTED BEAMS	
	W-Beam	Thrie-Beam	W-Beam	Thrie-Beam
6'-3"	5'-0"	3'-10"	N/A	N/A
3'-1½"	3'-10"	3'-2"	3'-0"	2'-10"
1'-6¾"	3'-2"	2'-10"	2'-8"	2'-6"

Note:  
*The values shown should be utilized unless changes are supported by empirical validation. Those desiring to develop offset values from the simulated deflection values shown in Table 5-6, "Summary of Maximum Deflections" of the AASHTO Roadside Design Guide are cautioned to proceed only if background in the table development is understood.*

MINIMUM OFFSETS FOR SINGLE FACED GUARDRAIL (Ft.)

AASHTO Roadside Design Guide 4<sup>th</sup> Edition 2011

# Part 2 – Proposed Changes

- P.P.M., Vol. I, Chapter 4 – “Roadside Safety”**

Summary of Future Changes to Plans Preparation Manual			
Criteria	Existing	New	PPM, Vol. I, Chapter 4
Lateral Offset from the Edge of Travel Way	Delete Table 4.3.1 Minimum Offset of Barriers	Replace with Revised Table 4.3.1 Minimum Offset of Barriers	Section 4.3.5 “Placement”
Placement of Curb-Barrier Combinations	Delete Figure 4.3.1 Placement of Curb-Guardrail Combinations	Replace with Revised Figure 4.3.1 Placement of Curb-Barrier Combinations	Section 4.3.5 “Placement”
Offset Deflection Detail For Hazards Offset Between 4’-0” and 5’-0”	N/A	Proposed for Index 400 IDS	Section 4.3.5 “Minimum Offsets of Barriers”

# Part 2 – Proposed Changes

## ■ Table 4.3.1 Minimum Offset of Barriers

Minimum Offsets Derived from Table 5-4 & Table 5-6

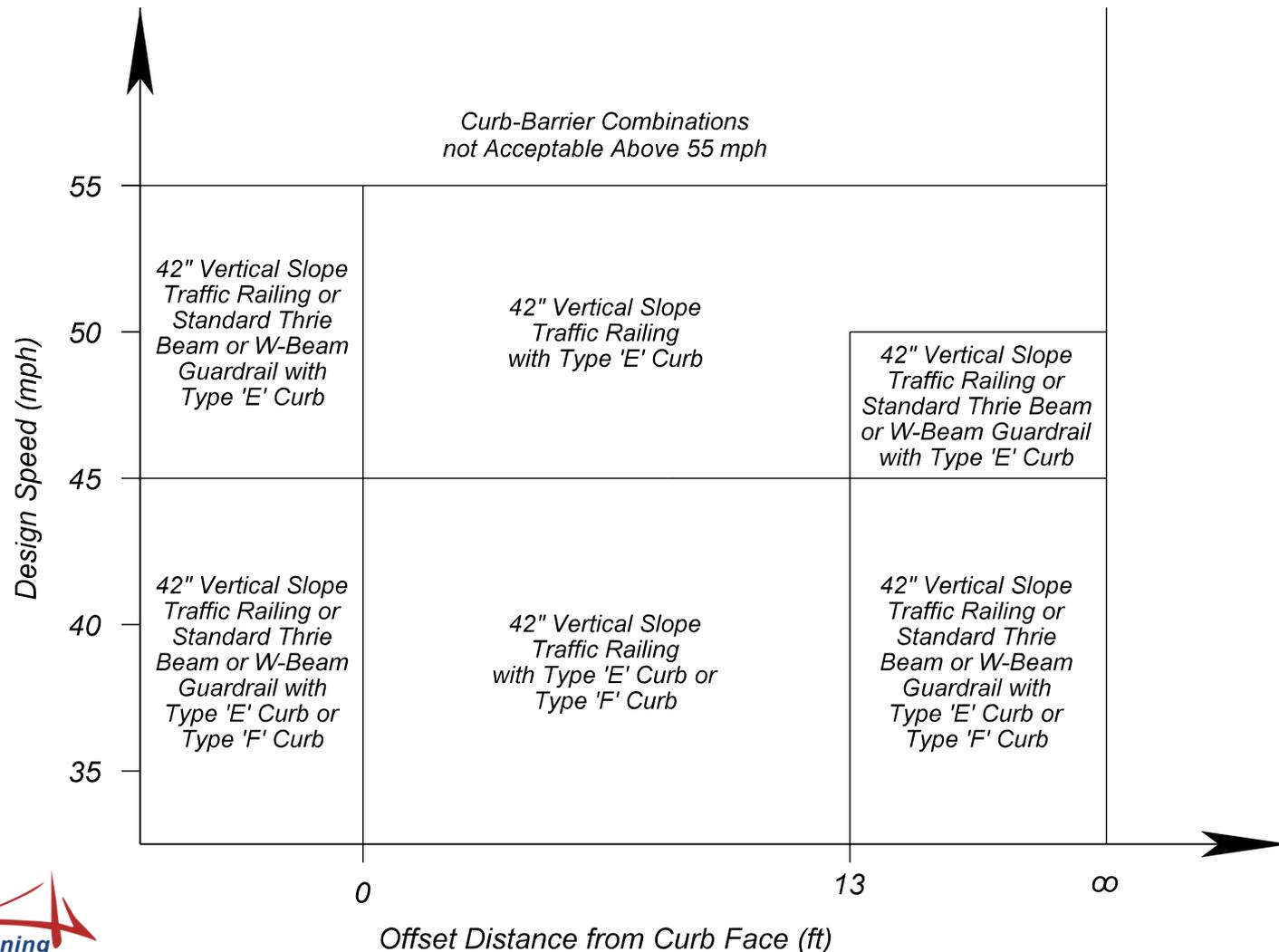
BARRIER TYPE	OFFSET
W-Beam with Post Spacing @ 6'-3"	5'-0"
W-Beam with Post Spacing @ 3'-1½"	3'-10"
W-Beam with Post Spacing @ 1'-6¾"	3'-2"
Thrie-Beam with Post Spacing @ 6'-3"	3'-10"
Thrie-Beam with Post Spacing @ 3'-1¼"	3'-2"
Thrie-Beam with Post Spacing @ 1'-6¾"	2'-10"
Concrete Barrier Wall	*
Double W-Beams (Nested) with Post Spacing @ 3'-1½"	3'-0"
Double W-Beams (Nested) with Post Spacing @ 1'-6¾"	2'-8"
Double Thrie-Beams (Nested) with Post Spacing @ 3'-1½"	2'-10"
Double Thrie-Beams (Nested) with Post Spacing @ 1'-6¾"	2'-6"

\* These offsets are specifically provided in the *Design Standards*.  
For additional information on offsets to barriers see *Section 7.1.2*.

Added Offset Values for W-Beam and Thrie-Beam  
With ¼ Post Spacing

# Part 2 – Proposed Changes

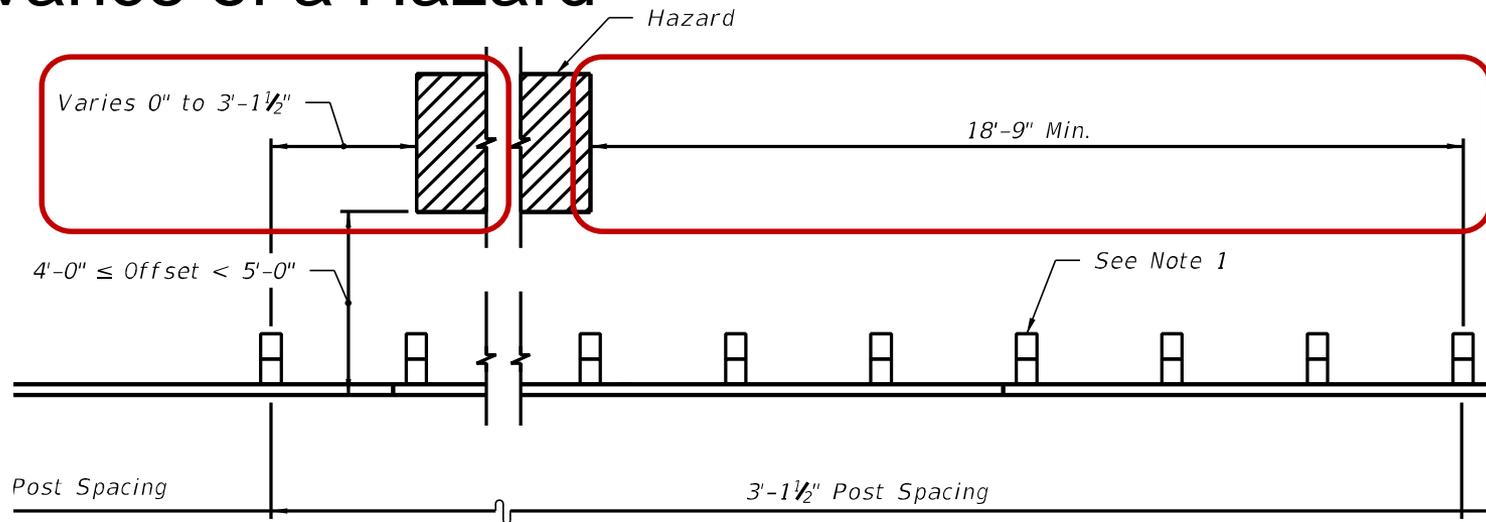
## ■ Figure 4.3.1 Placement of Curb-Barrier Combinations



# Part 2 – Proposed Changes

## ■ Offset Deflection Details

18'-9" Minimum Length of 3'-1½" Post Spacing in Advance of a Hazard



Post Spacing Varies (0' to 3'-1½") on the Trailing End of One-Way Hazards

# Final Notes

## ■ 31" Height W-Beam Guardrail Design:

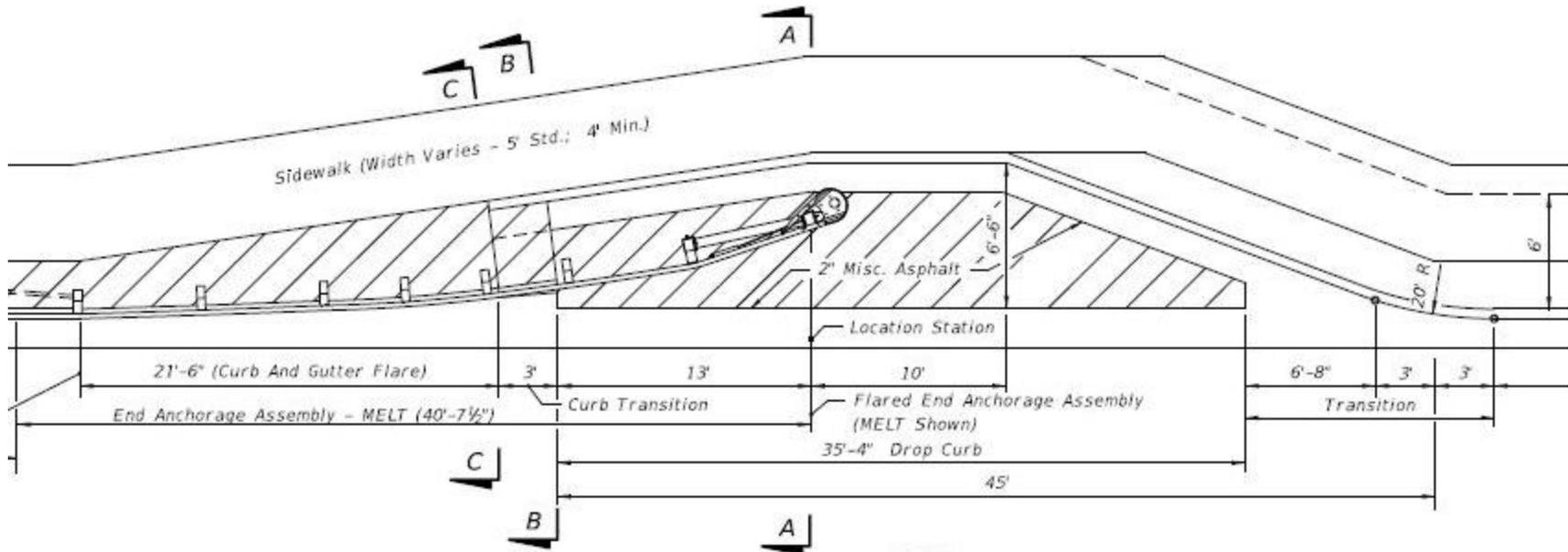
- 1) End Terminal Applications are Under Review for QPL Approval.
- 2) Questions on Calculating the Length of Need (LON) will be Covered in the Instructions for Design Standard (IDS).
- 3) Pay Item 536-85 Covers Payment of both TL-2 and TL-3 End Anchorage Assemblies (No Pay Item Change Made).
- 4) A "Mandatory Specifications Revision" was Hosted by the Construction Office for Specification Number 538, "Resetting Guardrail" (Revision Date March 6, 2014).

# Conclusion

- **A 31" Height W-Beam Guardrail Design:**
  - A) Improves the Safety Performance of Semi-Rigid Barriers by Reducing the Crash Severity.
  - B) Redirects Larger and Higher Center-of-Gravity Vehicles.
  - C) Moves the Splice Location, Increases the Guardrail's Effective Ribbon Strength and Improves its Capacity to Contain Heavier Vehicles by Reducing Penetrations.
  - D) Meets FHWA Eligibility Requirements and the Latest Crash Test Performance Requirements.

# Conclusion

- **A Career in Roadway and Drainage Design:**



Modified Eccentric Loader Terminal (MELT) TL-2 Detail was the First Drawing I Contributed to the Design Standards on September 30, 1987

*What are your QUESTIONS...?*

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***Florida Department of Transportation***

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