“Summary”
Guardrail Training

April 2016
Presenters:
From the FDOT Roadway Design Office in Tallahassee...

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We’re going to give you the Guardrail “crash course”

Here’s the Guardrail crash course....
• Index 400 – Guardrail
  • Complete Restructuring Project
    • New Index Sheets (Redrawn)
    • New Specifications
    • New Instructions for Design Standards (IDS)
    • New Length of Need Design Program (Excel)
    • Revised PPM Ch. 2 and 4
    • Modifications of Existing Indexes for Compatibility (e.g. Index 410, 411, 416)
PART 1: Choosing to Use Guardrail... and Where is Guardrail Located?

Use Plans Preparation Manual (PPM)
Volume 1, Chapter 4
PPM, Volume 1, Chapter 4

PPM, Chapter 4 Has Recently Undergone a Major Renovation:
All “Significant” Changes/Additions – RDB 15-16, Page 3 thru 6

Volume 1, Chapters 2, 4, 7, 10, 21, 25

Chapter 4 was substantially revised. All roadside safety criteria (New Construction, Temporary Traffic Control, TDLC, RRR) has been moved from Chapters 2, 7, 10, 21, and 25, and is now located in Chapter 4. New sections were added to Chapter 4 to provide clarification and to reference requirements found in other documents and Design Standards. There were also policy changes within this chapter, as described below:

- **Section 4.2.3 – Added “Basic” Clear Zone Concept.**
- **Section 4.2.7 – Added New “Drainage Features” Section.**
- **Section 4.2.8 – Added New “Traffic Separator” Section.**
- **Section 4.3.2 – Revised Barrier Placement requirements (i.e. outside of the clear zone and no closer to canal top slope than distances provided).**
- **Section 4.4 – Added New “Roadside Barriers” Section to provide list and limitations of various Standard Barriers, End Treatments, Crash Cushions, and Barrier Transitions.**
- **Section 4.4.1.2 – Three-Beam Guardrail, as a standard barrier type, has been removed from the PPM. With the introduction of 31” W-Beam Guardrail (MGS) as the standard guardrail barrier option on the State Highway System Three-Beam Guardrail, as it is currently configured, is considered obsolete. Three-Beam panels will still be used in barrier transitions and with Modified Three-Beam installations.**
- **Section 4.4.1.3 – Added statement that modifications to Rigid Barriers must be approved by the State Roadway Design Office or State Structures Design Office.**
- **Section 4.4.5 – Expanded Barrier Type Selection to include all barrier types, not just guardrail.**
- **Section 4.4.5.1 – Added barrier “Order of Bias” table.**
- **Section 4.4.5.4 – Added Flowchart for Per Protection Selection.**
- **Section 4.4.6.1 – Revised guardrail offset from curb face criteria. Modified Table 4.4.2 to remove Three-Beam and to include setback distances for all standard barrier types, not just guardrail.**
- **Section 4.4.6.2 – Added New “Grading Requirements” Section. Included maximum algebraic difference of 7% in advance of barrier.**
- **Section 4.4.6.2 – The Department has changed the method of calculating “Length of Need” and has added this new Section to explain this topic.**
- **Section 4.4.6.4 – Added new criteria for Median Barriers on high-volume, high-speed, non-limited access facilities.**

The following is a summary of the changes to the chapters impacted by the Chapter 4 reorganization:

<table>
<thead>
<tr>
<th>PPM Sections</th>
<th>Moved From 2015 PPM Volume 1 Section(s)</th>
<th>Moved To 2016 PPM Volume 1 Chapter 4 Section</th>
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<tr>
<td>Lateral Offset</td>
<td>2.11 Lateral Offset 21.5.6 Lateral Offset 25.4.14 Lateral Offset</td>
<td>4.2.4 Lateral Offsets</td>
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<td>Roadside Slope Criteria</td>
<td>2.4 Roadside Slopes 25.4.9 Side Slopes</td>
<td>4.2.6 Roadside Slope Criteria</td>
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<td>Curb</td>
<td>2.3.3 Use of Curb on High Speed Roadways 25.4.14.2 Use of Curb on RRR Projects</td>
<td>4.2.7.2 Curb</td>
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<td>Signing, Lighting, Traffic Signals, and Other Similar Roadside Features</td>
<td>4.6 Roadside Appurtenances</td>
<td>4.2.9 Signing, Lighting, Traffic Signals, and Other Similar Roadside Features</td>
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<td>Roadside Hazards</td>
<td>10.12.10 Above Ground Hazards 10.12.11 Drop-offs in Work Zones</td>
<td>4.3 Roadside Hazards</td>
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<td>Roadside Barriers</td>
<td>10.11.2 Barrier Walls (Temporary)</td>
<td>4.4.1.4 Temporary Barriers</td>
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<tr>
<td>Crash Cushions</td>
<td>4.5 Permanent Crash Cushions 10.11.2 Temporary Crash Cushions</td>
<td>4.4.3 Crash Cushions</td>
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Redevelopment Reorganization of Chapter 4:

- Includes Consolidation of **ALL** Roadside Safety Design Elements
  - Chapter 2 – Lateral Offsets, Clear Zones, Slopes, Curbs, Traffic Railings
  - Chapter 7 – Attachments to Traffic Barriers, Location Criteria
  - Chapter 10 – Clear Zones, Aboveground Hazards, Drop-offs, Temporary Barriers & Crash Cushions
  - Chapter 21 – Lateral Offsets, Clear Zones
  - Chapter 25 – Lateral Offsets, Clear Zones, Control Zones, Roadside Slopes, Curbs, Existing Traffic Barriers/Terminals & Crash Cushions,

- Includes Comprehensive Roadside Design Criteria
  - Added **NEW** Sections to prevent confusion of existing criteria
  - Provide Requirements to follow **AASHTO Roadside Design Guide (RDG)** where appropriate.
  - Including: General Section, Geometry Definitions, Drainage Features, Traffic Separators, Roadside Barrier Information, Grading Requirements, Length of Need.
Roadside Safety:

What is Considered in “Roadside Safety”?

- Everything Beyond Limits of the Shoulder
  Including: Curbs, Slopes, Clear Zone Widths, Traffic Barriers, etc.
Roadside Safety:

Section 4.2.3 – Clear Zone Concept – If a Hazard is Within the Clear Zone, it Should be Considered for Shielding (Possibly with Guardrail):
### Table 4.2.1, Clear Zone Width Requirements:

#### NEW CONSTRUCTION

<table>
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<th>Design Speed (mph)</th>
<th>≥ 1500 AADT (1)</th>
<th>&lt; 1500 AADT (1)</th>
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<td>TRAVEL Lanes &amp; SINGLE LANE Ramps (feet)</td>
<td>TRAVEL Lanes &amp; MULTIPLE Ramps (feet)</td>
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<tr>
<td>&lt; 45</td>
<td>18</td>
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<td>24</td>
<td>14</td>
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<td>18</td>
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<td>&gt; 55</td>
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#### TDLC PROJECTS

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<td>35</td>
<td>14</td>
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<tr>
<td>40</td>
<td>16</td>
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#### RESURFACING, RESTORATION AND REHABILITATION (RRR) PROJECTS (2)

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<th>Travel Lanes &amp; Multilane Ramps (feet)</th>
<th>Auxiliary Lanes &amp; Single Lane Ramps (feet)</th>
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<tr>
<td>&lt; 45</td>
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<tr>
<td>45 (3)</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>&gt; 45</td>
<td>16</td>
<td>8</td>
</tr>
</tbody>
</table>

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1. Annual Average Daily Traffic (AADT) for projected 20-year traffic.
2. RRR Criteria does not apply to Interstate and Freeways.
3. May be reduced to <45 mph widths if conditions more nearly approach those for lower speeds (40 mph or less).
Roadside Safety:

Section 4.2.4, Lateral Offsets:

- Clear Zone should be applied wherever possible per previous slides. However...
- **For urban areas with curbing** which, “...do not have sufficient right of way to provide the required clear zone widths.” minimum Lateral Offset distances must be used...

![Table 4.2.3 Lateral Offset Criteria](attachment:image.png)
Roadside Safety:

Section 4.3, Roadside Hazards:

- **Section 4.3.1, Aboveground Hazards**
  - Definition located in *Chapter 10* before
  - “…anything within the Clear Zone that is greater than 4 inches in height and is firm and unyielding or doesn’t meet breakaway criteria.”
  - Curbs are not considered an aboveground hazard
Roadside Safety:

Section 4.3, Roadside Hazards:

- **Section 4.3.2**, Canal Hazards
  - Simplified verbiage for offset criteria for Canal Hazards
    - Not less than 60 feet for flush shoulder roadways with design speeds of 50 mph or greater.
    - Not less than 50 feet for flush shoulder roadways with design speeds less than 50 mph.
    - Not less than 40 feet for curb or curb and gutter roadways.

- Updated Figures & Revised barrier placement requirements

Shield the canal hazard with an approved roadside barrier when the required minimum lateral offset cannot be met. Locate barrier as far from the travel way as practical. When shielding canal hazards locate the barrier outside of the clear zone where possible. Locate guardrail no closer than 6 feet from the canal front slope and place high tension cable barrier no closer than 15 feet from the canal front slope.
Roadside Safety:

Section 4.3, Roadside Hazards:

- **Section 4.3.3, Drop-off Hazard**
  - Removed language about shielding criteria
  - Added "vertical faced structures", as they do not meet traversable requirements
  - Added *Drop-offs in Work Zones* information from Chapter 10

- **Section 4.3.4, Additional Hazard Considerations**
  - Needed Section to cover other miscellaneous conditions.

Some roadside conditions may create situations which are hazardous for persons other than the motorist departing the roadway. Engineering judgment should be used when evaluating hazardous conditions, and should consider: roadway geometry, proximity to facility or building, level of activity, traffic conditions, etc. These conditions include, but are not limited to, bridge piers that are not designed for vehicle impact loads, bicycle and pedestrian facilities, residential buildings, schools, businesses, and the presence of personnel in work zones. Specific requirements for Bridge Pier Protection are provided in Section 4.4.5.4, and for considerations regarding Positive Protection in Work Zones see Section 4.4.7.4.
Roadside Safety:

**Section 4.4.1, Standard Longitudinal Barriers:**

- **Section 4.4.1.1, Flexible Barrier**
  - High Tension Cable Barrier (**HTCB**)

- **Section 4.4.1.2, Semi-Rigid Barrier**
  - W-Beam Guardrail, Index 400
    - 31” system with Lap Splices at the midspan
    - Minimum Installation Length of 75 feet
  - Modified Thrie-Beam Guardrail, Index 400
  - Thrie-Beam Guardrail as standard run has been removed as option

- **Section 4.4.1.3, Rigid Barrier**
  - Standard Concrete Barriers & Traffic Railings
  - Modifications to Rigid Barriers must be approved by the RDO or SDO

- **Section 4.4.1.4, Temporary Barrier**
  - Low Profile Barrier required for Work Zones Speeds ≤ 45 mph within 100 feet of an intersection, residential driveway or business entrance.
  - Transitions from Low Profile to other types of barrier are not permitted
  - Flexible and Semi-Rigid Barriers may only be used in Temporary Conditions if they meet the requirements for permanent installations (i.e. grading, deflection space, offset, etc.)
### Table 4.4.1 Roadway Barrier Type Selection

<table>
<thead>
<tr>
<th>Barrier Type</th>
<th>Deflection Space Requirement (feet)</th>
<th>Order of Bias</th>
<th>Test Level</th>
<th>Design Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTCB</td>
<td>12</td>
<td>LOW, LOW, HIGH</td>
<td>TL-4</td>
<td>Passenger Car, Pickup Truck, &amp; Single-Unit Truck</td>
</tr>
<tr>
<td>W-Beam Guardrail</td>
<td>5</td>
<td></td>
<td>TL-2 &amp; TL-3 (MASH)</td>
<td>Passenger Car &amp; Pickup Truck</td>
</tr>
<tr>
<td>Modified Thrie-Beam</td>
<td>3</td>
<td></td>
<td>TL-3 &amp; TL-4 (NCHRP 350)</td>
<td>Passenger Car, Pickup Truck, &amp; Single-Unit Truck</td>
</tr>
<tr>
<td>Rigid Barrier</td>
<td>0</td>
<td>HIGH, HIGH, LOW</td>
<td>TL-4 &amp; TL-5 (NCHRP 350)</td>
<td>Passenger Car, Pickup Truck, Single-Unit Truck &amp; Tractor-Van Trailer</td>
</tr>
</tbody>
</table>

Specific requirements for the selection of HTCB are provided in *IDDS-D450*. 
Section 4.4.5.4, Pier Protection

- New Construction Projects
  - Follow Flow Chart
- RRR Projects
  - Refer to SDG for Conditional Guidance
Roadside Safety:

Section 4.4.6, Barrier Placement:

- Controlling Factors
  1. Lateral Offset from the Edge of Traveled Way
  2. Deflection Space Tolerance
  3. Terrain Effects
  4. Length of Need
  5. Space for End Treatments
  6. Outside Shoulder or Median Application

- Section 4.4.6.1, Barrier Offset – OLD Chapter 4, Section 4.3.5
  - Modified Guardrail Offset requirements (Relocated Figure from Chapter 2)
  - Clarified difference in “Setback” and “Offset”
  - Removed OLD Figure 4.3.1
  - Changed Guardrail Offset from Face of Curb
    ✓ Preferred – 5” from Face
  - Modified Setback Table to include ALL Barriers
Section 4.4.6.1, Barrier Offset:

- **Figure 4.4.12**
  Lateral Offset to Guardrail
**Section 4.4.6.1, Barrier Offset:**
- Changed to “Setback”
- Removed Thrie-Beam
- Added Flexible & Rigid Barriers

### Table 4.4.2 Minimum Barrier Setback
(Measured from the face of the barrier)

<table>
<thead>
<tr>
<th>Barrier Type</th>
<th>Setback Distance</th>
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<tbody>
<tr>
<td><strong>Flexible Barrier</strong></td>
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<tr>
<td>High Tension Cable Barrier (HTCB)</td>
<td>12’-0”</td>
</tr>
<tr>
<td><strong>Semi-Rigid Barrier</strong></td>
<td></td>
</tr>
<tr>
<td>W-Beam with Post Spacing @ 6’-3” (TL-3)</td>
<td>5’-0”</td>
</tr>
<tr>
<td>W-Beam with Post Spacing @ 3’-1½” (½ Spacing)</td>
<td>3’-10”</td>
</tr>
<tr>
<td>W-Beam with Post Spacing @ 1’-6¼” (¼ Spacing)</td>
<td>3’-2”</td>
</tr>
<tr>
<td>Nested W-Beams with Post Spacing @ 3’-1½” (½ Spacing)</td>
<td>3’-0”</td>
</tr>
<tr>
<td>Nested W-Beams with Post Spacing @ 1’-6¾” (¼ Spacing)</td>
<td>2’-8”</td>
</tr>
<tr>
<td>Modified Thrie-Beam with Post Spacing @ 6’-3”</td>
<td>3’-0”</td>
</tr>
<tr>
<td><strong>Rigid-Barrier</strong></td>
<td></td>
</tr>
<tr>
<td>Concrete Barrier &lt; 40” Height</td>
<td></td>
</tr>
<tr>
<td>Non-crash Tested Continuous or Discontinuous Items</td>
<td>1’-6”</td>
</tr>
<tr>
<td>Concrete Barrier ≥ 40” Height</td>
<td></td>
</tr>
<tr>
<td>Non-crash Tested Continuous or Discontinuous Items</td>
<td>0’-0”</td>
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<tr>
<td>Bridge Traffic Railing &lt; 40” Height</td>
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<tr>
<td>Non-crash Tested Continuous Items</td>
<td>5’-0”</td>
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<tr>
<td>Non-crash Tested Discontinuous Items</td>
<td></td>
</tr>
</tbody>
</table>

**Temporary Barriers**
See “Deflection Space” of applicable *Design Standards Index* or APL drawing.
Roadside Safety:

Section 4.4.6, Barrier Placement:

- **Section 4.4.6.2, Grading Requirements** NEW
  - Terrain Effects have a significant impact on Performance of Barrier
  - Locate barrier on Slopes 1:10, or flatter
  - Provide 2 feet Setback from Slope Breakpoint (regardless of barrier type)
  - Follow grading details included in Design Standards
  - “For superelevated roadway sections, a maximum 7% algebraic difference is permitted between the travel lanes and shoulder in advance of barriers.”
The following conditions within the clear zone are normally considered more hazardous than a roadside barrier:

1. Drop-off Hazards, as defined in Section 4.3.3.
2. Bridge piers, abutments and railing ends.
3. Non-traversable culverts, pipes and headwalls.
4. Non-traversable parallel or perpendicular ditches and canals.
5. Canals, ponds and other bodies of water (other than parallel ditches).
6. Parallel retaining walls with protrusions or other potential snagging features.
7. Retaining walls at an approach angle with the edge of pavement larger than 7 degrees (1:8).
8. Non-breakaway sign or luminaire supports.
9. Trees greater than 4 inches in diameter measured 6 inches above the ground.
10. Utility poles.
11. Aboveground hazards.
Roadside Safety:

Section 4.4.7, Warrants for Roadside Barriers:

- Section 4.4.7.2, Shielding Requirements
  
  - Previously the first Section within Chapter 4

If natural or man-made hazards, including slopes steeper than 1:3, occur within the clear zone, implement one of the following treatments, in order of priority:

1. Eliminate the hazard.
   a. Remove the hazard.
   b. Relocate the hazard outside the clear zone.
   c. Make the hazard traversable or crashworthy.

2. Shield the hazard with a longitudinal barrier or crash cushion.

3. Leave the hazard unshielded when any of the following apply:
   - Longitudinal barrier or crash cushion would be a greater hazard than the hazard to be shielded; or
   - The likelihood of striking the hazard is negligible; or
   - The expense of shielding the hazard outweighs the benefits in terms of crash reduction as determined through the use of RSAP or HSM analyses.

If crash data or safety reports indicate that early treatment of the hazards will result in fewer or less severe crashes, implementing those treatments should be the first order of work.
Roadside Safety:

Section 4.4.7, Warrants for Roadside Barriers:

- Section 4.4.7.3, Warrants for Median Barrier

Provide a median barrier on interstate and expressway facilities where reconstruction reduces the median width to less than the standard for the facility. Deviation from this criteria is not permitted. An RSAP or HSM analysis may be used to evaluate barrier alternatives and supplement the following requirements.

On Interstate and expressway projects, review crashes that occurred in the most recent 5-year period within the limits of 1 mile in advance of the exit ramp gore to 1 mile beyond the entrance ramp gore. If one or more are determined to be cross median crashes, provide shielding with a median barrier. The District may require shielding outside these areas after reviewing the most recent 5-year crash history.

For High Speed (Design Speed ≥ 50 mph), High Volume facilities that lack full access control, the most recent 5-year cross median crash history must also be reviewed for potential shielding with a median barrier. For these facilities, alignment, sight distance, design speed, traffic volume, median width and frequency of median openings should be evaluated on a case-by-case basis for implementation of median barrier.
PART 2: Index Sheets Overview

FY 2016-17 Design Standards
Effective for Projects with Lettings in the Fiscal Year (FY) from July 1, 2016 through June 30, 2017

State of Florida Department of Transportation
Office of Design
Mail Station 32
605 Suwannee Street
Tallahassee, Florida 32399-0450

Index 400 is a DSR, as of February 1, 2016
Why change?...

*Clarity. Updates. Effectiveness.*

**OLD INDEX:**
- 34 sheets long
- lengthy verbiage, ‘passive voice’
- old scanned-in drawings
- includes information for the designer
- includes Spec. style language
- has previous NCHRP350 Guardrail Transition to ‘Bridge Railings’
- has only TL-3 guardrail options
- ‘Length of Need’ uses a simplified method based on previous criteria

**NEW INDEX:**
- 22 sheets long (with Table of Contents)
- concise verbiage, ‘active voice’, note headings
- new drawings to scale, latest labeling practice
- designer information moved to PPM and IDS
- Spec. language moved to the Specifications
- has latest MASH tested Guardrail Transitions to ‘Rigid Barrier’ (Both Railings and Barriers)
- has both TL-3 & TL-2 guardrail options
- ‘Length of Need’ calculations cover more cases, based on AASHTO RDG criteria
### Where is it?

Easiest to Google “FDOT Standards”

http://www.dot.state.fl.us/rrdesign/DesignStandards/Standards.shtm

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<tr>
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### Design Information

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<td>Guardrail</td>
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Implementation Schedule...

Roadway Design Bulletin 16-01

The Index Sheets and Instructions for Design Standards discussed refer to the February 1st DSR to the 2016-17 Design Standards eBook. The Specifications referred to will soon be available as Modified Special Provisions (MSPs).

These documents are available for use at the option of the Districts for all FDOT projects let prior to July 1st, 2017.

On July 1st, 2017 this update will become mandatory for FDOT projects, as it will be released with the 2017-18 Design Standards eBook.
Table of Contents and General Notes:

GENERAL NOTES:

1. INSTALLATION: Construct guardrail in accordance with Specification Section 339.

   This Index, along with the plans and the manufacturers’ drawings, is sufficiently detailed for installation of General Guardrail, Low-Speed Guardrail, End Treatment assemblies, and their connecting options shown herein. This procedure requires permit drawing submittals unless otherwise specified in the plans.

2. COMPATIBILITY: The General Guardrail in this Index is based on the Midwest Guardrail System (MGS) design, with a 32” height at the top of the Panel (2’-1” traveling height at £ of Panel) and a middle panel splice as shown on Sheet 2. Guardrail components included in this Index are compatible with this Index, may also be identified as 32” or MGS Guardrail.

3. INSTALLATION: Standard guardrail components, including posts, panels, and bolt systems, are based upon English unit conversion of the AASHTO-MC-AMTB Joint Committee Task Force 12 Report: A Guide to Standardized Highway Barrier Hardware (http://www.aashto.org/Barrier-Hardware.php)

4. BUTTON-HEAD BOLTS: Install Button-Head Bolts where indicated using bolts, nuts, and washers as defined on Sheet 22. Place washers under nuts; washers are optional against steel flanges. Do not place washers between bolt heads and panels, except where otherwise shown in this Index.

5. HEX-HEAD BOLTS: Install hex-head bolts where indicated using bolts, nuts, and washers in accordance with material properties of Specification Section 567. Place washers under nuts; washers are optional against steel flanges.

6. MISCELLANEOUS ASPHALT PAVEMENT: Install Miscellaneous Asphalt Pavement where indicated in accordance with Specification Section 339.

7. ADJACENT SIDEWALKS & SHARED USE PATHS: When guardrail posts are placed within 4’ of a sidewalk or shared use path, use timber posts, or use metal posts only if treated with Pipe Seal as shown on Sheet 20. When timber posts are used, one of the following safety treatments is required for the bolts protruding from the back face of the posts:

   a. After tightening the nut, trim the protruding post bolt flush with the nut and galvanize per Specification Section 562.

   b. Tie post bolts 10” in length and counterbore the washer and nut a distance of 1” and 3/4” deep into the back face of the post.

   c. Use 19” post bolts with sleeve nuts and washers.

When End Treatment posts are within 4’ of a sidewalk or shared use path, steel posts are not permitted within the End Treatment segment. Terminate the Pipe Seal outside of End Treatment segment, as noted per Sheet 20.

8. CONNECTION TO EXISTING GUARDRAIL: Where a transition to existing guardrail at 20” height is required, linearly transition the guardrail height over a distance ranging from 25’-0” to 35’-0”. Provide an immediate transition to the required standard splice using the available panel options on Sheet 4.

9. PLAN CALLOUTS: Begin/End Station labels are shown throughout this Index as they correspond to the station and offset callouts specified in the plans.

   In the plans, Begin/End Guardrail (Station refers to General TL-2 Guardrail, and it may be abbreviated as Begin/End GR). Where Low-Speed TL-2 Guardrail is specified, the callout in the plans will then specify BeginEnd TL-2 GR.

10. QUANTITY MEASUREMENT: Measure guardrail component lengths in accordance with Specification Section 339. The Guardrail length is measured along the centerline of installed Panels between the points (labeled Begin/End Guardrail Station boxes on the following index sheets) and defined in the plans (typically measured from the £ of the panel post bolt slots at the approach/trailing ends).
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<th>CONTENTS</th>
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<td>General, TL-3 Guardrail - Installed Plan and Elevation</td>
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<tr>
<td>3</td>
<td>Low-Speed, TL-2 Guardrail - Installed Plan and Elevation</td>
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<td>4</td>
<td>W-Beam and Thrie-Beam Panel Details</td>
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<td>5</td>
<td>Post and Offset Block Details</td>
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<td>6</td>
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<td>13</td>
<td>Approach Transition Connection to Rigid Barrier - General, TL-3</td>
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<td>14</td>
<td>Approach Transition Connection to Rigid Barrier - Low-Speed, TL-2</td>
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<td>15</td>
<td>Approach Transition Connection to Rigid Barrier - Details</td>
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<td>16</td>
<td>Approach Transition Connection to Rigid Barrier - Double Faced Guardrail</td>
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<td>17</td>
<td>Layout to Rigid Barrier - Approach Ends</td>
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<td>18</td>
<td>Layout to Rigid Barrier - Approach Ends with Double Faced Guardrail</td>
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<tr>
<td></td>
<td>Layout to Rigid Barrier - Trailing Ends</td>
</tr>
<tr>
<td>19</td>
<td>Rub Rail Details</td>
</tr>
<tr>
<td>20</td>
<td>Pedestrian Safety Treatment - Pipe Rail</td>
</tr>
<tr>
<td>21</td>
<td>Modified Mount - Special Steel Post for Concrete Structure Mount;</td>
</tr>
<tr>
<td></td>
<td>Modified Mount - Encased Post for Shallow Mount;</td>
</tr>
<tr>
<td></td>
<td>Modified Mount - Frangible Leave-Out for Concrete Surface Mount</td>
</tr>
<tr>
<td>22</td>
<td>Barrier Delineators - Post Mounted;</td>
</tr>
<tr>
<td></td>
<td>Clear Space - Reduced Post Spacing for Hazards;</td>
</tr>
<tr>
<td></td>
<td>5/8” Button-Head Bolt System</td>
</tr>
</tbody>
</table>

**Sheet Organization/Groupings:**

- 2-3) Guardrail run types
- 4-5) Basic components
- 6) Guardrail Cross-Sections:
  - 7-12) End Treatments:
    - Approach “Terminal”
    - Trailing “Anchorage”
    - CRT (with layouts)
- 13-16) Transition Connections to Rigid Barriers
- 17-18) Example guardrail layouts showing how segments above will fit together
- 19-20) Guardrail supplements
  - Rub Rail
  - Pipe Rail
- 21) Modified Post Mounts
- 22) Miscellaneous Details
NOTES Highlights:

2. This is considered 31” height Guardrail (based on MGS design)

8. How to connect to existing guardrail (transition)

9. Plans Callouts

10. Guardrail Length Measurement
General, TL-3 Guardrail Details:

- Configuration for "General" run of W-beam guardrail
- Applicable for TL-3 Design Speed and below
General, TL-3 Guardrail Details:

- Configuration for “General” run of W-beam guardrail
- Applicable for TL-3 Design Speed and below
General, TL-3 Guardrail Details:

- 31” Height
- 6’-3” Post Spacing
- Midspan Panel Splice
- 2” Miscellaneous Asphalt Pavt. (Mow Strip)
- 1 Offset Block Per Post

General, TL-3 Guardrail is the same as the Previous Standard:
NOTES Highlights:

1. Contractors must use 12’-6” or 25’-0” Panels, but they may use a 6’-3” Panel at the end of the run. *Designers should design the nearest 6’-3” Panel length, measured along CL of panels.

2. Midspan Panel Lap Splices need to have exposed ridge facing downstream. This orientation is not required for TTC phasing.

8. General Guardrail is “base configuration” (e.g. post spacing, midspan splice, offset block). It is then “modified” where defined in the plans to add Pipe Rail, Double Faced Guardrail, Rub Rail, Deep Posts etc...
Low-Speed, TL-2 Guardrail Details:

- **All New!**
- **Double the post spacing**
- **Half the posts for cost savings (where applicable)**
- **Permitted for design speeds 45 MPH and Less (TL-2)**
- **Use only for flush shoulder conditions (no raised curbs)**
Low-Speed, TL-2 Guardrail Details:

- **All New!**
- Double the post spacing
- Half the posts for cost savings (where applicable)
- Permitted for design speeds 45 MPH and Less (TL-2)
- Use only for flush shoulder conditions (no raised curbs)
Low-Speed, TL-2 Guardrail Details:

Vehicle at rest

0.000 s 0.196 s 0.392 s 0.588 s
Low-Speed, TL-2 Guardrail Details:

Low-Speed, TL-2 Guardrail is the same as General Guardrail, **except**:

- **12’-6” Post Spacing**
- **Run ends with a 9’-4½” Panel** to transition to other segment types (with 6’-3” span and midspan splice)
W-Beam and Thrie-Beam Panel Details:

- Panel Options Shown on single Sheet
- Panels are used in General and Low-Speed Guardrail, Approach Transitions, End Treatments Etc...
**W-Beam and Thrie-Beam Panel Details:**

**Traditional Panel Jargon:**
- Double Panel = 25’-0”
- Full Panel = 12’-6”
- Half Panel = 6’-3”
- Quarter Panel = 3’-1½”
More Flexibility Provided for Contractors:

- **6'-3” Panel** may be used at end of run to meet new guardrail length tolerance of ± 3’-1½” (Spec. 536)

- **9’-4½” or 15’-7½” Panels** may be used to transition to midspan panel lap splices (for connecting to existing older guardrail with splices at post location)

- **25’-0” Panels** may now be used to reduce the number of splice bolt installations required by half
Post and Offset Block Details:

- Covers all Options for Post and Offset Block Configurations
Offset Block
Dimension is
6” x 8” Nominal
(5.5” x 7.5” Actual)

7.5” is the offset dimension
Post Details:

- 2 Post Lengths (Depths)
  - Standard ‘L’
  - Deep Post ‘L’

TIMBER POST (6"X8" Nominal)

STEEL POST (W6X8.5 or W6X9)
Guardrail Sections:

Guardrail Sections:

Guardrail Heights & Depths
- Adjacent Grading (a.k.a. Slopes)
- 2” Misc. Asphalt Mow Strip
- Concrete Sidewalk
- Curb Conditions
- Shoulder Gutter
- Rub Rail

Summary:

W-Beam Mow Strip

Concrete Sidewalk

Curb Conditions

Shoulder Gutter

DOUBLE FACED W-BEAM

THREE-BEAM

DOUBLE FACED THREE-BEAM

MODIFIED THREE-BEAM

SLOPE BREAK CONDITION TIMBER DEEP POST

SLOPE BREAK CONDITION STEEL DEEP POST

GUARDRAIL TYPES - MOUNTING HEIGHTS & POST DEPTHS

GUARDRAIL SECTIONS - TYPICAL

GUARDRAIL SECTIONS - CURB & GUTTER

GUARDRAIL SECTIONS - SHOULDERS

GUARDRAIL HEIGHT SUMMARY TABLE:

<table>
<thead>
<tr>
<th>Type</th>
<th>Min. Depth (°)</th>
<th>Mounting Height (cm)</th>
<th>Foot Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W-Beam (Upright &amp; Double Faced)</td>
<td>5-10°</td>
<td>2-7</td>
<td>4-5</td>
</tr>
<tr>
<td>Timber Beam (Upright &amp; Double Faced)</td>
<td>3-10°</td>
<td>1-4</td>
<td>6-6</td>
</tr>
<tr>
<td>Timber Deep Post</td>
<td>4-10°</td>
<td>See Above</td>
<td>7-4</td>
</tr>
<tr>
<td>Steel Deep Post</td>
<td>6-6</td>
<td>See Above</td>
<td>9-6</td>
</tr>
</tbody>
</table>

NOTES:
1. GUARDRAIL SECTIONS: Construct Sections as indicated in the plans. The details shown on the plans are the only details that will be made permanent. Details not shown on the plans are subject to change.
2. GUARDRAIL TYPES: Mounting Heights & foot lengths are shown on the plans.
3. SLOPE BREAK CONDITION: Install Deep Posts only where calibrated in the plans. Deep Posts are only permitted where toe spacing is 6'-0" or less.
4. LATERAL OFFSETS: The Lateral offsets shown are governed by the states and offset (tol) is for Face of Guardrail, as shown in the plans.
5. ADJACENT TO CURB: Place the Face of Guardrail consistently offset either from the Face of Curb or 2'-0" behind the Face of Curb, as indicated by the plans states and offset tol. For offset changes, transfer the Face of Guardrail as shown in the plans.

GUARDRAIL SECTIONS
**Guardrail Sections:**

**Slope Break Condition, “Deep Posts” NEW!**

- Contractor may only use Deep Posts where called for in the Plans.

PPM 4.4.6.2 “With approval of the District Design Engineer and where right-of-way is restricted (i.e. constrained condition), the Deep Post guardrail option, as detailed in Design Standards, Index 400 Slope Break Condition, may be used in lieu of providing a 2 ft. setback to the slope break point. Coordinate the use of the Deep Post guardrail option with the District Drainage Engineer and District Maintenance Engineer.”
**Guardrail Sections:**

**Typical Grading and Pavement Placement Detail**

![Diagram of Typical Grading and Pavement Placement Detail]

This Provides basic dimensions that may then be superseded by specific differences of other Standard Guardrail Sections.
(e.g. curbed or shoulder gutter sections)
**Guardrail Sections:**

**Curb and Gutter Sections**

- Notice where Height, ‘H’, is measured up from in each scenario.
- **NEW!** Guardrail placed ‘Adjacent to Curb’ may now be placed at either 0” or 5” from Face of curb, defined per the Plans. (5” preferred to avoid nuisance hits, such as rearview mirrors)
- Lateral Offsets are defined per the Plans.

*See PPM Section 2.3 “Shoulders” & Figure 4.4.12 “Offset to Guardrail”*
Guardrail Sections:

With Shoulder

- Rub Rail is now only permitted for median side, slopes between 1:6 & 1:10
Guardrail Sections: **Concrete Sidewalk NEW!**

Concrete is not permitted around base of post. A low strength “frangible” material must be used (either misc. asphalt of flowable fill)

- 7” Clearance is required from the back of post to the rigid concrete to facilitate proper rotation of posts upon vehicle impact
- If 2” Misc. Concrete Can’t be placed at post location due to surrounding concrete, use the “Frangible Leave-Out” (defined later in the Index)
- When the back of steel posts will be within 4’ of a Sidewalk or Shared Use Path, Pipe Rail must be used for pedestrian safety.
  
  **NOTE:** requires defining Begin/End Stations and length in the Plans
Approach Terminal Geometry, Parallel and Flared:

- Shows basic geometry and grading requirements for APL Approach Terminals.
- Provides predefined Lengths ‘LE’ that will accommodate all APL Terminals (for simpler Plans design).

Design Standards Index 400, Sheet 7
Approach Terminal Geometry, Parallel and Flared:

- Shows basic geometry and grading requirements for APL Approach Terminals
- Provides pre-defined Lengths ‘LE’ that will accommodate all APL Terminals (for simpler Plans design)
Approach Terminal Geometry, Flared:

- **Begin/End Guardrail Station** called out – Corresponds to Roadway Plans callout (Plans station & offset given at Face of Guardrail) – *Length of guardrail measured from here*

- Maximum flare is still 4’-0”, measured at post(1).
Approach Terminal Geometry, Curbed and Double Faced:

- Same idea as Sheet 7, but shows “Curbed” and “Double Faced” segments
Approach Terminal Geometry, Curbed:

- **Type ‘E’ Curb** Required where shown

**CURBED’ SECTION A-A**
(Height, ‘H’, Measured from Misc. Asphalt Pavt.)
Approach Terminal Geometry, Double Faced:

- ‘Double Faced’ option has always been available on the APL, but now it’s shown in the Standard for better awareness.
  - Crash tested
  - Initial installation cost savings versus crash cushion

- 1:10 Max. cross slope extends to Approach Terminal on both sides.
  - Drainage structures may be required to convey median water
  - Outside of ‘LE’, transition longitudinally to typical median cross slope at 1:10 Max (in direction parallel to roadway).
Trailing Anchorage - Type II:

- Apply to “Trailing” guardrail ends to “Anchor” the guardrail. (Not “head-on” crashworthy like Approach Terminals are)

- Nearly same as previous Standard, just drafted more clearly
**Trailing Anchorage - Type II:**

- **Begin/End Guardrail Station** called out – Corresponds to Roadway Plans callout (Stationing and Offset given at Face of Guardrail) – Length of guardrail measured from here
End Treatment Component Details:

- Component Details are used in Type II and CRT End Treatments (on the previous and following pages, respectively)

- Construction Stuff!
End Treatment - Controlled Release Terminal (CRT) System:

- For use with short radius guardrail systems as shown on the next sheet.
- This is the same as the previous Standard, only detailed more clearly.
Layout for Controlled Release Terminal (CRT) System:

- Used for 90 degree intersection of principle roadway and side road or driveway
- This is nearly the same as the previous standard, only detailed more clearly
- Draw corresponding dimensions and radius in the Plans
- When terminating with a CRT End Treatment, the guardrail extends 15’-7½” from Match Line

NOTES:
1. INSTALLATION: Construct the specified radius layout and Connecting Detail option as shown in the plans.
2. MIN. CLEAR AREA: Keep the area behind the CRT free of fixed objects and aboveground hazards within the Min. Clear Area limits shown. Maintain a slope not steeper than 1:10 for a minimum 2' below the posts, and maintain a flare not steeper than 3:2 beyond 2' from the posts.
3. APPROACH GRADE: Maintain grading on the roadway side of the guardrail face at a maximum slope of 1:30.
4. MATERIALS: For CRT posts, use timber post material in accordance with Specification Section 6.7. Use steel panels and hardware in accordance with Specification Section 6.7.
5. BOLT omission: For the 8 Foot Radius CRT System only, do not place a panel-to-post mount bolt at the center CRT Post (even the 9g Button-Head Bolt only at the location shown).
6. SPECIAL PANELS: For all Steel-Beam panels where indicated using 2407 or 2254 W-Beam Panels. Splice at post locations within the CRT radius using the General configuration of 9g or Button-Head BOLTS (prefer, per supplier).
7. GENERAL, SPANS, General Guardrail intrados includes posts and post spacing as shown on Sheet 2, including parallel and raked intrados sections. Advance Warning Signs, Cat-Eye Panels, or Reduced Post Spacing Guardrail segments may be substituted for the General Guardrail intrados as indicated in the plans.

LAYOUT FOR CONTROLLED RELEASE TERMINAL (CRT) SYSTEMS - SIDE ROADS AND DRIVEWAYS
Layout for Controlled Release Terminal (CRT) System:

- Begin/End CRT Station called out – Corresponds to Roadway Plans callout (e.g. “Begin CRT 24 Ft. R. Sta. 100+00”)
- Begin/End Guardrail Station called out – Corresponds to Roadway Plans callout. It’s also shown on Elevation view. – Length of guardrail measured from here
- Min. Clear Area - Maintain 1:10 Slope to 2’ behind the posts. Beyond that, maintain an area clear of hazards with a 1:2 or flatter slope.
Approach Transition Connection to Rigid Barrier, General TL-3:

- **ALL NEW!**
- **MASH Tested**
- Applicable to all Design Speeds
- About 12’-6” shorter than old “Detail J” from Rigid Barrier (about 25’ shorter including previous barrier overlap)
- New raised ‘Alignment Curb’ required
- Section Views on Sheet 15
Approach Transition Connection to Rigid Barrier, General TL-3:
Approach Transition Connection to Rigid Barrier, General TL-3:

- **Begin/End Guardrail Station** called out – Corresponds to Roadway Plans callout – Length of guardrail measured from here

- **Begin/End Rigid Barrier** Station called out - Different from Begin/End Guardrail Station (governed by Thrie-Beam Terminal Connector with its Edge flush with Rigid Barrier) Guardrail’s 7¾” overlap with the Rigid Barrier should be drawn this way in Plans

- **End Transition of Curb** – This is where typical curb type begins, if here on project (e.g. Type F, Shoulder Gutter) Starts 28'-1½” from Begin/End Guardrail Station
**Approach Transition Connection to Rigid Barrier, General TL-3:**

- **Taper to Guardrail Offset per the Plans:** If roadway guardrail has a different lateral offset than the bridge railing guardrail, then your “Begin/End Taper” callout is given at Section E-E. (Starts 28’-1½” from Begin/End Guardrail Station)
  
  *This leads to typical section, generally meeting PPM Fig 4.4.12*

- **End Transition of Curb** – This is *where typical curb type begins*, if here on project (e.g. Type F, Shoulder Gutter; Starts 28’-1½” from Begin/End Guardrail Station)
Approach Transition Connection to Rigid Barrier, Low-Speed TL-2:

- **ALL NEW!**
- MASH Tested
- Applicable to Design Speeds ≤ 45 mph
- Shorter and less robust design for cost savings
- New raised ‘Alignment Curb’ required
- Section Views on Sheet 15
Approach Transition Connection to Rigid Barrier, Low-Speed TL-2:

- ALL NEW!
- MASH Tested
- Applicable to Design Speeds \( \leq 45 \text{ mph} \)
- Shorter and less robust design for cost savings
- New raised ‘Alignment Curb’ required
- Section Views on Sheet 15
Approach Transition Connection Details:

- Shows Cross Section details for Approach Transitions on previous Sheets.
- Provides curb transitions for three types of curb Options
  1. Shoulder Gutter
  2. Raised Curb
  3. No Curb
Approach Transition Connection to Rigid Barrier, Double Faced:

- **ALL NEW!**
- Applicable to all Design Speeds
- “Hybrid” of previous Double Faced Transition and MASH-Tested TL-3 Approach Transition
- Adds 12’-6” barrier overlap needed to transition guardrail to Rigid Barrier Width
## Layouts to Rigid Barrier, Single Barrier Approach or Median Crossover:

- Provides Example Layout “Types” that will correspond to callouts in the Plans
- Shows how segments in previous sheets connect together

### TYPE A APPROACH TO RIGID BARRIER - PLAN VIEW
MEDIUM OR OUTSIDE SHOULDERS (Mirror Horiz. and Vert. for Opposite Direction and/or Side of Road)

1. **GENERAL**: The Plan views shown are schematic only; showing example geometry for connecting guardrail segments. Actual guardrail segments include taper locations and Single Faced Guardrail requirements as applicable. Work this design with the plans where engineering and offsets from Beginning Tapered, Beginning Rigid Barrier, and Beginning Guardrail are specified.

2. **GENERAL**: This segment shows guardrail only. This segment is designed for the purpose of showing how segments from the previous sheets connect to each other. This segment may be omitted as shown in the plan.

3. **LENGTH OF APPROACH TRANSITION**: Install the Approach Transition as shown per Sheet 13 or 14 as called for in the plans.

4. **LENGTH OF END TREATMENT**: Install the Approach Tapered End Treatment as shown per Sheet 13 or 14, as called for in the plans. See the corresponding APL drawings for construction details.

### TYPE B APPROACH TO RIGID BARRIER - PLAN VIEW CROSSWALK GUARDRAIL FOR MEDIUM SHOULDERS ONLY
DUAL BRIDGE APPROACH CONFIGURATION (Mirror Horiz. and Vert. for Opposite Direction)

1. **GENERAL**: The Plan views shown are schematic only; showing example geometry for connecting guardrail segments. Actual guardrail segments include taper locations and Single Faced Guardrail requirements as applicable. Work this design with the plans where engineering and offsets from Beginning Tapered, Beginning Rigid Barrier, and Beginning Guardrail are specified.

2. **GENERAL**: This segment shows guardrail only. This segment is designed for the purpose of showing how segments from the previous sheets connect to each other. This segment may be omitted as shown in the plan.

3. **LENGTH OF APPROACH TRANSITION**: Install the Approach Transition as shown per Sheet 13 or 14 as called for in the plans.

4. **LENGTH OF END TREATMENT**: Install the Approach Tapered End Treatment as shown per Sheet 7 or 8, as called for in the plans. See the corresponding APL drawings for construction details.

5. **CROSSOVER TERMINAL**: Install the crossover segment tapering linearly from the Beginning Tapered and offset to the End Tapered and offset as specified in the plans.
Layouts to Rigid Barrier, Single Barrier Approach:

- Shows Approach Transition, General Guardrail, and Approach Terminal End Treatment as one system. NOTE: For shortest case of Rigid Barrier end protection, General Guardrail segment may be omitted (simply ‘LA’ + ‘LE’)

- **Begin/End Guardrail Stations** called out – Corresponds to Roadway Plans callout – Corresponds to callouts on preceding sheets – *Defines length of Guardrail*

- **Begin/End Taper Stations** called out - Corresponds to Roadway Plans callout – This is typically where the Guardrail begins tapering to its typical section on Sheet 6 (guardrail face usually goes to paved shoulder line plus 2 feet, or it’s measured from face of curb). *This starts at Section E-E on Sheets 13-15!* Taper rate guidance is provided in the IDS.
layouts to rigid barrier, “median crossover guardrail”: 

- Shows layout for shielding Rigid Barriers of dual bridges, where the concrete railing across the median is within the clear zone (this places the back of the shielding guardrail in the opposing lane’s clear zone as well)

- The “Median Guardrail Crossover” is most efficient design for the shortest Length of Need

- The new ‘Guardrail Length of Need Program’ assists with this design, providing station and offset information. We’ll cover specifics of ‘Double Faced Approach Terminals’ and ‘Crash Cushions’ when we discuss this later.
• **Begin/End Double Faced Guardrail Stations** called out – Corresponds to Roadway Plans  
  **NOTE:** The Double Faced Guardrail Pay Item applies from the Rigid Barrier Connection to the End Treatment (even over the single faced Approach Transition Connection).

• **Begin/End Taper Stations** called out - Corresponds to Roadway Plans callout. The station and offset callouts define the linear taper rate for the contractor.  
  **NOTE:** The ‘Guardrail Length of Need Program’ assists with providing these stations and offsets.
Layouts to Rigid Barrier, Double Faced Approach and Trailing End:

- More Example Layout “Types” that will correspond to callouts in the Plans
- Shows how segments in previous sheets connect together
Rub Rail Details:

- **NEW!** Rub Rail Details are now provided for the same old Rub Rail!

- Remember, from Sheet 6, use Rub Rail only for median slopes greater than 1:10 (with a 1:6 Max. slope in general)

- Now added more specific detail about where to begin and end Rub Rail, Place outside of other segments
Pedestrian Safety Treatment – Pipe Rail:

This is the same as the previous Standard, only detailed more clearly and with more construction issues addressed.
Special Steel Post, Encased Post, Frangible Leave Out:

- **NEW AND IMPROVED!**
  (mostly)

- “Modified Mounts” allow different post mounting options for the scenarios of:
  - Posts atop a concrete structure
  - Posts over shallow underground utilities
  - Post atop concrete surface (sidewalk)
Barrier Delineators, Reduced Post Spacing, Bolt System:

**NOTES:**
1. **INSTALLATION:** Install Barrier Delineators as shown in accordance with the specifications section 3.6. Follow the manufacturer's instructions as specified on the parts.
2. **DESIGN:** The design of the barrier delineators is as specified in specifications section 3.6. Follow the manufacturer's instructions as specified on the parts.
3. **COLOR:** Use either yellow or yellow reflective sheeting to match the color of the reduced post spacing.
4. **MOUNTING:** Mount barrier delineators in accordance with section 3.6. Follow the manufacturer's instructions as specified on the parts.
5. **ALTERNATE:** Mount barrier delineators at intervals as shown in accordance with section 3.6. Follow the manufacturer's instructions as specified on the parts.

**STEEL POSTS**

**TIMBER POSTS**

**MOUNT LOCATION - ISOMETRIC VIEWS**

**BARRIER Delineators**

**NOTE:**
1. **INSTALLATION:** Install barrier delineators in accordance with section 3.6. Follow the manufacturer's instructions as specified on the parts.

**DETAIL 'S' - HALF SPACING ELEVATION**

**DETAIL 'S' - QUARTER SPACING ELEVATION**

**REDUCED POST SPACING FOR HAZARDS**

**BUTTON-HEAD BOLT**

**LAST INDEX SHEET!**

- Includes Miscellaneous Details for the Contractor like Barrier Delineation and Standard Bolt Information
- The “Reduced Post Spacing for Hazards” detail simplifies post spacing transitions for designers
Reduced Post Spacing for Hazards (Reduced Setback Clearance):

• When an aboveground hazard is within 5'-0" behind the face of guardrail, *reduced post spacing* may be used to reduce the “Setback” requirement to the hazard (see PPM Table below)

• The designer must call out the reduced post spacing as required per the table, and the Design Standard will handle the transition of post spacing before and after

• The Standard extends the reduced post spacing to the nearest post outside of the station range called for.

• The Standard also handles Low-speed Guardrail 12’-6” spacing, explaining that the spacing sequence remains the same, but with the 12’-6” adjacent to the 6’-3” spacing.

*From PPM: Table 4.4.2 Minimum Barrier Setback:*

<table>
<thead>
<tr>
<th>Semi-Rigid Barrier</th>
<th>Setback Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>W-Beam with Post Spacing @ 6’-3” (TL-3)</td>
<td>5’-0”</td>
</tr>
<tr>
<td>W-Beam with Post Spacing @ 3’-1½” (½ Spacing)</td>
<td>3’-10”</td>
</tr>
<tr>
<td>W-Beam with Post Spacing @ 1’-6¼” (¼ Spacing)</td>
<td>3’-2”</td>
</tr>
<tr>
<td>Nested W-Beams with Post Spacing @ 3’-1½” (½ Spacing)</td>
<td>3’-0”</td>
</tr>
<tr>
<td>Nested W-Beams with Post Spacing @ 1’-6¼” (¼ Spacing)</td>
<td>2’-8”</td>
</tr>
<tr>
<td>Modified Thrie-Beam with Post Spacing @ 6’-3”</td>
<td>3’-0”</td>
</tr>
</tbody>
</table>
BEGIN PART 3:
Instructions for Design Standards (IDS)

Index 400 is a DSR, as of February 1, 2016
Where is it?...

Office of Design

<table>
<thead>
<tr>
<th>Index Number</th>
<th>Revised Sheets</th>
<th>Index Title</th>
<th>Design Information</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1-22 of 22</td>
<td>Guardrail</td>
<td>IDS-00400 XLS DGN RDB16-01</td>
</tr>
<tr>
<td>410</td>
<td>2,10, 16-18 of 25</td>
<td>Concrete Barrier Wall</td>
<td>N/A N/A DGN</td>
</tr>
<tr>
<td>411</td>
<td>6 of 10</td>
<td>Pier Protection Barrier</td>
<td>N/A N/A DGN</td>
</tr>
</tbody>
</table>
Length of Need Concept:

Length of Need (LON) is the length of guardrail required to provide a degree of shielding to prevent errant vehicles from impacting roadside hazards – measured from the hazard’s approach face to the approach end of the redirective guardrail segment.

From the Guardrail-LON program:

A picture is worth a thousand words, so....
Length of Need Concept:

\[ X = \frac{L_A - Y}{L_A / L_R} \]

AASHTO RDG (5-3)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral Area Concern, ( L_A ) (Ft.)</td>
<td>the lesser distance from the 'Edge of Traffic Lane' to the 'Clear Zone Limit' or 'Back of Hazard'</td>
</tr>
<tr>
<td>End Treatment Offset, ( Y ) (Ft.)</td>
<td>the distance from the Edge of Traffic Lane at the start of the guardrail's gating portion “Start LON” (shown at Post 3)</td>
</tr>
<tr>
<td>Runout Length, ( L_R ) (Ft.)</td>
<td>taken from the AASHTO RDG, Table 5-10(b), based on Design Speed (mph) and Traffic Volume (AADT)</td>
</tr>
</tbody>
</table>
Length of Need

Quick Example:
Design Speed = 45 mph
AADT = 5000 veh/day

Y = 8.5 Ft. (by design, guardrail offset plus flare effect)
Back of Hazard = 22 Ft. (from ‘Edge of Traffic Lane’)
Clear Zone = 24 Ft. (from PPM Table 4.2.1)
Lateral Area Concern, \( L_A \) = 22 Ft.
Runout Length, \( L_R \) = 160 Ft. (from RDG Table 5-10b)

\[
X = \frac{L_A - Y}{L_A / L_R} = \frac{(22-8.5)}{(22/160)}
\]

X = 98.2 Ft.
Miscellaneous Guardrail Layout Examples (from IDS):

TYPICAL HAZARD SHIELDING EXAMPLE:
ROADSIDE AND MEDIAN
('LON' Program Part 'A')
TYPICAL HAZARD SHIELDING EXAMPLE:
2-LANE, 2-WAY ROAD; HAZARD WITHIN
OPPOSING LANE CLEAR ZONE
("LON" Program Parts 'A' & 'B')
Miscellaneous Guardrail Layout Examples (from IDS):

**BRIDGE RAILING SHIELDING EXAMPLE:**
**OPPOSING LANE'S CONCRETE RAILING OUTSIDE OF CLEAR ZONE**
Miscellaneous Guardrail Layout Examples (from IDS):

BEGIN RAILING SHIELDING EXAMPLE:
'CROSSOVER GUARDRAIL'; OPPOSING LANE'S CONCRETE RAILING WITHIN CLEAR ZONE
('LON' Program Part 'C' or 'D')
BRIDGE RAILING SHIELDING EXAMPLE:
2-WAY, 2-LANE ROAD; CONCRETE RAILING
WITHIN OPPOSING LANES' CLEAR ZONE
(Min. Length Guardrail Shown)
GUARDRAIL LENGTH OF NEED v1.0 - ROADSIDE HAZARD SHIELDING:

PART A: LENGTH OF NEED FOR NEAR LANE
### Office of Design

**Where is it?...**

**Office of Design / Design Standards / Design Standards Revisions FY 2016-17**

**Design Standards Revisions FY 2016-17**

### Design Information

<table>
<thead>
<tr>
<th>Index Number</th>
<th>Revised Sheets</th>
<th>Index Title</th>
<th>Instructions (IDS)</th>
<th>Design Tools</th>
<th>Data Table Cell Library</th>
<th>Borderless DGNs</th>
<th>Associated Design Bulletin</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>1-22 of 22</td>
<td>Guardrail</td>
<td>IDS-00400</td>
<td>(PDF)</td>
<td>(ZIP) Terms of Use</td>
<td>DGN</td>
<td>RDB16-01</td>
</tr>
<tr>
<td>410</td>
<td>2,10, 16-18 of 25</td>
<td>Concrete Barrier Wall</td>
<td>N/A</td>
<td>(Link)</td>
<td>(ZIP)</td>
<td>DGN</td>
<td></td>
</tr>
<tr>
<td>411</td>
<td>6 of 10</td>
<td>Pier Protection Barrier</td>
<td>N/C</td>
<td></td>
<td></td>
<td>DGN</td>
<td></td>
</tr>
</tbody>
</table>

*n/a = Non Applicable*  

*n/c = No Change*
### “Part A” Drawing:

#### Table of Data:

<table>
<thead>
<tr>
<th>Input:</th>
<th>Comment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction of Near Lane Traffic</td>
<td>for relative stationing calculations</td>
</tr>
<tr>
<td>AADT (Vehicles Per Day)</td>
<td></td>
</tr>
<tr>
<td>Design Speed (MPH)</td>
<td></td>
</tr>
<tr>
<td>Approach Face of Hazard Station</td>
<td>enter as total feet (do not input a plus sign)</td>
</tr>
<tr>
<td>Length of Hazard, ( L_H ) (Ft.)</td>
<td></td>
</tr>
<tr>
<td>Lateral Area Concern, ( L_A ) (Ft.)</td>
<td>the lesser distance from the ‘Edge of Traffic Lane’ to the ‘Clear Zone Limit’ or ‘Back of Hazard’</td>
</tr>
<tr>
<td>Lateral Offset of Guardrail, ( L_O ) (Ft.)</td>
<td>the typical guardrail offset from the ‘Edge of Traffic Lane,’ near the ‘Hazard’ location (outside of flare)</td>
</tr>
<tr>
<td>Length of Gating, ( L_G ) (Ft.)</td>
<td>“Gating” Terminals typically have a ‘Start LON’ at Post 3 or Post 4, per the APL Drawings. For &quot;Non-Gating&quot; Terminals, the ‘Start LON’ is at ‘Post 1’ ( L_G =0 ). [NOTE: The flare rate effect on ( L_G ), assumed parallel to the roadway, is negligible and may be omitted.]</td>
</tr>
<tr>
<td>Terminal Flare @ Post(1) (Ft.)</td>
<td>4 Ft. Max. per Index 400 detail, measured offset at Post(1); enter zero for &quot;Parallel&quot; Terminals</td>
</tr>
<tr>
<td>Flare Taper Length (Ft.)</td>
<td>default value is acceptable at 35'-0&quot;, but this may be refined per specific APL drawing (Input used to calculate ( Y ))</td>
</tr>
</tbody>
</table>
“Part B” Drawing:

<table>
<thead>
<tr>
<th>Input:</th>
<th>Comment:</th>
</tr>
</thead>
</table>
| **PART B Required?** (User Input Needed) | *Y/N (Toggle)*  
Is this a 2-lane, 2-way road with the Hazard in the Far Lane’s Clear Zone limit? If "No" Part B will be excluded from the placement calculation output below. |
| **Lateral Area Concern, L_A (Ft.)** | the lesser distance from the 'Edge of Traffic Lane' (Far Lane) to the 'Clear Zone Limit' or 'Back of Hazard'                                                                                               |
| **Lateral Offset of Guardrail, L_O (Ft.)** | the typical guardrail offset from the 'Edge of Traffic Lane' (Far Lane), near the 'Hazard' location (outside of flare)                                                                                     |
| **Length of Gating, L_G (Ft.)** | per the APL Drawings, "Gating" Terminals typically have a 'Start LON' at Post 3 or Post 4. For "Non-Gating" Terminals, the Start LON is at 'Post 1' (L_G =0).  
NOTE: The flare rate effect on L_g, assumed parallel to the roadway, is negligible and may be omitted. |
| **Terminal Flare @ Post(1) (Ft.)** | 4 Ft. Max. per Index 400 detail; measured to Post(1); enter zero for 'Parallel' Terminals                                                                                                                   |
| **Flare Taper Length (Ft.)** | default value is acceptable at 35'-0", but this may be refined per specific APL drawing (Input used to calculate 'Y')                                                                                       |
**Part A & B – Result Summary**

### TYPICAL HAZARD SHIELDING EXAMPLE:
2-LANE, 2-WAY ROAD; HAZARD WITHIN OPPOSING LANE CLEAR ZONE ('LON' Program Parts 'A' & 'B')

<table>
<thead>
<tr>
<th>DESIGN OUTPUT SUMMARY: GUARDRAIL ROADSIDE HAZARD SHIELDING</th>
<th>Limit</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adjusted Begin/End Guardrail Sta.</strong> @ PRIMARY Approach Terminal (From Part A)</td>
<td>≥</td>
<td>101+28.7</td>
</tr>
<tr>
<td><strong>Guardrail Offset from Nearest Edge of Traffic Lane (Ft.)</strong> :</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td><strong>Adjusted Begin/End Guardrail Sta.</strong> @ Trailing Anchorage (Type II) (From Part A, If Applicable)</td>
<td>-</td>
<td>N.A.</td>
</tr>
<tr>
<td><strong>Guardrail Offset from Nearest Edge of Traffic Lane (Ft.)</strong> :</td>
<td>N.A.</td>
<td></td>
</tr>
<tr>
<td><strong>Adjusted Begin/End Guardrail Sta.</strong> @ SECONDARY Approach Terminal (From Part B, If Applicable)</td>
<td>≤</td>
<td>98+91.2</td>
</tr>
<tr>
<td><strong>Guardrail Offset from Nearest Edge of Traffic Lane (Ft.)</strong> :</td>
<td>10.0</td>
<td></td>
</tr>
</tbody>
</table>

*Outputs assume linear stationing: To adjust for curvature, lengthen the guardrail with the Begin/End Guardrail stations placed outside of the stationing limits shown here. Use CADD measurement to bring the final guardrail length to a multiple of 6’-3” panels.*
Guardrail Length of Need v1.0

"Part D"

Drawing:

<table>
<thead>
<tr>
<th>Input:</th>
<th>Comment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction of Near Lane Traffic</td>
<td>for relative stationing calculations</td>
</tr>
<tr>
<td>AADT (Vehicles Per Day)</td>
<td></td>
</tr>
<tr>
<td>Design Speed (MPH)</td>
<td></td>
</tr>
<tr>
<td>Begin/End Rigid Barrier Sta. (@ guardrail connecting location)</td>
<td>enter as total feet (do not input a plus sign); located at the end of the 'Rigid Barrier' (not the Begin/End Guardrail Sta.)</td>
</tr>
<tr>
<td>Lateral Offset of Guardrail, $L_O$ (Ft.)</td>
<td>the starting guardrail offset from the 'Edge of Near Traffic Lane' at the location where the guardrail connects to the 'Rigid Barrier' (determined by the designer)</td>
</tr>
<tr>
<td>Lateral Area Concern, $L_A$ (Ft.)</td>
<td>the lateral distance from the 'Edge of Near Traffic Lane' to the far edge of the opposing 'Rigid Barrier' (i.e. Concrete Traffic Railing) across the median</td>
</tr>
<tr>
<td>Parallel Approach Trans. Length, $L_{P1}$ (Ft.)</td>
<td>the length of the guardrail Approach Transition Connection prior to the start of the taper; per Index 400 options, $TL-3=27.5$ Ft. and $TL-2=18.2$ Ft. Note: This is measured from the end of the 'Rigid Barrier' (not the 'Begin/End Guardrail Sta.')</td>
</tr>
<tr>
<td>Parallel Approach Terminal Length, $L_{P2}$ (Ft.)</td>
<td>the length of the parallel segment required for the Approach Terminal, just beyond the taper; Per Index 400, TL-3 = 56.3 Ft.</td>
</tr>
<tr>
<td>Length of Gating, $L_G$ (Ft.)</td>
<td>&quot;Gating&quot; Terminals typically have a 'Start LON' at Post 3 or Post 4, per the APL Drawings. For &quot;Non-Gating&quot; Terminals, the 'Start LON' is at 'Post 1' ($L_G=0$).</td>
</tr>
<tr>
<td>Taper Rate of Crossover, 1:TR (Ft.)</td>
<td>the linear taper rate for the Median Crossover Segment; 1:10 for Design Speeds ≤ 45 MPH and 1:15 for Design Speeds &gt; 45 MPH.</td>
</tr>
<tr>
<td>Rigid Barrier Skew, $S$ (Ft.)</td>
<td>the longitudinal &quot;skew&quot; distance between the guardrail's connecting Rigid Barrier end and the &quot;Hazard&quot; Rigid Barrier end (across the median). For the direction opposite the drawing dimension, use a negative value.</td>
</tr>
</tbody>
</table>
**Part D – Example - Median Crossover with Terminal:**

### Given:
- Design Speed = 65 mph
- AADT = 10,000 veh/day
- Clear Zone = 36 feet
- Terminal Type = Gating

(PPM Table 4.2.1)

---

**PART D: OUTPUT SUMMARY:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>End Treatment Offset, Y (Ft.)</td>
<td>16.7</td>
</tr>
<tr>
<td>Runout Length, L_r (Ft.)</td>
<td>330</td>
</tr>
<tr>
<td>Length of Need, X_n (Ft.)</td>
<td>171.0</td>
</tr>
<tr>
<td>Begin/End Guardrail Sta. @ Connection to Rigid Barrier</td>
<td>100+00.</td>
</tr>
<tr>
<td>Offset from Edge of Near Traffic Lane (Ft.)</td>
<td>10.0</td>
</tr>
<tr>
<td>Begin/End Taper Sta.</td>
<td>100+28.1</td>
</tr>
<tr>
<td>Offset from Edge of Near Traffic Lane (Ft.)</td>
<td>10.0</td>
</tr>
<tr>
<td>Begin/End Taper Sta.</td>
<td>101+27.9</td>
</tr>
<tr>
<td>Offset from Edge of Near Traffic Lane (Ft.)</td>
<td>16.7</td>
</tr>
<tr>
<td>Begin/End Guardrail Sta. @ Post (1)</td>
<td>101+84.1</td>
</tr>
<tr>
<td>Offset from Edge of Near Traffic Lane (Ft.)</td>
<td>16.7</td>
</tr>
</tbody>
</table>

The outputs assume stationing is linear and are adjusted to bring tapered segment panel lengths to a multiple of 6'-3".

The stations provided here may be used directly in the Plans, assuming that roadway curvature does not cause a discrepancy of more than 3'-0" between the these output stations and the actual guardrail panel slot/post locations (Tolerance per Specification Section 536).

If adjustments for curvature are required to bring the stationing closer to the actual panel slot and post locations, use L_x1 and L_x2, adjusted for curvature, and add additional length to the taper segment as needed.
BEGIN PART 5: Where to Find More Comprehensive Training:

- By the End of May, a 6 hour design webinar will be placed here...
For all future FDOT Roadway Design Training, sign up to receive notification e-mails at...
http://www.dot.state.fl.us/projectmanagement office/ContactDatabase.shtm
(Google “FDOT Contact Mailer”)

Production Support

Contact Management/E-Updates and Contact Mailer

The Contact Management System/E-Updates is a "self service" area where FDOT, Consultants and others can register for information pertinent to their jobs. This replaces several smaller contact databases that are maintained by individual offices. User-ids are the email address one registers with and the passwords are set by the individuals when registering. The passwords never expire.
THANK YOU!

QUESTIONS?

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derwood.sheppard@dot.state.fl.us