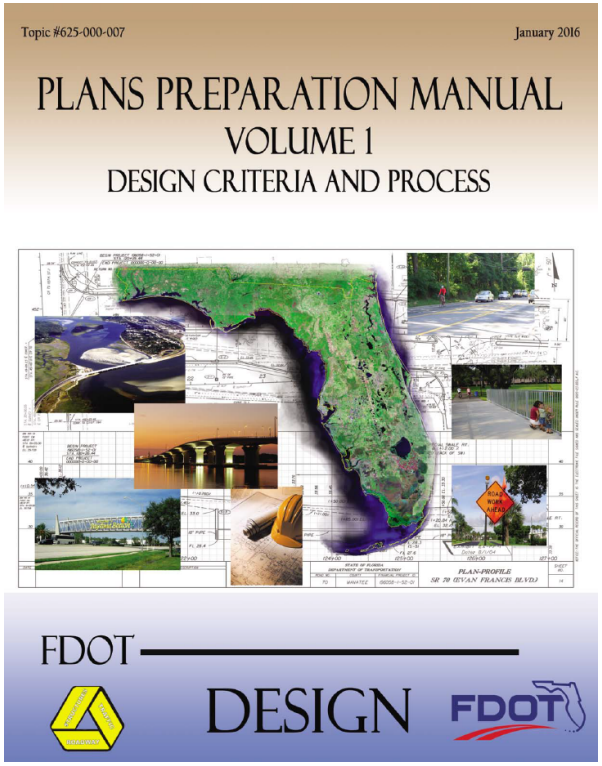
Plans Preparation Manual (PPM) Volume 1, Chapter 4: Roadside Safety

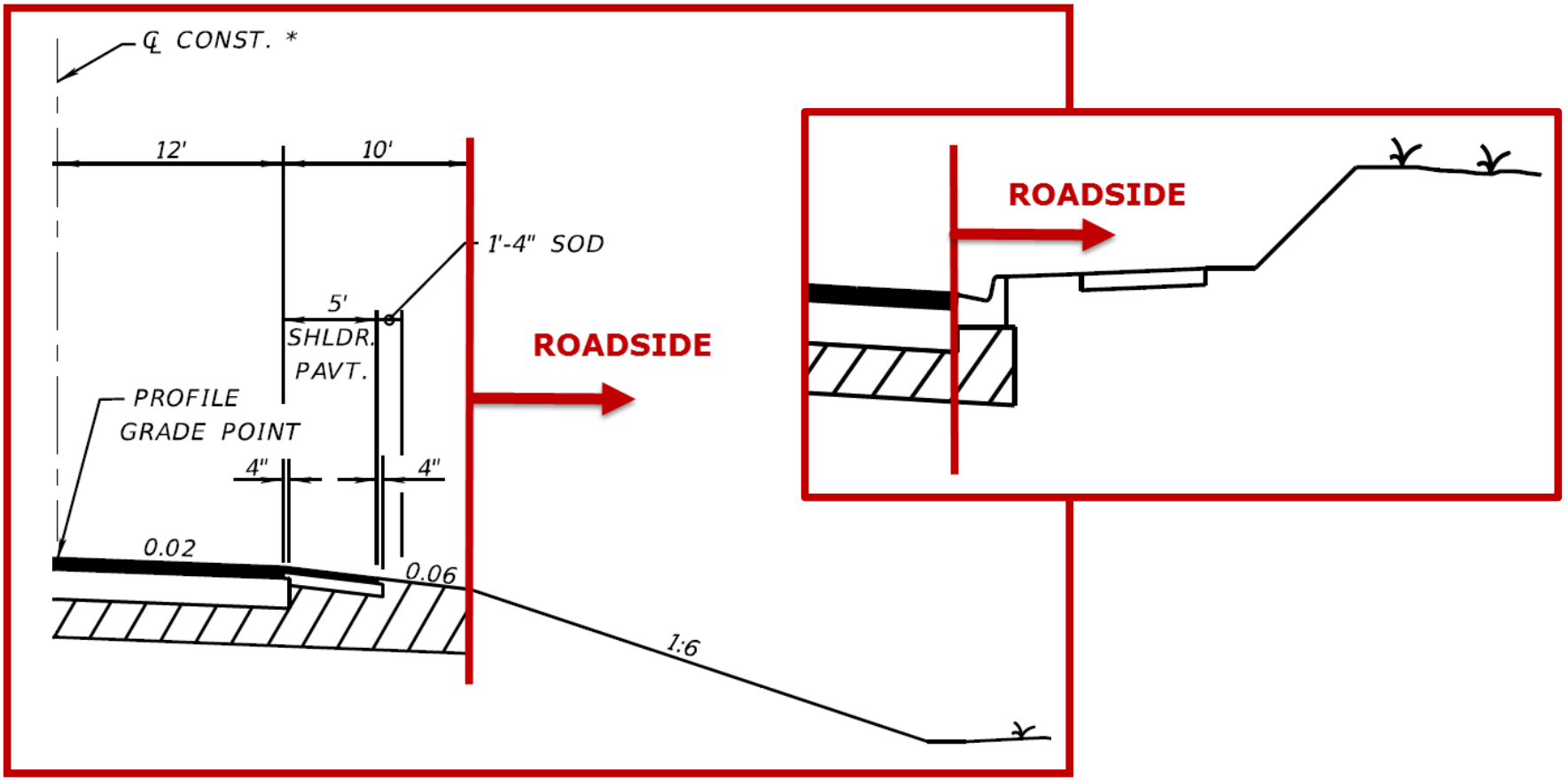


Presented by:
Derwood Sheppard, P.E.

Roadside Safety:

What is Considered in "Roadside Safety"?

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



PPM, Volume 1, Chapter 4

Roadside Safety:

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:

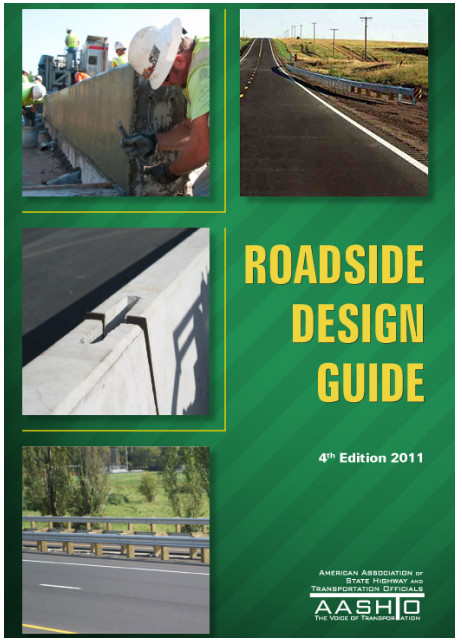
- *Section 4.2.3* – Added "Basic" Clear Zone Concept.
- *Section 4.2.7* – Added New "Drainage Features" Section.
- *Section 4.2.8* – Added New "Traffic Separator" Section.
- *Section 4.3.2* – Revised Barrier Placement requirements (i.e. outside of the clear zone and no closer to canal top slope than 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* – Thrie-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 Thrie-Beam Guardrail, as it is currently configured, is considered obsolete. Thrie-Beam panels will still be used in barrier transitions and with Modified Thrie-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 Pier Protection Selection.
- *Section 4.4.6.1* – Revised guardrail offset from curb face criteria. Modified *Table 4.4.2* to remove Thrie-Beam and to include setback distances for all standard barrier types, not just guardrail.
- *Section 4.4.5.2* – 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.

- *Section 4.4.6.5* – Added requirement for a "Refuge Area" on roadways with Temporary Barrier installations along both edge lines. Added requirement that existing permanent barriers must be maintained in accordance with the permanent system requirements (i.e. deflection space, grading, setbacks, etc.). Added limitation for placement of temporary barrier beyond the slope breakpoint in superelevated section.
- *Section 4.5.2* – Removed design criteria for sign attachments to traffic railings.
- *Section 4.7.2* – Updated language to clarify difference between *2013 Design Standards*, Index 400 and current (i.e. 27" vs. 31" Guardrail). Also, updated criteria for allowance of existing steel offset blocks to roadways with design speeds ≤ 45 mph only.
- *Section 4.7.5* – Removed reference to "Guardrail Continuous Across Bridge" to match removal of *Design Standards*, Index 403.

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

PPM Sections		
Topic	**Moved From 2015 PPM Volume 1 Section(s)**	**Moved To 2016 PPM Volume 1 Chapter 4 Section**
Lateral Offset	2.11 Lateral Offset 21.5.6 Lateral Offset 25.4.14 Lateral Offset	4.2.4 Lateral Offsets
Roadside Slope Criteria	2.4 Roadside Slopes 25.4.9 Side Slopes	4.2.6 Roadside Slope Criteria
Curbs	2.3.3 Use of Curb on High Speed Roadways 25.4.14.3 Use of Curb on RRR Projects	4.2.7.2 Curbs
Signing, Lighting, Traffic Signals, and Other Similar Roadside Features	4.6 Roadside Appurtenances	4.2.9 Signing, Lighting, Traffic Signals, and Other Similar Roadside Features
Roadside Hazards	4.2 Hazard Standards 10.12.10 Above Ground Hazards 10.12.11 Drop-offs in Work Zones	4.3 Roadside Hazards
Roadside Barriers	10.11.2 Barrier Walls (Temporary)	4.4.1.4 Temporary Barriers
Crash Cushions	4.5 Permanent Crash Cushions 10.11.5 Temporary Crash Cushions	4.4.3 Crash Cushions

PPM, Volume 1, Chapter 4



Roadside Safety:

- Redeveloped/Reorganized Chapter 4
- 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,
- Comprehensive Roadside Design Criteria
  - Added **NEW** Sections to prevent confusion of existing criteria
  - Provide Requirements to follow ***AASHTO Roadside Design Guide*** (***RDG***) were appropriate.
  - Including: General Section, Geometry Definitions, Drainage Features, Traffic Separators, Roadside Barrier Information, Grading Requirements, Length of Need.

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.1**, General*:

This Chapter contains roadside safety design criteria for three project types:

- New Construction
- Transportation Design for Livable Communities (TDLC)
- Resurfacing, Restoration and Rehabilitation (RRR) projects

New Construction criteria must be met for new and reconstruction projects, and for improvements included with RRR projects. The RRR criteria may be used for establishing the minimum requirements for intersection improvement projects with the understanding that when right of way is adequate, new construction criteria will be used to the maximum extent feasible. Refer to ***Chapter 25*** of this Volume for RRR criteria. Certain conditions may allow TDLC criteria to be used in accordance with the requirements provided in ***Chapter 21*** of this Volume.

The **AASHTO Roadside Design Guide (AASHTO RDG)** provides the foundation for the development of specific criteria contained in this Chapter and the FDOT ***Design Standards***.

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.2.2**, Roadside Slope Classification*:

Roadside Slopes include areas located beyond the edge of the traffic lane as shown in ***Figures 4.2.2*** and ***4.2.3***. These areas are divided into the following classifications:

1. Traversable Slope – Smooth terrain, unobstructed by fixed objects, and sloped at 1:3 or flatter
2. Recoverable Slope – Traversable Slope 1:4 or flatter
3. Traversable Non-Recoverable Slope – Traversable Slope steeper than 1:4 and flatter than 1:3
4. Non-Traversable Slope – Rough, obstructed, or slopes steeper than 1:3
5. Critical Slope – Non-Traversable Slope steeper than 1:3

PPM, Volume 1, Chapter 4

Roadside Safety:

Section 4.2.3 – Added "Basic" Clear Zone Concept:

Figure 4.2.2 Basic Clear Zone Concept

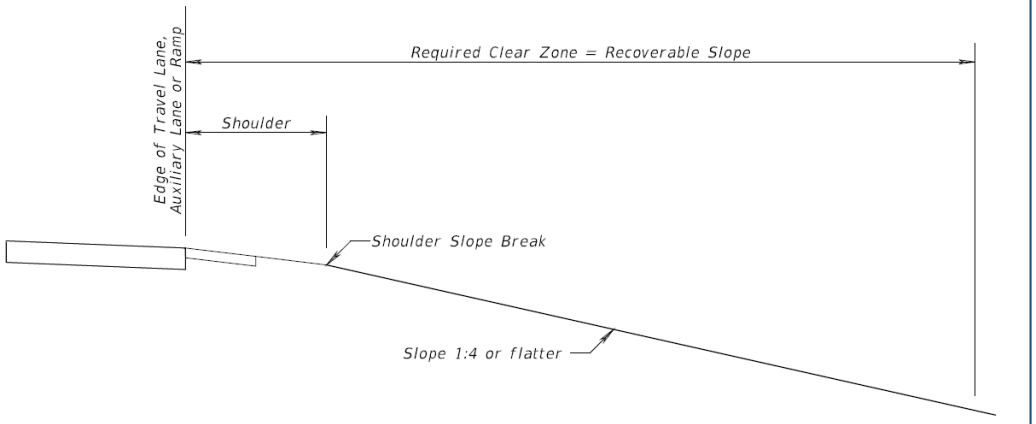
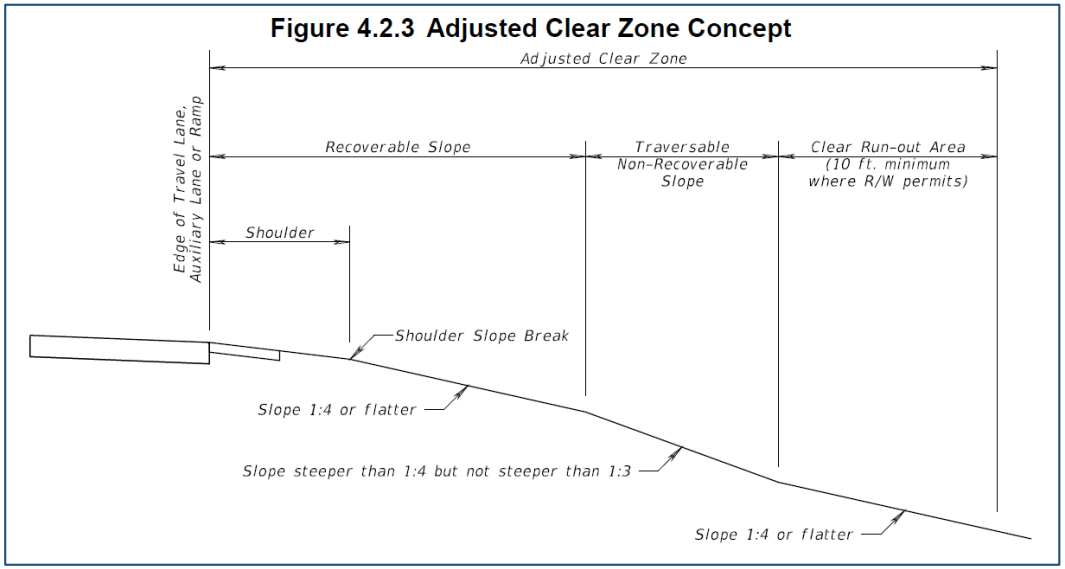


Figure 4.2.3 Adjusted Clear Zone Concept



PPM, Volume 1, Chapter 4

Roadside Safety:

***Table 4.2.1**, Clear Zone Width Requirements*:

Table 4.2.1 Clear Zone Width Requirements

NEW CONSTRUCTION				
	≥ 1500 AADT (1)		< 1500 AADT (1)	
DESIGN SPEED (mph)	TRAVEL LANES & MULTILANE RAMPS (feet)	AUXILIARY LANES & SINGLE LANE RAMPS (feet)	TRAVEL LANES & MULTILANE RAMPS (feet)	AUXILIARY LANES & SINGLE LANE RAMPS (feet)
< 45	18	10	16	10
45	24	14	20	14
50	24	14	20	14
55	30	18	24	14
> 55	36	24	30	18

TDLC PROJECTS	
DESIGN SPEED (mph)	ALL LANE TYPES (feet)
≤ 30	12
35	14
40	16

RESURFACING, RESTORATION AND REHABILITATION (RRR) PROJECTS (2)		
DESIGN SPEED (mph)	TRAVEL LANES & MULTILANE RAMPS (feet)	AUXILIARY LANES & SINGLE LANE RAMPS (feet)
< 45	6	6
45 (3)	14	8
> 45	18	8

(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).

Consolidated Tables from Chapters 2, 21, & 25

Previously referred to as "Recoverable Terrain"

PPM, Volume 1, Chapter 4

Roadside Safety:

***Table 4.2.2**, Clear Zone Width Requirements for Work Zones*:

Table 4.2.2 Clear Zone Width Requirements for Work Zones

WORK ZONE SPEED (mph)	TRAVEL LANES & MULTILANE RAMPS (feet)	AUXILIARY LANES & SINGLE LANE RAMPS (feet)
All Speeds w/Curb & Gutter	4' Behind Face of Curb	4' Behind Face of Curb
30 to 40	14	10
45 to 50	18	10
55	24	14
60 to 70	30	18

Information from Index 600

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.2.4**, Lateral Offsets*:

- Essentially an exception to Clear Zone for devices that are ***"…considered functionally necessary for the normal operation of the roadway…"***
- Clear Zone should be applied wherever possible.
- 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.
- Added general statement about objects placed ***"…behind a barrier that is justified for other reasons…"***

> If an aboveground object is to be placed behind a barrier that is justified for other reasons, the lateral offset to the object may be reduced to meet the setback requirements (deflection distance) of the barrier, see ***Section 4.4.6***. For permissible attachments to barriers, refer to ***Section 4.5***.

- Consolidation of ***Tables*** from Chapters 2, 21, & 25

PPM, Volume 1, Chapter 4

Roadside Safety:

Table 4.2.3, Lateral Offset Criteria:

- Consolidated of information
- Offsets/Intent did not change

Table 4.2.3 Lateral Offset Criteria

Design Element		Urban Curb or Curb and Gutter Design Speed ≤ 45 mph			All Other
		New Construction	RRR	TDLC	
Light Poles	Conventional [1] Lighting	Do not locate in Medians, except in conjunction with barriers that are justified for other reasons			
		4 feet from face of curb	1.5 feet from face of curb	1.5 feet from face of curb	20 feet from Travel Lane, 14 feet from Auxiliary Lane or Clear Zone width, whichever is less
	High Mast Lighting	Outside Clear Zone			
Signal Poles and [1] Controller Cabinets		Do not locate in Medians			
		4 feet from face of curb	1.5 feet from face of curb	1.5 feet from face of curb	Outside Clear Zone

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.2.5**, Roadside Slope Criteria*:

- New Construction – from Chapter 2
- RRR Slope Criteria – removed overlapping New Construction Criteria

Front Slopes:

~~1. 1:6 are desirable.~~

~~2. 1:4 may be constructed within the clear zone.~~

~~3. 1:3 may be constructed outside the clear zone.~~

4. Existing front slopes 1:3 or flatter may remain within the clear zone. ~~Shielding may be required.~~

~~5. Steeper than 1:3 shall be shielded as per ***Design Standards, Index 400, General Notes.***~~

6. Consideration should be given to flattening slopes of 1:3 or steeper at locations where run-off-the-road type crashes are likely to occur (e.g., on the outsides of horizontal curves).

~~7. The proposed construction should not result in slopes steeper than the existing slopes in violation of the above values.~~

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.2.7**, Drainage Features*:

- Added Section to provide clarification of the relationship and requirements between Drain Features and the roadside.
- ***Section 4.2.7.1**, Roadside Ditches*
  - Redrew figures for consistency
  - Clarified role of District Drainage Engineer and intent of ***Figure 4.2.14*** and ***Figure 4.2.15***
    - ✓ Minimum Ditch Bottom width = 5 feet, per ***Drainage Manual***
    - ✓ Figures only for use when approved by District Drainage Engineer
    - ✓ Figures provide acceptable “traversable” options

Figure 4.2.14 Roadside Ditches – Bottom Width 0 to 4 feet

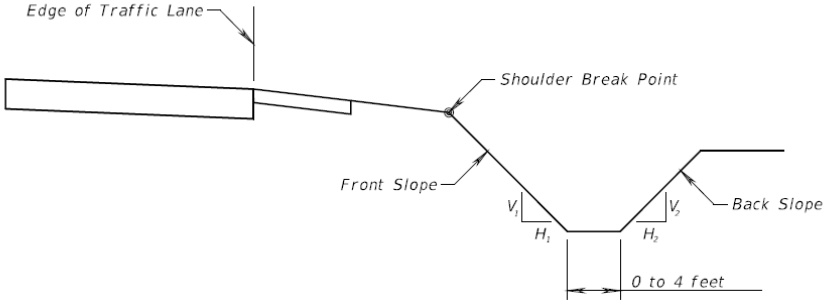
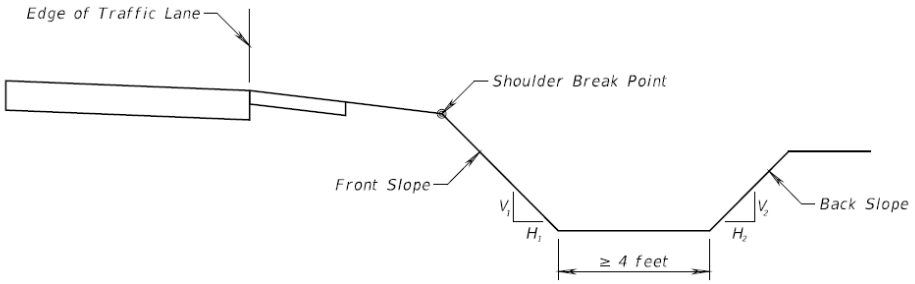


Figure 4.2.15 Roadside Ditches – Bottom Width ≥ 4 feet



PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.2.7**, Drainage Features*:

- ***Section 4.2.7.2**, Curbs*
  - Consolidated information previously located in Chapters 2, 4, & 25.
  - Added Drainage Manual reference for Shoulder Gutter requirements
  - Updated allowances for curbs on roadways with Design Speeds > 45mph

> Curbs are not permitted on high speed roadways (Design Speed > 45 mph) except for high speed urban and suburban sections, median openings, and transit stops. Use only Type E curb on high speed roadways with the face of the curb placed at the following offsets:
>
> - High Speed Urban and Suburban Section
>   - See ***Section 2.16*** of this Volume for requirements.
> - Directional Median Openings
>   - See ***Design Standards, Index 527***.
> - Transit Stops
>   - The curb face must be no closer to the edge of the traveled way than the required full width shoulder for a flush shoulder roadway.

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.2.7**, Drainage Features*:

- ***Section 4.2.7.3**, Drainage Structures*
  - Added Section to emphasizes importance of traversable drainage inlets and end treatments (i.e. Structures)

> Drainage structures, and their associated end treatments, located along the roadside should be implemented using either a traversable design or located outside the required clear zone. The various drainage inlets and pipe end treatments needed for an efficient drainage design typically contain curb inlets, ditch bottom inlets, endwalls, wingwalls, headwalls, flared end sections and/or mitered end sections. If not adequately designed or properly located, these features can create hazardous conditions (e.g. abrupt deceleration or rollovers) for vehicles. For detailed background information concerning traversable designs, refer to the ***AASHTO RDG***.
>
> ***Design Standards*** for drainage structures and end treatments are provided in the ***Index 200 Series***. Drainage features shown in the ***Design Standards*** have the potential for conflict with a vehicle either departing the roadway or within a commonly traversed section of a roadway. Refer to the ***Drainage Manual*** for those standard drainage structures which are permitted within the Clear Zone.

- ***Section 4.2.7.4**, Drainage Structures in RRR Projects*
  - At "Minimum" Relocate structures impacted 3 times in 5 years
  - New drainage structures must meet New Construction location criteria

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.2.8**, Traffic Separators*:

> Traffic separators are used to provide delineation of narrow roadway medians, manage access points and turning movements, provide for drainage, and offer pedestrian refuge areas. Refer to the ***Section 2.16.4*** of this Volume, the ***Florida Intersection Design Guide***, and ***Design Standards, Index 302*** for additional information.
>
> Bridge mounted traffic separators are intended to match up geometrically with adjacent roadway traffic separators or the face of curb. Design separators on new and reconstruction projects in accordance with the ***Structures Design Guidelines***, and ***Design Standards, Index 302.***

***Section 4.2.9**, Signing, Lighting, Traffic Signals, and Other Similar Roadside Features*:

- Previously ***Chapter 4 "Roadside Appurtenances"*** only covered Sign Supports
- Added Reference to Lighting, Traffic Signals and similar devices covered in ***Chapter 7***.

***Section 4.2.10**, Roadside Flashing Beacons*:

- Previously covered by ***Chapter 7 "Electronic Display Signs"***
- Included reference to Index 11862 and Index 17302 for Location/Assembly

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.2.13**, Breakaway Devices*:

- Previously ***"Location Criteria"*** in old ***Chapter 4***

> The criteria for breakaway supports is covered in the ***AASHTO RDG, Chapter 4***. Department-approved breakaway devices are covered in the ***Design Standards*** and included on the Approved Products List (***APL***).
>
> Breakaway devices are designed to be impacted at normal bumper heights with vehicles traveling along relatively flat level ground. If impacted at a significantly higher point the breakaway mechanism may not function as designed resulting in non-activation or improper fracturing of the device. For this reason do not locate breakaway supports in ditches or along slopes steeper than 1:6.

***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

PPM, Volume 1, Chapter 4

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
- ***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.

PPM, Volume 1, Chapter 4

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***.

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.4**, Longitudinal Barriers, Barrier Transitions, End Treatments & Crash Cushions:*

- New – Provides general information concerning the crash testing requirements and performance levels (i.e. Test Levels) of roadside hardware.
- Non-Standard Roadside Hardware

> Non-standard roadside devices (i.e. devices not included in either the ***Design Standards*** or the ***APL***) may sometimes be needed to address unique situations, but are not permitted without prior approval by the Structures Design Office (SDO) for traffic railings (e.g. bridges, noise walls and wall copings), or the Roadway Design Office (RDO) for other roadside hardware. For additional information on the use of Non-Standard Roadside Safety Devices refer to ***Section 4.8***.

- New Sections added to cover the following:
  - ***Section 4.4.1**, Standard Longitudinal Barriers*
  - ***Section 4.4.2**, End Treatments*
  - ***Section 4.4.3**, Crash Cushions*
  - ***Section 4.4.4**, Barrier Transitions*
  - ***Section 4.4.5**, Barrier Type Selection*
  - **Section 4.4.6**, *Barrier Placement*
  - ***Section 4.4.7**, Warrants for Roadside Barriers*

Lists/Limitations of each Standard Hardware

Criteria for Selection, Proper Placement, & Validation of Devices

PPM, Volume 1, Chapter 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.)

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.4.2**, End Treatments:*

- ***Section 4.4.2.1**, Guardrail End Treatments*
  - Approach Terminals – Proprietary Devices listed on ***APL***
    - ✓ Flared – preferred for all locations
    - ✓ Parallel – use in constrained locations with no room for flare
    - ✓ Double Face – preferred treatment for double faced guardrail
  - Crash Cushions
  - Trailing End Anchorages (Type II) – not permitted on guardrail runs within the clear zone of opposing traffic
- ***Section 4.4.2.2**, Rigid Barrier End Treatments*
  - Transition to other barrier type (e.g. guardrail)
  - Crash Cushion
  - Tapered transitions are not included as option and should not be used unless absolutely necessary due constrained conditions
  - Treatment of the trailing end not required unless within the clear zone of opposing traffic

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.4.2**, End Treatments:*

- ***Section 4.4.2.3**, Temporary Barrier End Treatments*

The required treatments for exposed ends of Temporary Barriers are:

1. Connecting to an existing barrier (smooth, structural connections are required - Refer to ***Design Standards, Indexes 410*** and ***414***, or the ***APL***)
2. Shield end with a crash cushion as detailed in the ***Design Standards*** or ***APL*** for the specific type of Temporary Barrier (i.e. portable concrete barrier, Steel, or Water Filled)
3. Attaching or Transitioning to a crashworthy end treatment as described above
4. Flaring outside of the Work Zone Clear Zone (For Work Zone Clear zones, see ***Design Standards***, ***Index 600***)

Design Standards, Indexes 415 provides details for shielding exposed ends of temporary concrete barrier wall using crash cushions. A minimum of four (4) units or 50 feet of bolted or staked Type K Barrier is required adjacent to crash cushions.

No modifications to the end treatments included in the ***Design Standards*** or ***APL*** are permitted. Special conditions may require end treatments other than those included above. If this occurs, consult the State Roadway Design Office (RDO) and provide special details in the Plans.

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.4.3**, Crash Cushions:*

- ***Section 4.4.3.1***, Permanent Crash Cushions
  - No significant change.
  - **Do Not Locate Crash Cushions Behind Curbs!!!**
  - Classification still to come!
- ***Section 4.4.3.2**, Temporary Crash Cushions*

> Gating crash cushions are designed to decelerate errant vehicles from a direct, in-line impact at the terminus of the crash cushion by absorbing the energy, but provide no redirective capabilities for side impacts. Gating crash cushions are permitted only with prior approval from the State Roadway Design Office (RDO). They may be appropriate on low speed facilities and in work zones with higher speeds where only low impact angle hits are expected. An adequate clear runout area must be provided beyond a gating crash cushion (between the departure line and the clear zone). Plan details for site specific design are required.

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.4.4**, Barrier Transitions:*

Guardrail transitions are necessary, whenever standard W-Beam guardrail converges with rigid barriers. Guardrail transitions must include sound structural connections, nested panels and additional posts for increased stiffness, as shown in the ***Design Standards***. Use the guardrail transitions included in the ***Design Standards*** as follows:

1. General, Guardrail Approach Transition to Rigid Barrier – ***Design Standards, Index 400*** (Single or Double Face Guardrail, TL-3, MASH), Approved for all Design Speeds.
2. Low Speed, Guardrail Approach Transition to Rigid Barrier – ***Design Standards, Index 400*** (Single Face Guardrail only, TL-2, MASH), Approved for Design Speeds ≤ 45 mph only with Flush Shoulder or Curb.
3. Trailing End Transition Connection – ***Design Standards, Index 400*** (Test Level N/A), Approved for all Design Speeds.

Various other barrier transitions are detailed throughout the ***Design Standards*** and ***APL*** drawings for transitions from temporary barriers to permanent rigid barriers and transitions from variable height/shape rigid barriers.

Low Speed Transition ONLY available in the DSR for Index 400 (FY 2016-17 eBook)

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.4.5**, Barrier Type Selection:*

- W-Beam only barrier previously mentioned

1. Barrier Placement requirements (see ***Section 4.4.6***)
2. Traffic characteristics (e.g. vehicles types/percentages, volume, and growth)
3. Site characteristics (e.g. terrain, alignment, geometry, access facility type, access locations, design speed, etc.)
4. Expected frequency of impacts
5. Initial and replacement/repair costs
6. Ease of maintenance
7. Exposure of workers when conducting repairs/maintenance
8. Aesthetics

For additional information about considerations for barrier selections refer to the ***AASHTO RDG***. Document barrier type selection decisions and warrants.

- ***Section 4.4.5.1**, Longitudinal Barrier Selection*
  - See SGD for Traffic Railing Selection
  - Added Selection Matrix to assist in evaluating alternatives
- ***Section 4.4.5.3**, Crash Cushion Selection – From OLD Chapter 4, Section 4.5.2*
- ***Section 4.4.5.4**, Pier Protection*
  - Added Selection Flow Chart

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***Section 4.4.5.1**, Longitudinal Barrier Selection*

Table 4.4.1 Roadway Barrier Type Selection

Barrier Type	Deflection Space Requirement (feet)	Order of Bias			Test Level	Design Vehicles
		Initial Cost	Vehicle Impact Severity	Maintenance Cost		
HTCB	12	LOW	LOW	HIGH	TL-4 (NCHRP 350)	Passenger Car, Pickup Truck, & Single-Unit Truck
W-Beam Guardrail	5	↓	↓	↑	TL-2 & TL-3 (MASH)	Passenger Car & Pickup Truck
Modified Thrie-Beam	3	↓	↓	↑	TL-3 & TL-4 (NCHRP 350)	Passenger Car, Pickup Truck, & Single-Unit Truck
Rigid Barrier	0	HIGH	HIGH	LOW	TL-4 & TL-5 (NCHRP 350)	Passenger Car, Pickup Truck, Single-Unit Truck & Tractor-Van Trailer

Specific requirements for the selection of HTCB are provided in ***IDDS-D450***.

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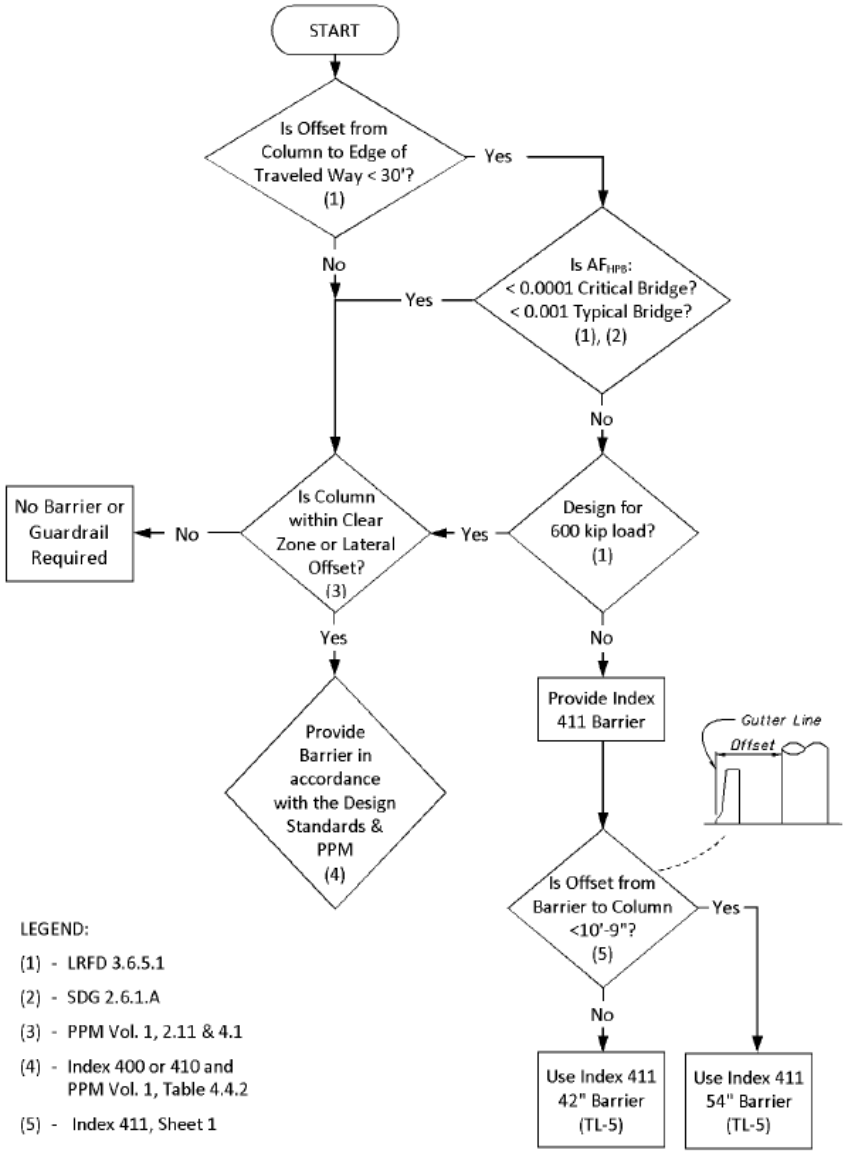
***Section 4.4.5.4**, Pier Protection*

- *New Construction Projects*
  - ✓ *Follow Flow Chart*
- *RRR Projects*
  - ✓ *Refer to SDG for Conditional Guidance*

Figure 4.4.11 Pier Protection Selection Flowchart (New Construction)



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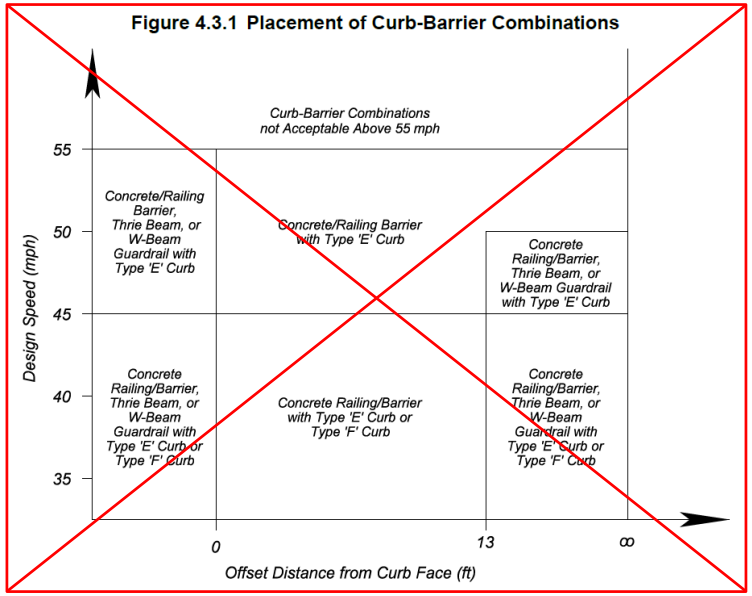
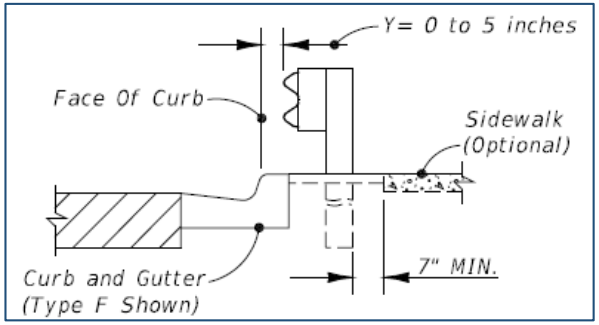
Roadside Safety:

***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



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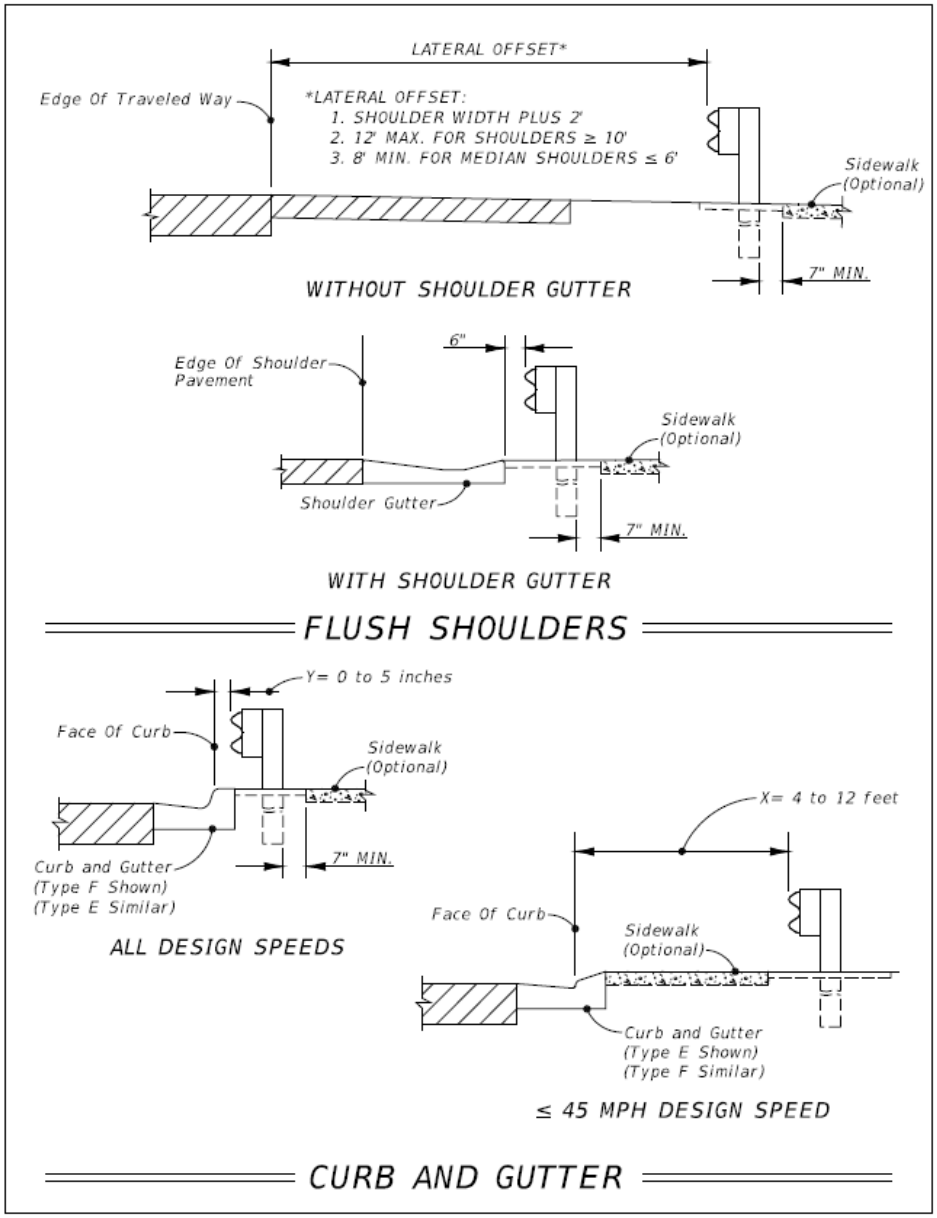
***Section 4.4.6.1**, Barrier Offset:*

- ***Figure 4.4.12***
  Lateral Offset to Guardrail



PPM, Volume 1, Chapter 4

***Section 4.4.6.1**, Barrier Offset:*

- Changed to “Setback”
- Removed Thrie-Beam
- Added Flexible & Rigid Barriers

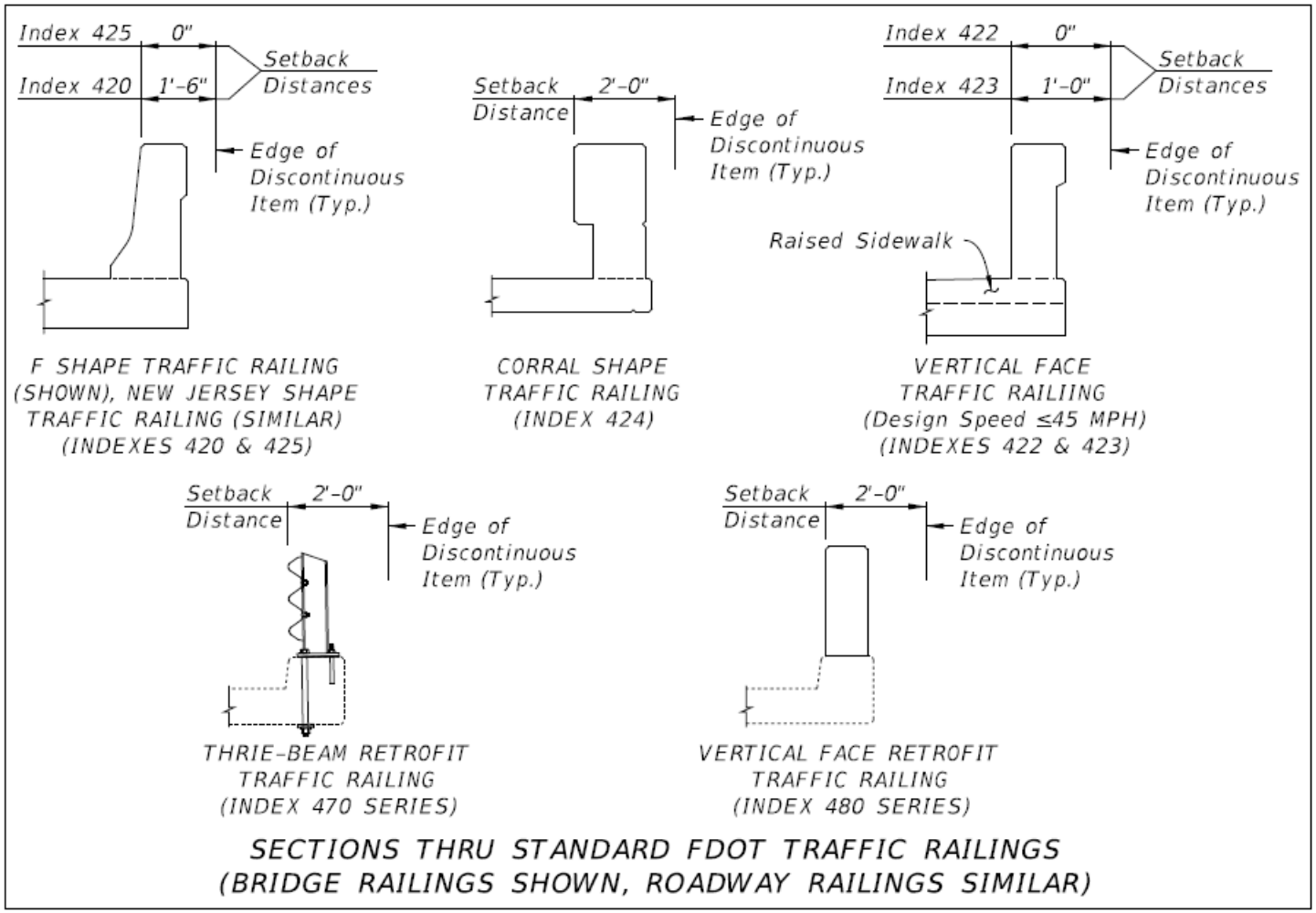
Table 4.4.2 Minimum Barrier Setback
(Measured from the face of the barrier)

Barrier Type	Setback Distance
Flexible Barrier	
High Tension Cable Barrier (HTCB)	12’-0”
Semi-Rigid Barrier	
W-Beam with Post Spacing @ 6'-3" (TL-3)	5’-0”
W-Beam with Post Spacing @ 3'-1½" (½ Spacing)	3’-10”
W-Beam with Post Spacing @ 1'-6¾" (¼ Spacing)	3’-2”
Nested W-Beams with Post Spacing @ 3'-1½" (½ Spacing)	3’-0”
Nested W-Beams with Post Spacing @ 1'-6¾" (¼ Spacing)	2’-8”
Modified Thrie-Beam with Post Spacing @ 6’-3”	3’-0”
Rigid-Barrier	
Concrete Barrier < 40” Height Non-crash Tested Continuous or Discontinuous Items Concrete Barrier ≥ 40” Height Non-crash Tested Continuous or Discontinuous Items	 1’-6” 0’-0”
Bridge Traffic Railing < 40” Height Non-crash Tested Continuous Items Non-crash Tested Discontinuous Items	 5’-0” See ***Figure 4.4.13***
Temporary Barriers See “Deflection Space” of applicable ***Design Standards Index*** or ***APL*** drawing.	

***Section 4.4.6.1**, Barrier Offset:*

- Relocated From ***Chapter 7***

Figure 4.4.13 Setback Distances for Discontinuous Elements

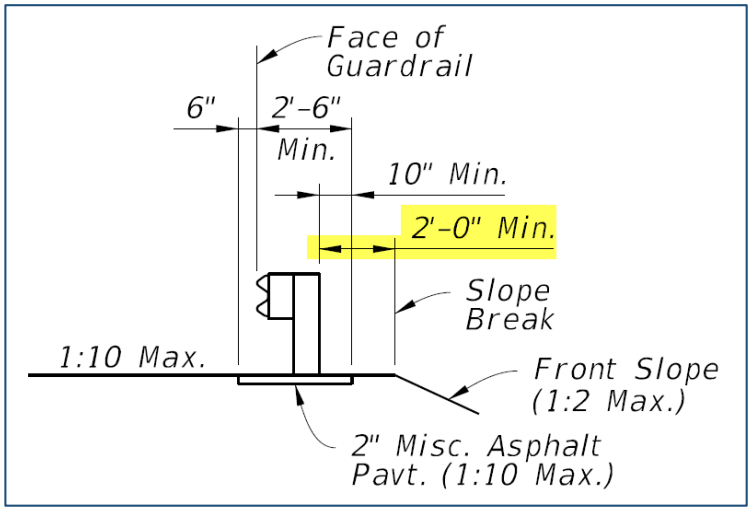


PPM, Volume 1, Chapter 4

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."***



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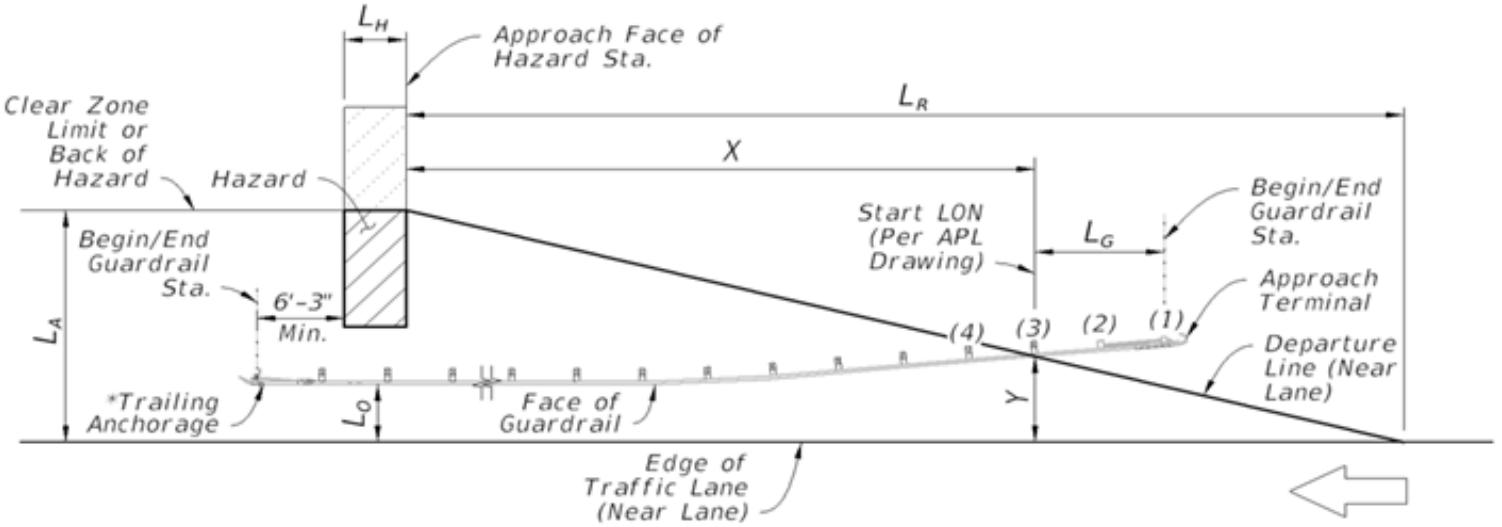
Roadside Safety:

***Section 4.4.6**, Barrier Placement:*

- ***Section 4.4.6.3**, Length of Need (LON)*
  - Currently refers to ***Design Standards*** or ***Instructions for Design Standards*** (***IDS***) for each barrier type.
  - Will transition to ***AASHTO RDG*** Calculation Method

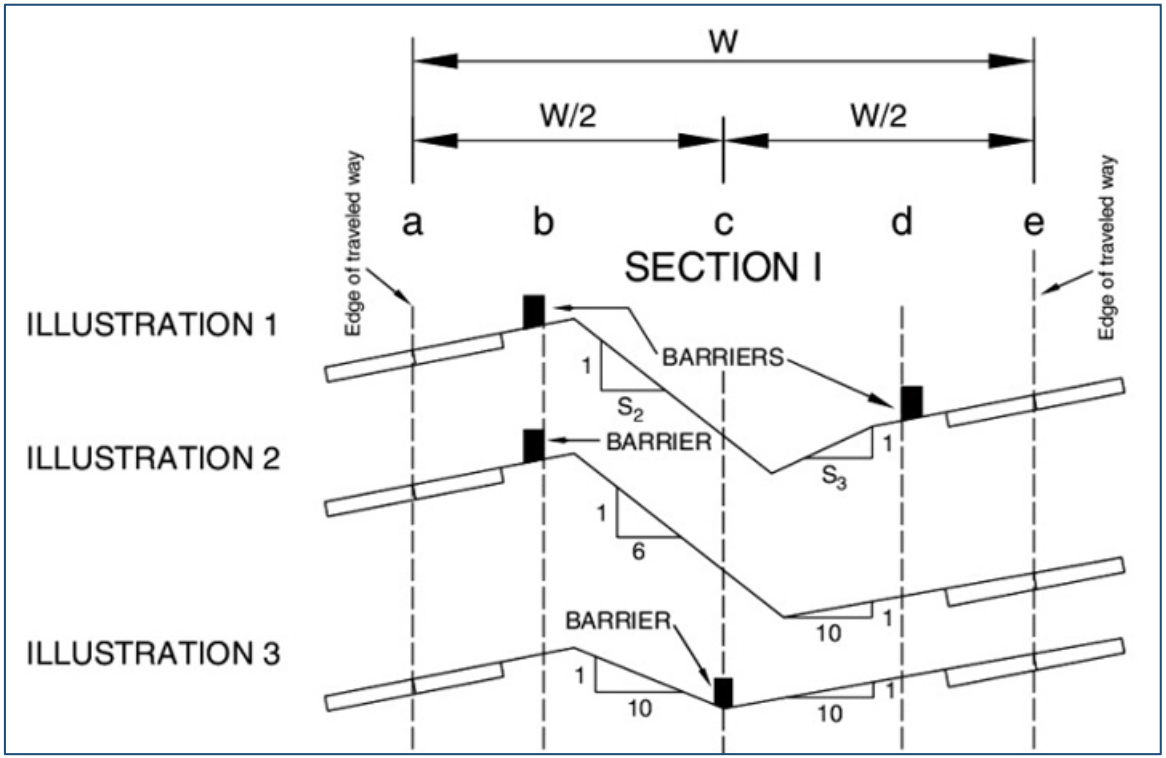
$$X = \frac{L_A - Y}{L_A / L_R}$$



Roadside Safety:

***Section 4.4.6**, Barrier Placement:*

- ***Section 4.4.6.4**, Median Barriers*
  - For prevention of Cross-Over Collisions
  - Locate in accordance with ***AASHTO RDG, Section 6.6*** and ***Design Standards***
  - Preferred Barrier Option is High Tension Cable Barrier (**HTCB**)



Portion of:
AASHTO RDG, Figure 6-18. Recommended Barrier Placement in Non-Level Medians

PPM, Volume 1, Chapter 4

Roadside Safety:

***Section 4.4.6**, Barrier Placement:*

- ***Section 4.4.6.5**, Considerations for Placement of Temporary Barrier*
  - Combined information from ***Chapter 10***
  - Added "Refuge Area" requirement

> In some situations, the installation of barriers on both shoulders will eliminate any practical shoulder width or refuge area. Therefore, on any project requiring barriers on both sides of the work zone traveled way, a minimum 10 foot lateral offset from the edge of the traveled way to the barrier is required on at least one side of the roadway. For all other applications, provide the minimum lateral offset required per ***Design Standards, Index 415***.

  - Use of Existing Permanent Barriers during TTC Phasing

> Existing permanent barriers used during temporary traffic control operations must meet grading, offset, and setback (i.e. deflection space) requirements for the permanent installation.

  - No Slope Breakpoints in Advance of Temporary Barriers

> Temporary barriers, as defined in ***Section 4.4.1.4***, located in superelevated roadway sections must be installed on the same roadway cross slope as the travel lanes (i.e. no slope break in advance of the barrier).

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Roadside Safety:

***Section 4.4.7**, Warrants for Roadside Barriers:*

> The evaluation of Roadside Safety is highly dependent on site specific conditions and constraints which are unique to a given situation. Therefore the determination as to when shielding is warranted for given hazardous roadside feature must be made on a case-by-case basis, and generally requires engineering judgment. It should be noted that the installation of roadside barriers presents a hazard in and of itself, and as such, the designer must analyze whether or not the installation of a barrier presents a greater risk than the feature it is intended to shield. The analysis should be completed using the *Roadside Safety Analysis Program* (***RSAP***) or in accordance with the *AASHTO Highway Safety Manual* (***HSM***). Refer to ***Section 23.5*** of this Volume for guidance on evaluating the benefits of shielding using ***RSAP*** or the ***HSM***.

- ***Section 4.4.7.1**, Evaluation of Roadside Hazards*
  - From OLD ***Chapter 4**, Section 4.3.1, Recommendations*
- ***Section 4.4.7.2**, Shielding Requirements*
  - From OLD ***Chapter 4**, Section 4.1.1*
- ***Section 4.4.7.3**, Warrants for Median Barrier*
  - Add Criteria for High Speed, High Volume, Non-Limited Access Facilities
- ***Section 4.4.7.4**, Positive Protection in Work Zones*
  - From ***Chapter 10***

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Roadside Safety:

***Section 4.4.7**, Warrants for Roadside Barriers:*

- ***Section 4.4.7.1**, Evaluation of Roadside Hazards*

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.

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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.

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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.

PPM, Volume 1, Chapter 4

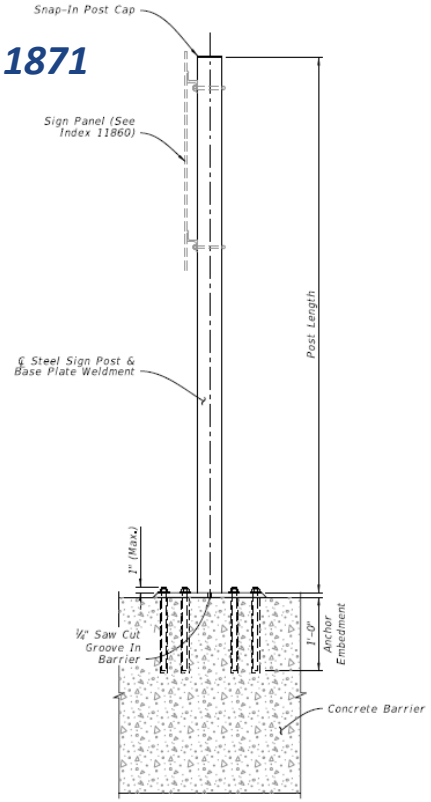
Roadside Safety:

***Section 4.5**, Attachments to Barriers:*

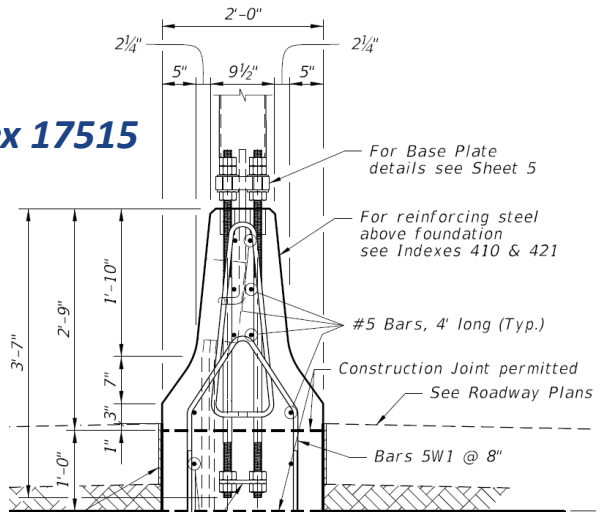
- Relocated information from ***Chapter 7***
- **NOT Permitted** for Flexible or Semi-Rigid Barriers
- For Rigid Barriers – design and detail in accordance with the ***SDG***
- ***Section 4.5.1**, Attachments to Median Barrier*
  - Lighting – If in accordance with *Index 17515*
  - Signing – If in accordance with *Index 410* or *Index 11871*:

*NOTE: Only signs Included in **PPM**, Vol. 1, Section 7.2.5* are permitted for use with *Index 11871.*

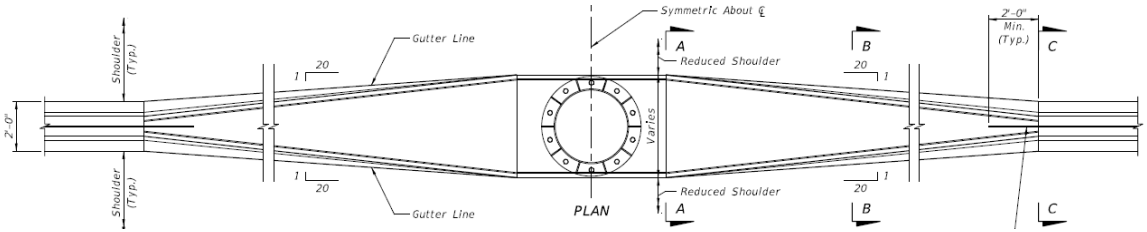
Index 11871



Index 17515



Index 410



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Roadside Safety:

***Section 4.5**, Attachments to Barriers:*

- ***Section 4.5.2**, Existing Attachments to Median Barriers and Traffic Railings*

> Evaluate existing rigid barrier attachments on a case-by-case basis to ensure they are installed in accordance with the provisions of this Section and ***Design Standards***, ***Index 11870***, ***Index 11871***, or ***Index 17515***. Remove existing attachments not meeting these requirements.

- ***Section 4.5.3**, Temporary Attachments to Barriers*

> For temporary/work zone signs, when ***Design Standards***, ***Index 600*** cannot be achieved for post mounted signs, and concrete barrier or traffic railing exists, use ***Design Standards***, ***Index 11871***.
>
> For additional information on the attachment and design of Temporary Lighting in combination with temporary barrier, refer to ***Section 10.12.13*** of this Volume.

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Roadside Safety:

***Section 4.6**, Surface Finishes:*

- No Changes, from OLD ***Chapter 4**, Section 4.3.7*

***Section 4.7**, Upgrading Existing Barrier:*

- From OLD ***Chapter 4**, Section 4.3.6*
- Added provision for replacement of **ALL** existing hardware found not to comply with at least ***NCHRP 350***.
- Relocated information about Existing Barriers from ***Chapter 25***
- ***Section 4.7.1**, Resetting Guardrail*
  - Provided definition and conditions for “resetting” guardrail
  - Mounting Height and Splice Location must meet current standards
- ***Section 4.7.2**, Existing Longitudinal Roadway Barriers on RRR Projects*
- ***Section 4.7.3**, Existing End Treatments & Crash Cushions on RRR Projects*
- ***Section 4.7.4**, Bridge Traffic Railing on RRR Projects*
- ***Section 4.7.5**, Guardrail to Bridge Railing Transitions on RRR Projects*

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Roadside Safety:

***Section 4.7**, Upgrading Existing Barrier:*

- ***Section 4.7.2**, Existing Longitudinal Roadway Barriers on RRR Projects*
  - 27” Guardrail Vs. 31” Guardrail (i.e. *2013 Design Standards* Vs. Current)
  - Existing Thrie-Beam may remain in place

    Note: Extending Thrie-Beam not be permitted
  - Steel Offset Blocks for Design Speed ≤ 45 mph
- ***Section 4.7.3**, Existing End Treatments & Crash Cushions on RRR Projects*
  - Previously only covered “Guardrail Terminals”
- ***Section 4.7.4**, Bridge Traffic Railing on RRR Projects*
- ***Section 4.7.5**, Guardrail to Bridge Railing Transitions on RRR Projects*
  - Removed *“Guardrail Continuous Across Bridges” (Not Crash Tested)*
  - Allowance for leaving included in ***Section 4.7.4***

***Section 4.8**, Non-Standard Roadside Safety Hardware:*

- Added that Non-Standards Hardware must be **Approved by the RDO**

Thanks

Questions?

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Design Standards Publication Manager
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Chapter 7 Updates

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Presentation Agenda

- PPM Volume 1, Chapter 7
  - Section 7.3 – Lighting
  - Section 7.6 – Pavement Marking

Section 7.3 - Lighting

7.3.1 Design Criteria

Use the illuminance method for all lighting design. The design values for light levels given by the ***AASHTO Roadway Lighting Design Guide*** are maintained values. These maintained values have been adjusted for Department assigned light loss and maintenance factors and are provided in ***Tables 7.3.1 - 7.3.7*** as required light level criteria.

Section 7.3 - Lighting

7.3.2 Design Methodology

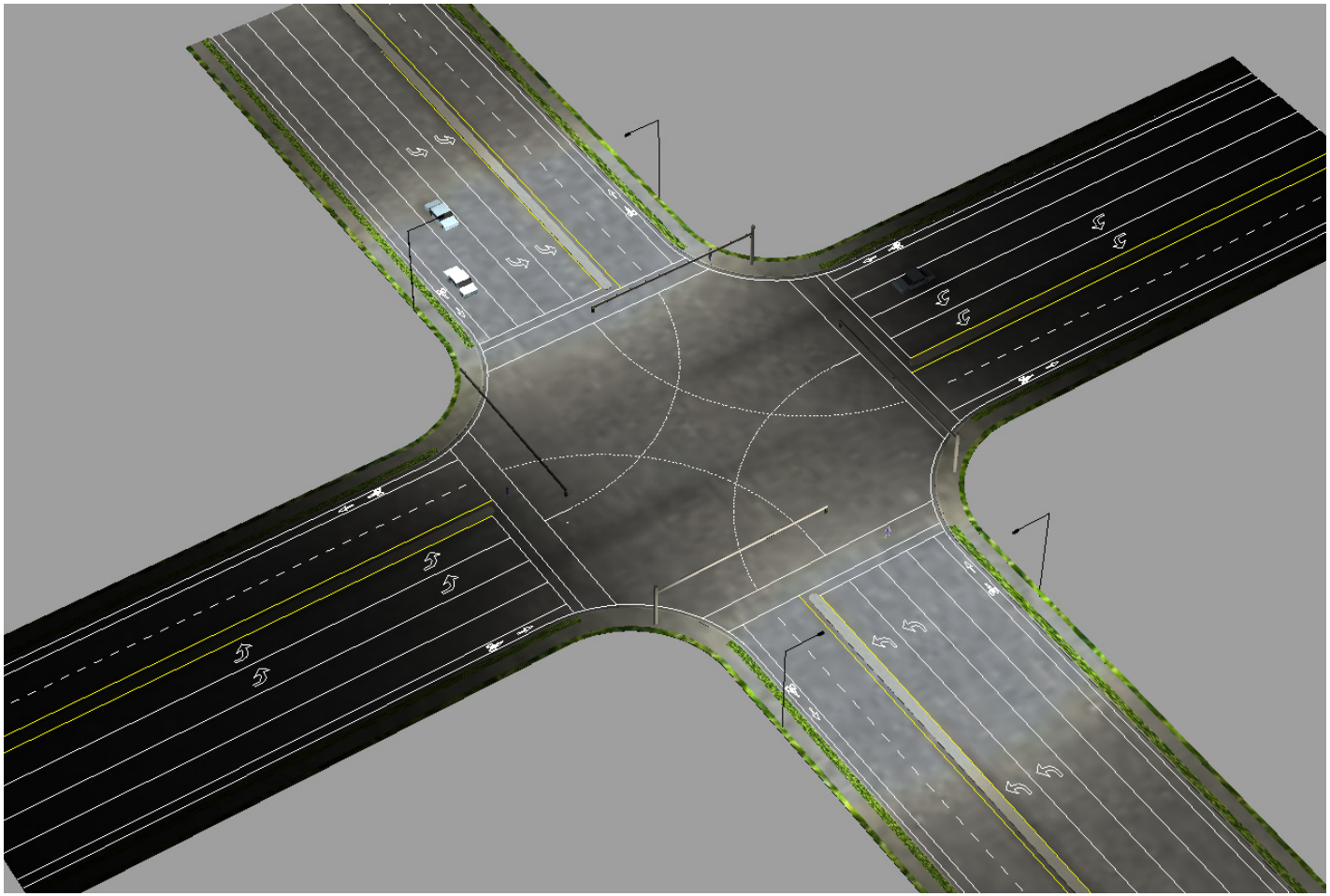
Use the polygon method for all photometric calculations. Establish illumination points within the polygon at 15 foot intervals longitudinally and 5 foot intervals transversely along the roadway for roadway segments. Establish illumination points within the polygon at 5 foot intervals longitudinally and 5 foot transversely along the roadway for signalized intersections.

Section 7.3 - Lighting

7.3.2.1 Analysis Zones

Establish independent analysis zones for each signalized intersection and for each roadway segment between signalized intersections. Roadway segments and signalized intersection segments are to meet the criteria shown in *Table 7.3.1.* New or reconstructed signalized intersections located in Urban 3 or larger designated areas are to meet the criteria in *Table 7.3.3*.

Section 7.3 - Lighting



Section 7.3 - Lighting

7.3.2.2 Analysis for Pedestrian Lighting at Signalized Intersections

Pedestrian lighting criteria in *Table 7.3.3* applies to new or reconstructed signalized intersections located within Urban 3 or larger designated areas.

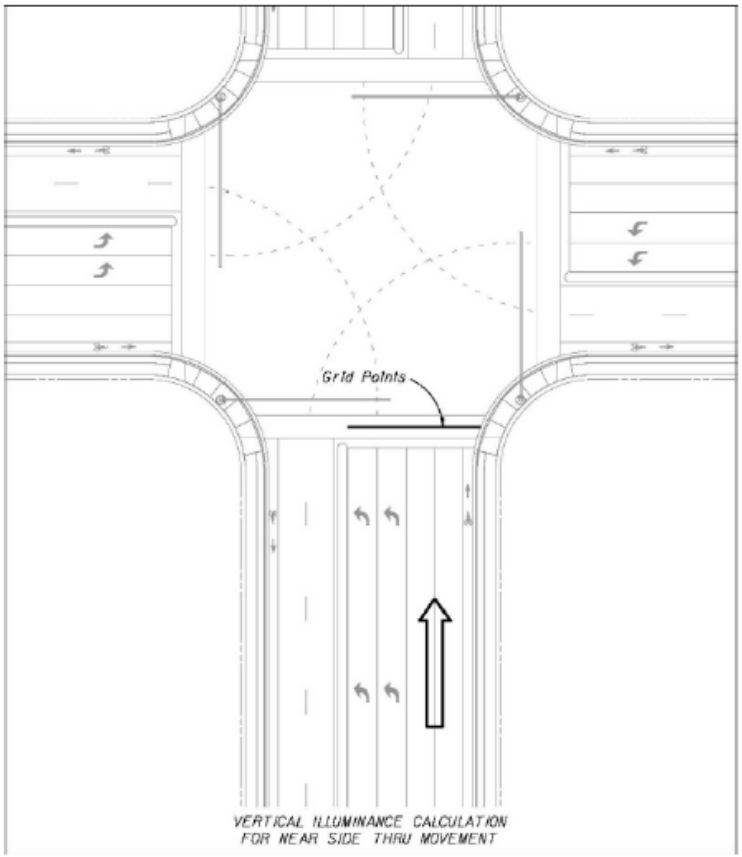
Table 7.3.3 Signalized Intersection Lighting
Urban 3 to Urban 5 Designated Areas

ROADWAY CLASSIFICATIONS	ILLUMINATION LEVEL AVERAGE INITIAL FOOT CANDLE		ILLUMINATION UNIFORMITY RATIOS		VEILING LUMINANCE RATIO
			AVG./MIN.	MAX./MIN.	Lv(max)/Lavg
MAJOR ARTERIALS	Horizontal (H.F.C.)	3.0	4:1 or Less	10:1 or Less	0.3:1 or Less
	Vertical (V.F.C.)	2.3*	N.A.	N.A.	N.A.

Note: * Vertical illumination value is only valid for new projects or where the intersection is being reconstructed. The vertical illumination is a target value and may not be achievable for all traffic movements.

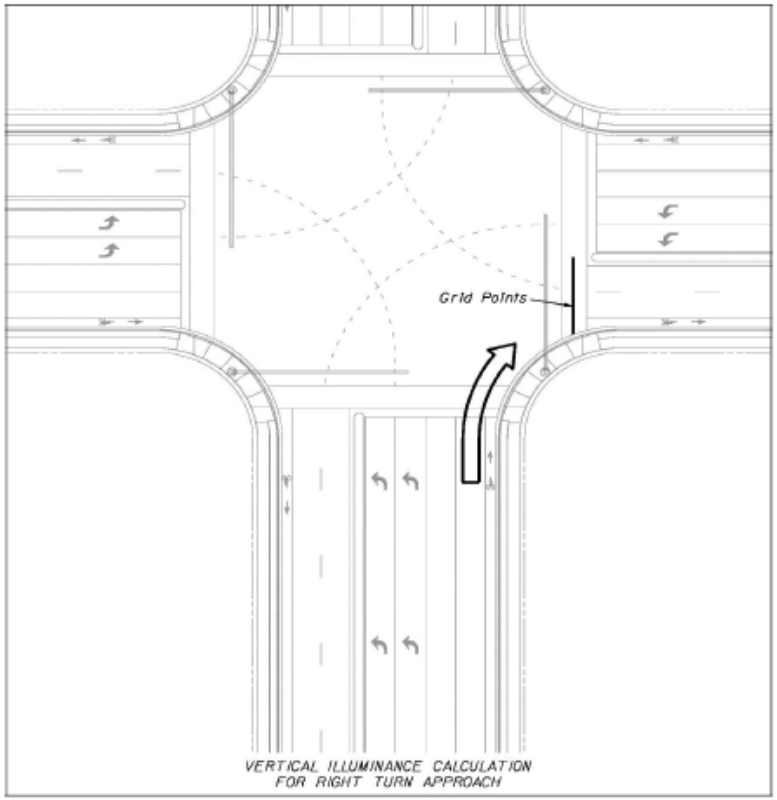
Section 7.3 - Lighting

Figure 7.3.1 Vertical Illuminance Calculation for Near Side Movement



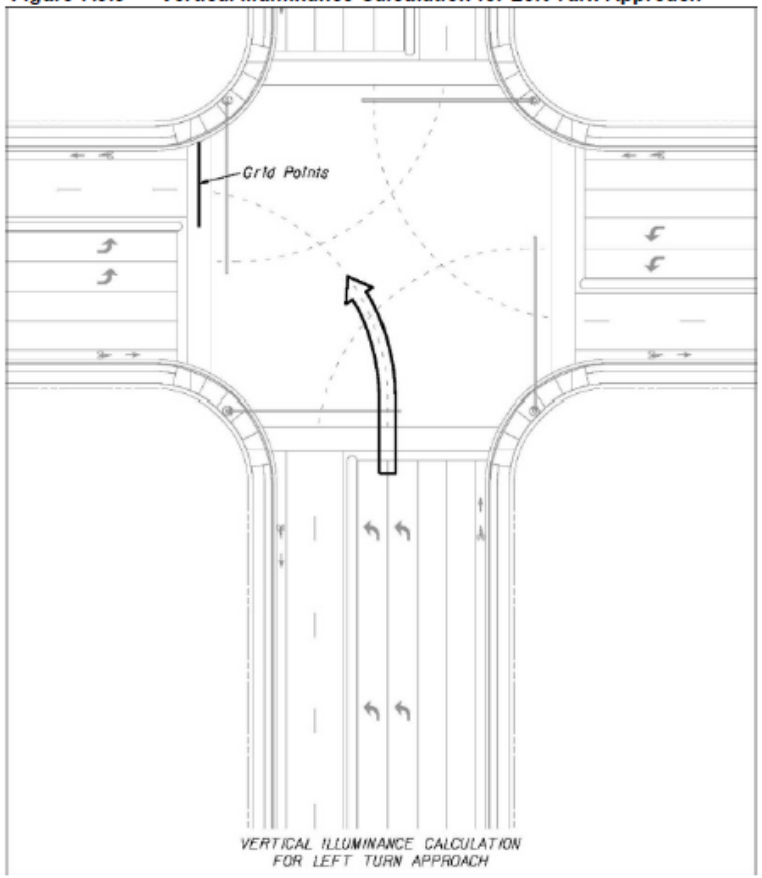
Section 7.3 - Lighting

Figure 7.3.2 Vertical Illuminance Calculation for Right Turn Approach



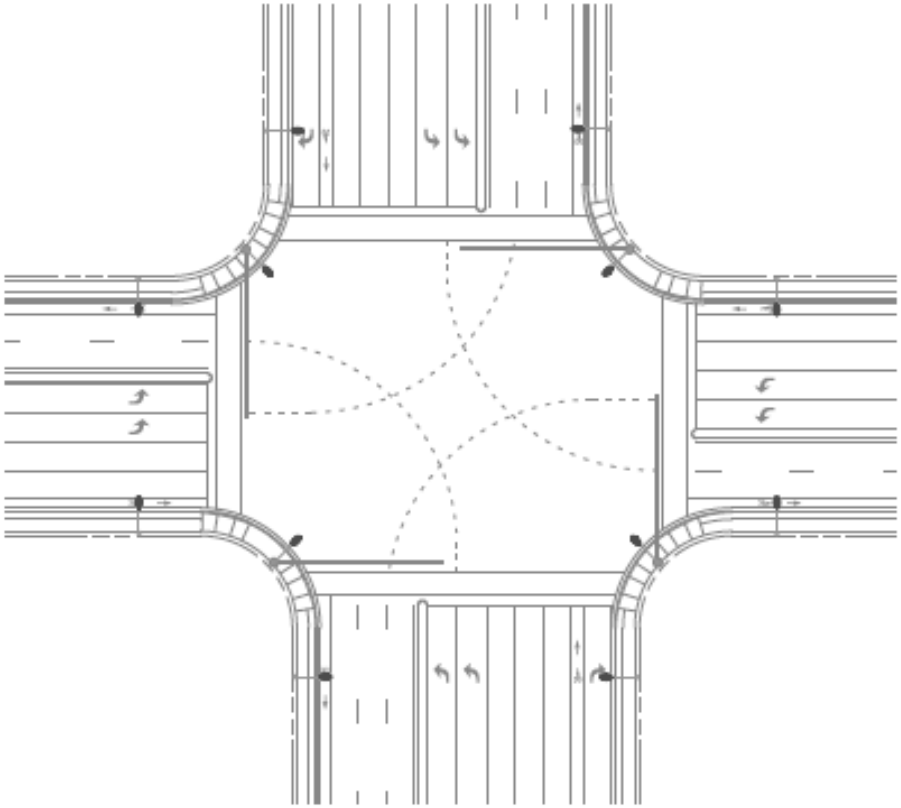
Section 7.3 - Lighting

Figure 7.3.3 Vertical Illuminance Calculation for Left Turn Approach

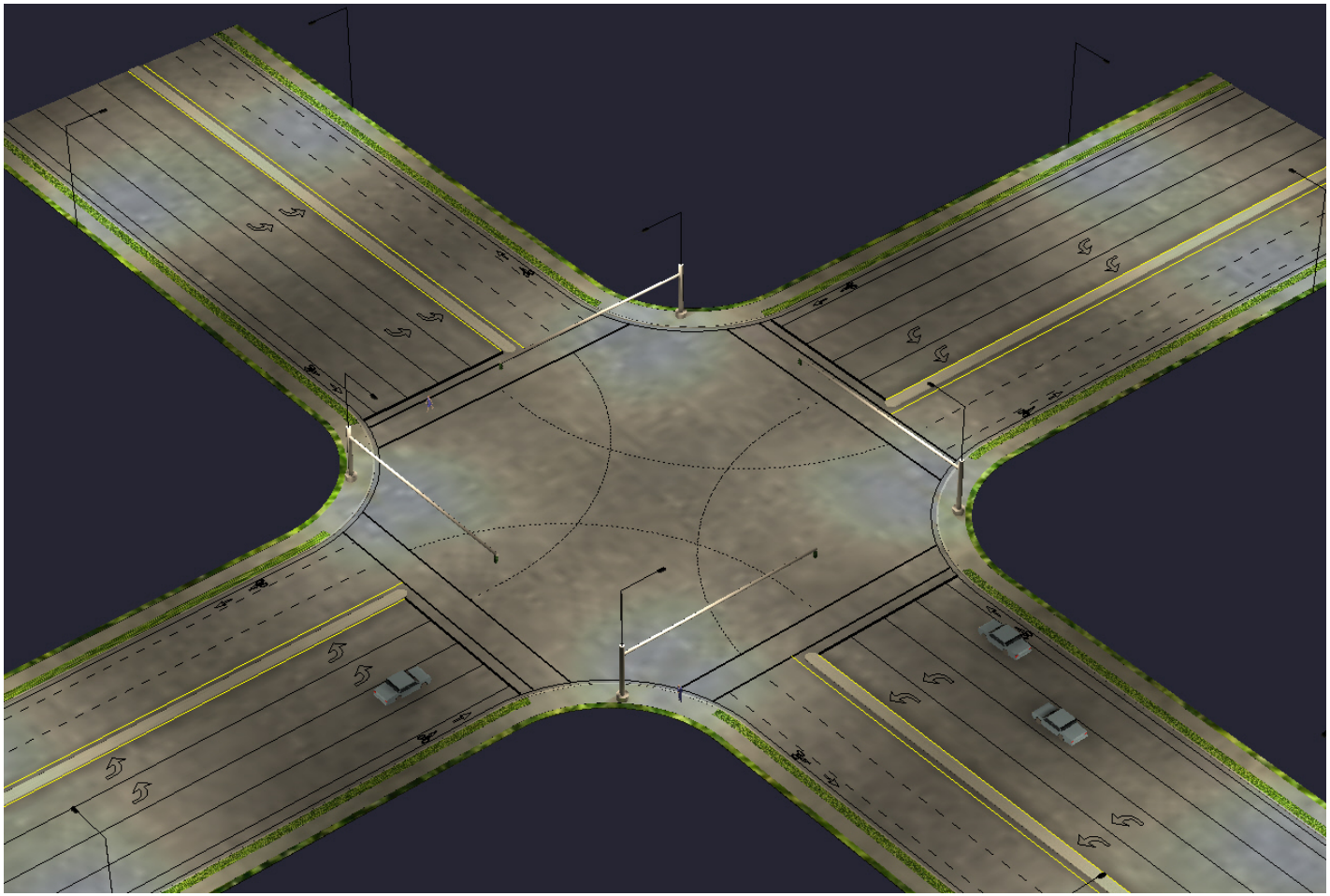


Section 7.3 - Lighting

Figure 7.3.4 Typical Lighting Layout for Large Intersection



Section 7.3 - Lighting



Section 7.3 - Lighting

7.3.2.3 Analysis of Roundabouts

The criteria in *Table 7.3.3* will apply to all roundabouts where pedestrian features are provided. Calculate the vertical illuminance for the crosswalk on each near side approach and for each right turn movement in accordance with the methodology outlined in 7.3.2.2.

Section 7.3 - Lighting

7.3.2.4 Analysis of Midblock Crosswalks

The criteria in *Table 7.3.4* will apply to all midblock crosswalks. Calculate the vertical illuminance for the crosswalk on each near side approach in accordance with the methodology outlined in *Section 7.3.2.2*.

Table 7.3.4 Midblock Crosswalk Lighting

AMBIENT LUMINANCE	VERTICAL ILLUMINATION LEVEL AVERAGE INITIAL FOOT CANDLE (V.F.C.)
LOW	2.3
MEDIUM & HIGH	3.0

Section 7.3 - Lighting

Table 7.3.6 in the old Manual has been removed

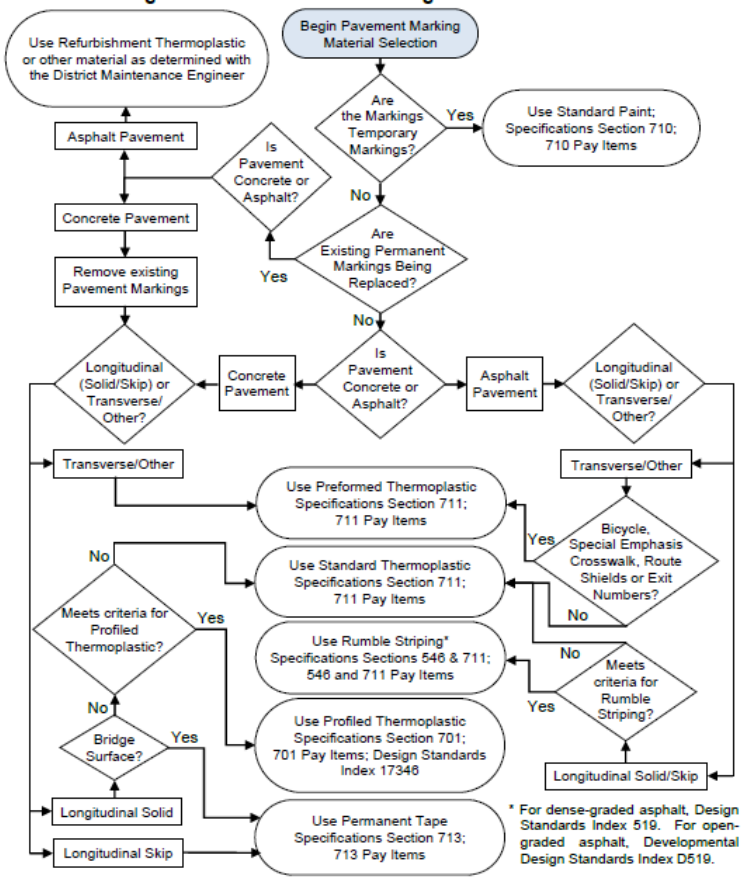
Table 7.3.6 Mounting Height Restrictions

LUMINAIRE WATTAGE	LIGHT SOURCE	MOUNTING HEIGHT (MIN.) (FEET)
150	High Pressure Sodium (HPS)	25
200	High Pressure Sodium (HPS)	30
250	High Pressure Sodium (HPS)	30
400	High Pressure Sodium (HPS)	40
750	High Pressure Sodium (HPS)	50
1000	High Pressure Sodium (HPS)	80

2015 Roadway Design Bulletins (RDB)

RDB 15-02 – Pavement Marking Materials Selection

Figure 7.6.1 Pavement Marking Material Selection



Chapter 7 Revisions

Section 7.6 – Pavement Markings

Section 7.6 – Pavement Markings

- Rumble Striping Policy

For roadways which do not have paved shoulders, profiled thermoplastic may be used in lieu of rumble striping.

Section 7.6 – Pavement Markings

In the past District's had the option to install permanent markings as part of the construction contract or to put them later in a maintenance contract.

This option created issues in our specifications, on how to handle various pavement marking materials.

Section 7.6 – Pavement Markings

At the Joint Director's of Operations meeting in September of 2015, all districts agreed that permanent markings would be in construction contracts the permanent pavement markings would be installed as part of that construction contract where new paving was installed.

Section 7.6 – Pavement Markings

There was a change in Chapter 8, specifically Section 8.3.3.1, which expands the use of special emphasis crosswalks to crosswalks at all approaches to signalized intersections.

Section 7.6.1.4 requires that special emphasis crosswalk markings utilize preformed thermoplastic material..

Section 7.3 and 7.6 Updates

Questions?