220 Railroads

220.1 General

Title 23 United States Code (U.S.C.), Chapter 1, Section 109(e) and ***Code of Federal Regulations (CFR) 646.214(b)*** establish minimum national requirements and specify the required compliance with the ***MUTCD*** for highway-railroad grade crossings.

Florida Administrative Code (FAC) 14-57.013 contains the minimum requirements for all public highway-railroad grade crossings in the State of Florida.

CFR 646.214(b)(2) addresses highway-railroad grade crossings "near the terminus of a Federal-aid highway project". The Department and the FHWA Florida Division have agreed that all projects on the SHS, regardless of Federal-aid, must meet these criteria.

"Near the Terminus" is defined as either of the following:

- The project begins or ends between the crossing and where the MUTCD-mandated railroad advanced warning sign is or will be placed. See ***MUTCD Table 2C-3*** (Condition B, column "0" mph) for the placement requirements of this sign.
- An intersection traffic signal within the project is connected to the crossing's flashing light signal and gate.

FAC 14-57.013(4) establishes specific thresholds to support the requirements of ***CFR 646.214(b)(3)(i)***.

This chapter provides requirements for highway-railroad crossings on the State Highway System (SHS).

220.1.1 Railroad Companies

State-owned rail corridors include the Central Florida Rail Corridor and South Florida Rail Corridor.

The Central Office maintains a list of railroad companies currently operating in the state of Florida on the following webpage: ***Florida Railroad Contacts***.

Short line railroad companies and terminal switching companies also operate in the state of Florida.

220.1.2 Higher-Speed Rails

Criteria specifying “higher-speed” highway-rail grade crossings is for those with a passenger timetable speed corresponding to Class 5, 6, and 7 track per ***Code of Federal Regulations (CFR), 49 CFR Part 213*** (81 to 124 mph).

220.2 Highway–Railroad and Light Rail Transit Grade Crossings

This section provides requirements in addition to ***MUTCD, Part 8*** for highway-railroad grade crossings on the State Highway System. See also ***Florida Administrative Code (FAC) 14-57.013*** which contains additional Florida-specific criteria for installation of warning devices for public (state and local) highway-railroad grade crossings.

Design considerations are discussed in the ***AASHTO Green Book***.

220.2.1 General – Grade Crossings

See ***Table 220.2.1*** for FDOT Modifications to ***MUTCD 11th Edition, Part 8A (General)***; and refer to the ***FDM 220 – MUTCD Part 8 Crosswalk*** for these FDOT Modifications incorporated into ***MUTCD Part 8*** as tracked changes, with some additional FDOT requirements.

Table 220.2.1 FDOT Modifications to *MUTCD, Part 8A*

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8A.02	5	Guidance	Standard	Change "should" to "must".
8A.02	6	Option	Guidance	Change "may be used as determined" to "should be used unless otherwise determined".
8A.05	3	Guidance	Standard	Change "should" to "must".
8A.05	4	Option	Standard	Change "may" to "must".
8A.06	3	Guidance	Standard	Change "should" to "must".
8A.06	4	Guidance	Standard	Change "should" to "must". Expand “raised median island is” to “raised median island and/or tubular markers are..."
8A.06	5	Guidance	Standard	Change first occurrence of “should” to “must”. Expand “median islands” to “median islands and/or tubular markers..." Change “should also be considered” to “must also be used”.
8A.06	6	Option	Standard	Change "extending the automatic gate across the lane may be considered." to "extend the automatic gate across the lane."
8A.08	2	Guidance	Standard	Change "should" to "must".
8A.08	3	Guidance	Standard	Change "should" to "must".
8A.08	4	Guidance	Standard	Change "should" to "must".
8A.08	5	Guidance	Standard	Change "should" to "must".
8A.08	6	Guidance	Standard	Change "should" to "must" twice.
8A.09	1	Option	Option	Add new sentence “See also, the Department’s “Opening Closure Program” webpage (***https://www.fdot.gov/rail/programs/opening-closure***) for requirements and resources”

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8A.09	2	Guidance	Standard	Change "should" to "must".
8A.09	3	Guidance	Standard	Change the second "should" to "must".
8A.09	5	Guidance	Standard	Change "should" to "must".
8A.09	6	Guidance	Standard	Change "should" to "must" twice.
8A.09	7	Guidance	Standard	Change "should" to "must".
8A.12	3	Guidance	Standard	Change "should" to "must".
8A.13	3	Guidance	Standard	Change "should" to "must" twice.
8A.13	4	Guidance	Standard	Change "should" to "must".
8A.13	5	Guidance	Standard	Change "should" to "must" twice.
8A.13	6	Guidance	Standard	Change "should" to "must".

220.2.1.1 Work Near or Within Railroad Right of Way (R/W)

A flagger must be present while any work within railroad R/W is being performed.

Railroad companies often impose additional requirements as deemed necessary when roadway improvements are adjacent to, near, above, or below the railroad R/W, and there is potential for impacts to the railroad or for construction materials and equipment to foul the tracks.

220.2.1.2 Diagnostic Team

The purpose and membership of a Diagnostic Team is established in ***MUTCD, Section 8A.01***. The Department's Diagnostic Team member must be the District Traffic Operations Engineer or their designee.

220.2.1.3 Quiet Zones

Highway-railroad grade crossings within a designated Quiet Zone must comply with ***49 CFR Part 222*** and should be equipped with a Supplemental Safety Measure identified in ***49 CFR Part 222, Appendix A***.

Highway-railroad grade crossings within Quiet Zones should be evaluated to determine if driveways, minor side streets, or turn lanes near the crossing require additional safety measures.

220.2.1.4 Required Coordination

Coordinate projects within or near railroad R/W as follows:

(1) New highway-railroad grade crossings must be permitted in accordance with ***Section 335.141, Florida Statutes (F.S.)***. Early coordination with the Department's Freight and Rail Office is required concerning the Rail Crossing Opening/Closure Program.

(2) Coordinate the design of traffic control devices with the District Rail Coordinator who will then coordinate with the railroad company. Warning devices that are on or within railroad R/W or interact with trains are installed by the railroad company.

(3) Coordinate with the District Traffic Operations Engineer to determine if a preemptive system is required.

(4) Coordinate with the Department's Freight and Rail Office to determine if a highway-railroad grade crossing is located within a designated Quiet Zone.

(5) Coordinate with the District Rail Coordinator when a waiver is being considered for standard lateral offset requirements for structures; see ***FDM 220.3.2***.

Some railroads may require an increase in Railroad Protective Liability Insurance greater than what is provided in the ***Standard Specifications***. The District Specifications Engineer and the District Rail Coordinator will develop a Modified Special Provision and submit it through the Central Specifications Office for special processing. For projects involving CSX Railroad, use Special Provision SP0071303.

Modification for Non-Conventional Projects:
Delete ***FDM 220.2.1.4*** and see RFP for requirements.

220.2.1.5 Grade Crossing Skews

Grade crossings should intersect railroad tracks as close to 90 degrees as possible. For all modes of travel, this reduces the crossing distance and time. This is especially critical for bicycle and pedestrian facilities where bicyclists and pedestrians are vulnerable to challenges with flangeway gaps at skewed crossings. The Diagnostic Team must consider redesign of pathways and pedestrian/bicycle-only facilities skewed 30 degrees or greater from perpendicular.

220.2.1.6 Hump Crossings

A highway-railroad grade crossing with high-profiled vertical geometry is considered a "hump crossing" and can adversely affect the safety and operations of road users, posing a risk of low-clearance vehicles and trailers (e.g., low-profile vehicles, vehicles with long wheelbases, "lowboy" towing trailers) becoming stuck on the tracks. A hump crossing is defined as an existing grade crossing not meeting the dimensions and description of the detail entitled, "*Vertical Roadway Alignment Through A Railroad Crossings*" contained in ***Standard Plans*, *Index 830-T01***. Perform a site-specific analysis for rail clearances on any grade crossing not meeting the vehicle clearance criteria prescribed in ***Standard Plans, Index 830-T01***. Install a W10-5 sign if the site-specific analysis shows potential for low-clearance vehicles to be caught on the tracks. All new crossings must be designed in accordance with ***Standard Plans, Index 830-T01***.

Ensure all new construction and reconstruction grade crossings are in accordance with Standard Plans***, Index 830-T01***. For existing humped crossings to remain***,*** install a Low Ground Clearance Grade Crossing (W10-5) warning sign with LOW GROUND CLEARANCE (W10-5P) plaque**.**

220.2.1.7 Surfaces

The roadway travel lanes at a highway-railroad grade crossing should be constructed for a suitable length with all-weather surfacing. A roadway section equal to the current or proposed cross section of the approach roadway, including any existing or proposed pedestrian walkways, should be carried through the railroad crossing. The railroad crossing surface itself should have a riding quality equivalent to that of the approach roadway. When selecting the type of crossing and the material to be used in its construction, consideration should be given to the character and volume of traffic using the roadway.

220.2.1.8 Selection of Warning Devices

Selection of the warning devices to be used is a function of the geometrics of the highway-railroad grade crossing (e.g., alignment, profile, sight distance, cross section of both the roadway and the railroad), available R/W, and proximity to signalized intersections.

When warning signs or traffic control signals are used in advance of a highway-railroad grade crossing, they must be placed so as not to obstruct the view of the crossing signals.

220.2.1.9 Illumination at Grade Crossings

In further support of ***MUTCD, Section 8A.10***, when determining number of train passages at night, consider seasonal and daily variations in freight and passenger rail schedules as well as seasonal variations of nighttime conditions. See ***FDM 231*** for lighting requirements.

Install grade crossing lighting at locations meeting one or more of the following conditions:

(1) Train traffic exceeds 17 trains in nighttime conditions over a 24-hour period,

(2) Crossing comprises two or more tracks, or

(3) Track is skewed 30 degrees or greater from perpendicular.

220.2.2 Signing

See ***Table 220.2.2*** for FDOT Modifications to ***MUTCD 11th Edition, Part 8B (Signs)***; and refer to the ***FDM 220 – MUTCD Part 8 Crosswalk*** for these FDOT Modifications incorporated into ***MUTCD Part 8*** as tracked changes, with some additional FDOT requirements.

Table 220.2.2 FDOT Modifications to the *MUTCD, Part 8B*

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8B.03	3	Standard	Standard	Delete "alone or". Add new sentence "The Crossbuck sign may be used alone only for existing passive grade crossings."
8B.03	4	Standard	Standard	Delete "alone or". [The Crossbuck sign must not be used alone in any condition on highway-LRT crossings.]
8B.03	8	Standard	Standard	Delete "passive".
8B.03	9	Option	Deleted	[Required in 8B.03, Paragraph 8 above]
8B.04	6	Guidance	Standard	Change "should" to "must" twice.
8B.04	7	Guidance	Standard	Change "consideration should be given to installing a STOP sign" to "a STOP sign must be installed". Change "the Diagnostic Team should consider" to "the Diagnostic Team must consider".
8B.04	12	Standard	Standard	Change "rural areas" to "Context Classifications C1 and C2". Change "areas where parking or pedestrian movements are likely to occur." to "all other Context Classifications." [See FDM 200.4 for definitions of Context Classifications]
8B.05	1	Guidance	Deleted	[STOP and YIELD signs are not allowed without Crossbuck Signs at Highway-LRT Grade Crossings.]

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8B.05	2	Standard	Deleted	[STOP and YIELD signs are not allowed without Crossbuck Signs at Highway-LRT Grade Crossings.]
8B.06	1A	Standard	Standard	[FDOT interpretation for this specific section only: The "edge of the parallel roadway" is the "edge of the traveled way of the parallel roadway".]
8B.06	1B	Standard	Standard	[FDOT interpretation for this specific section only: "low-volume" is an AADT less than or equal to 5,000 and "low-speed" is a posted or statutory highway speed of less than or equal to 40 mph.]
8B.06	5	Standard	Standard	[FDOT interpretation for this specific section only: The "edge of the parallel roadway" is the "edge of the traveled way of the parallel roadway".]
8B.07	1	Guidance	Standard	Change "should" to "must". Add new sentence "At higher-speed grade crossings the DO NOT STOP ON TRACKS (R8-8) signs must be LED-enhanced. See Standard Plans, Index 700-120, Roadside Sign Assembly 8."
8B.07	3	Guidance	Guidance	Add two new sentences "Position R8-8 sign to provide optimal visibility of the other signs and signals to approaching drivers. The visibility of the signals must be the top priority."
8B.07	5	Option	Standard	Change "may" to "must".
8B.08	1	Option	Standard	Change "may" to "must".

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8B.08	4	Guidance	Standard	Change "should" to "must".
8B.09	1	Option	Standard	[Applicable only when sign can be placed without blocking or reducing line of sight to the flashing signals.] Change "may" to "must".
8B.10	2	Option	Standard	Replace paragraph with “STOP HERE ON RED signs must be used at all stop lines associated with traffic signals with a red signal face”.
8B.11	1	Option	Standard	Change "may" to "must" twice.
8B.11	2	Option	Standard	Change "may" to "must".
8B.12	2	Option	Standard	Change "may" to "must".
8B.12	3	Guidance	Standard	Change "should" to "must".
8B.12	4	Option	Standard	Change "may" to "must".
8B.13	2	Option	Standard	Change "may" to "must" twice.
8B.13	4	Guidance	Standard	Delete "If used". Change "should" to "must".
8B.14	2	Guidance	Standard	Change "should" to "must".
8B.14	3	Option	Standard	Change the first "may" to "must".
8B.14	4	Option	Deleted	[Not an option for FDOT.]
8B.15	1	Option	Standard	Change "may" to "must" twice.
8B.15	2	Guidance	Standard	Change "should" to "must".
8B.16	1	Guidance	Standard	Replace paragraph with " All new crossings must be designed in accordance with Standard Plans, Index 830-T01. For existing humped crossings to remain, install a Low Ground Clearance Grade Crossing

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
				(W10-5) sign (see Figure 8B-4) in advance of all hump crossings."
8B.16	5	Guidance	Standard	Change "should" to "must".
8B.16	6	Guidance	Standard	Change "should be posted" to "must be posted with the W10-1 sign".
8B.16	7	Guidance	Standard	Change "should" to "must".
8B.17	2	Option	Standard	Change "may" to "must".
8B.18	2	Guidance	Standard	Change "should" to "must" twice.
8B.19	1	Guidance	Standard	Change "should" to "must".
8B.21	1	Guidance	Standard	Change "should" to "must".
8B.21	2	Guidance	Standard	Change "should" to "must".
8B.21	3	Option	Standard	Change "may" to "must".
8B.22	1	Option	Standard	Change "may" to "must". [Applicable to grade crossings skewed 30 degrees or greater from perpendicular.]
8B.22	2	Guidance	Standard	Delete "If Skewed Crossing sign is used,". Change "should" to "must".
8B.23	1	Option	Standard	Change "may" to "must".
8B.24	2	Option	Standard	Change "may" to "must".
8B.27	8	Guidance	Standard	Change "should" to "must" three times.
8B.27	9	Guidance	Standard	Change "should" to "must".
8B.27	10	Guidance	Standard	Change "should" to "must" twice.
8B.27	11	Guidance	Standard	Change "should" to "must".

220.2.2.1 Vehicle Refuge Area

For higher-speed highway-railroad grade crossings, the Diagnostic Team must consider providing a vehicle refuge area outside of the traveled way that may be used as escape lanes at locations where traffic routinely backs up over the track. For multilane approaches with medians, vehicle refuge areas should be provided within the median in addition to the outside shoulder. If provided, the refuge area must be a minimum width of 10 feet to provide refuge for vehicles trapped on the railroad tracks. Install ESCAPE LANE signing notifying the driver to utilize the refuge area as the escape lane as shown in ***Exhibit 220-1.***

220.2.2.2 LED-Enhanced Signs

LED-Enhanced signs are used to enhance conspicuity of traffic control for the most critical safety concerns at the grade crossing.

LED-Enhanced signs should be provided at grade crossings with one of the following criteria:

(1) The crossing is located in a Quiet Zone.

(2) A history of crashes attributable to “Stopped on crossing”.

220.2.2.3 Advance Warning Signs

Where intersections occur between the W10-1 sign shown in ***Exhibits 220-2*** through ***220-5*** and the tracks, place an additional W10-1 sign between the intersection and the railroad gate. Use the W10-1 sign as shown in ***Standard Plans, Index 509-100***.

The W3-1, W3-2, or W10-1 signs may be enhanced by transverse rumble strips to bring early attention to the traffic control sign advising motorists they are approaching a passive crossing.

For side roads with active and passive grade crossings within 100 feet of the edge of traveled way, include W10-2, W10-3 or W10-4 signs on the mainline state road in accordance with the ***MUTCD***. Include W10-5 signs with W10-5P signs as described in ***FDM 220.2.1***.

220.2.2.4 Sign Placement

Do not place turning movement lane-use signs on the upstream approach between the railroad crossing pavement message and the tracks.

Remove all existing traffic control signs and pavement markings (e.g., turning signs and turning arrow lane-use pavement markings) from the upstream approach that may lead to driver confusion on the correct turning point for downstream turning movements.

Ensure placement of all signs allows a clear sight line to all rail signal flasher units. Sight line distance requirements vary by rail company. Consult with the operating railroad company for a project-specific determination of sight line distance.

220.2.3 Pavement Markings

Do not place turning movement lane-use pavement markings on the upstream approach between the railroad crossing pavement message and the tracks.

Remove all existing turning arrow lane-use markings from the upstream approach between the railroad crossing pavement message and the tracks that may lead to driver confusion on the correct turning point for downstream turning movements.

Consider the use of through lane-use arrows immediately upstream of the grade crossing in lanes where a turning movement must be made or is permitted to be made downstream of the grade crossing. For turn lanes, a route shield may be used in conjunction with the through lane-use arrow.

For pavement marking material selection, see ***FDM 230***.

See ***Table 220.2.3*** for FDOT Modifications to ***MUTCD 11th Edition, Part 8C (Markings)***; and refer to the ***FDM 220 – MUTCD Part 8 Crosswalk*** for these FDOT Modifications incorporated into ***MUTCD Part 8*** as tracked changes, with some additional FDOT requirements.

Table 220.2.3 FDOT Modifications to the *MUTCD, Part 8C*

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8C.01	1	Support	Support	Change "Passive" to "Existing passive".

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
				[All new grade crossings must have active traffic control systems per FAC 14-57.013. Therefore, this paragraph only applies to existing crossings.]
8C.02	2	Standard	Standard	Add sentence "Approach lanes include adjacent dedicated turn lanes on parallel roadways less than 100 feet from the grade crossing."
8C.03	1	Guidance	Standard	Change "should" to "must".
8C.03	2	Option	Standard	Change "yield line (see Section 3B.19) or stop line may" to "yield line (see Section 3B.19) must". [FDOT prohibits the use of stop lines for yield conditions.]
8C.03	8C-2B	Option	Deleted	[Figure 8C-2B Grade crossing alternative (narrow) pavement marking symbol is prohibited by FDOT]
8C.03	3	Guidance	Standard	Change "should" to "must" twice.
8C.03	5	Guidance	Standard	Change the first "should" to "must".
8C.03	6	Guidance	Standard	Change the first "should" to "must".
8C.04	1	Standard	Standard	Delete "stop line of the grade crossing" and replace with "grade crossing pavement marking and the track(s)".
8C.04	2	Guidance	Standard	Change "should" to "must". Delete "less than 100 feet upstream from the stop line for the grade crossing or".

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8C.05	1	Guidance	Standard	Change "should extend up to" to "must be solid for the entire distance between the beginning of each Grade Crossing Pavement Marking Symbol of each approach and extend up to". Add new sentence "Continue solid longitudinal edge line, lane line, and centerline markings through the dynamic envelope pattern, maintaining a 9-inch clear space between the Dynamic Envelope pattern and the longitudinal lane lines or gore areas." Add new sentence "See FDM Exhibits 220-2 through 220-5 for examples." Add [as an Option] new sentence "The edge line may be dashed for bike lane conflict markings where the grade crossing pavement marking is beyond a right-turn lane taper."
8C.05	2	Guidance	Standard	Change "should" to "must".
8C.05	6	Option	Deleted	[FDOT Requires the use of RPMs.]
8C.05	8	Guidance	Standard	Change "Tubular markers should" to "If used, tubular markers must". Add sentence "Place tubular markers with a center-to-center spacing of 3 feet minimum and 10 feet maximum at the discretion of the Diagnostic Team."
8C.06	1	Option	Standard	Change "may be installed at a grade crossing" to " must be installed at Active and Passive grade crossings on State Roads, State-owned rails, and state-owned property".

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
				Add sentence "Design Variations to not install dynamic envelope markings must be approved by the Chief Engineer."
8C.06	2	Standard	Standard	Delete "If used ". Change "not less than 4 inches or greater than 24 inches in width." to "in accordance with FDOT Standard Plans, Index 711-001."
8C.06	4	Guidance	Deleted	[See FDM 220.2.1 for requirements.]
8C.06	8C-3	Guidance	Deleted	[See FDM Exhibits 220-2 through 220-5 and Standard Plans, Index 711-001]
8C.06	5	Option	Deleted	[See FDM 220.2.1 for requirements.]

220.2.3.1 Dynamic Envelope Markings

Exhibits 220-2 through ***220-5*** provide typical signing and pavement markings for Active Grade Crossings.

Detail dynamic envelope pavement markings in the plans in accordance with Standard Plans***, Index 711-001*** and the details shown in ***Exhibits 220-2*** through ***220-5***. Ensure the details in the plans include the following:

(1) Orient dynamic envelope pavement markings:

(a) In the direction of the travel lanes at all approaches upstream of the crossing (i.e., transverse to the travel lanes).

i. For railroads skewed less than 30 degrees from perpendicular, extend the dynamic envelope markings transverse across all lanes, as shown in ***Exhibits 220-3*** and ***220-4***.

ii. For railroads skewed 30 degrees or greater from perpendicular, step the dynamic envelope markings transverse across each lane, as shown in ***Exhibit 220-5***.

(b) Along the railroad (i.e., parallel to the railroad tracks) for areas between tracks and downstream of the crossing.

(c) In a manner to ensure the “X” pattern is identifiable to the motorists and bicyclists and centered in the lanes to the extent practicable that will maximize visibility from both the upstream and downstream sides of the track.

(2) Place dynamic envelope markings through the foul area as shown in ***Exhibits 220-4*** and ***220-5***. If the railroad owner will not allow the dynamic envelope markings through the foul area, or the substrate material will not provide an appropriate bonding surface for the markings, keep the dynamic envelope markings outside of the railroad’s foul area as shown in ***Exhibits 220-2*** and ***220-3***.

(3) Refurbish all existing longitudinal lane lines, edge lines, and centerlines to remain in-place for the entire distance between the beginning of each Grade Crossing Pavement Marking Symbol of each approach and extend up to and across the grade crossing.

(4) Place RPMs at 10-ft maximum on center for the entire distance of the solid edge lines, lane lines, and center lines to reduce the likelihood that road users might inadvertently turn into the track area. Use Tubular Markers instead of RPMs when crest vertical curves impede the visibility of RPMs.

(5) For conditions where multiple tracks are configured non-parallel to each other, maintain the typical dynamic envelope pattern and fill the gap between the tracks, as necessary.

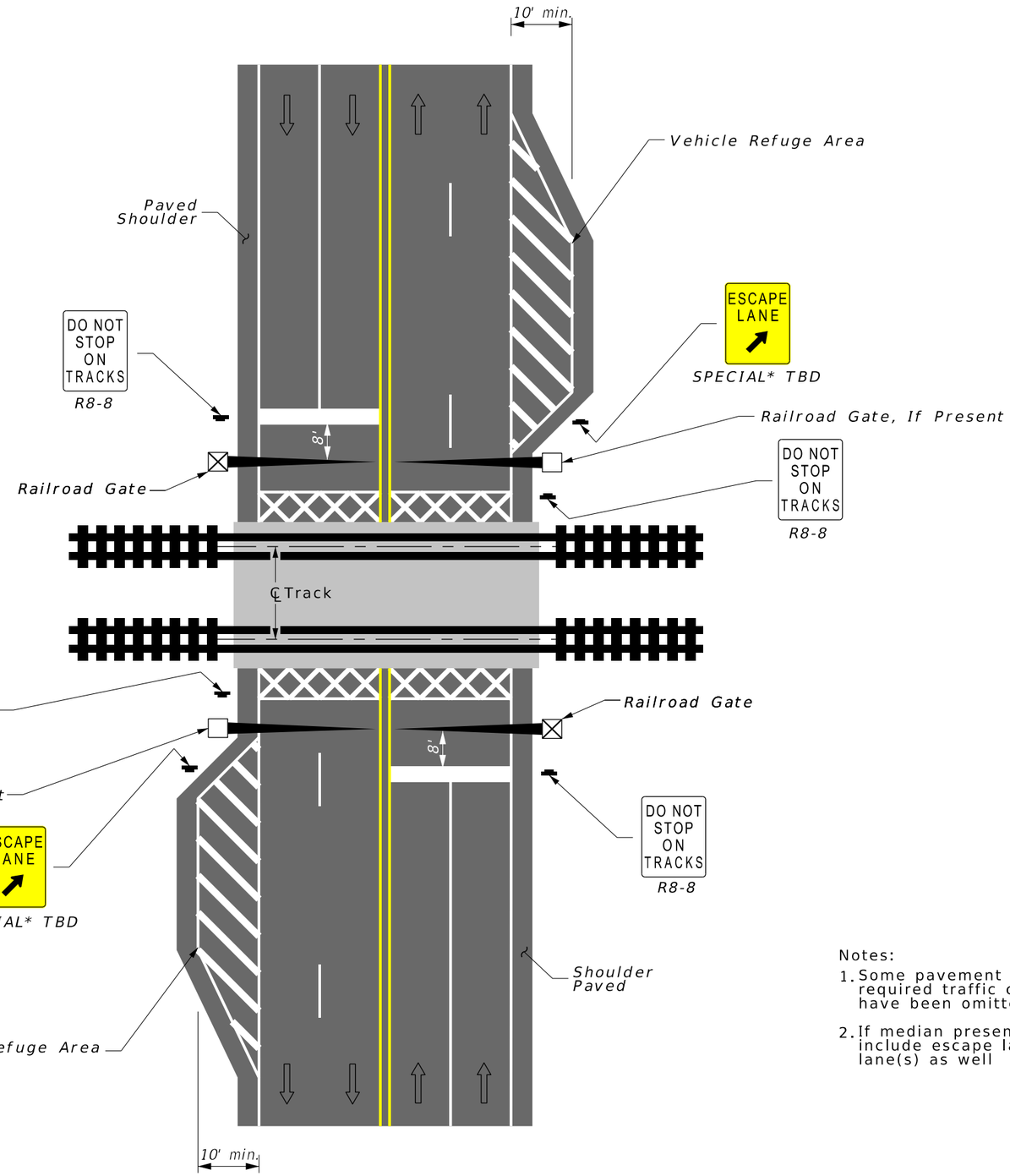
(6) Dynamic envelope markings must not interfere with any pedestrian crosswalk.

(7) Consider extending the dynamic envelope markings beyond any railroad gates to reduce the potential for railroad gates closing on top of stopped vehicles.

Consider the following additional provisions for Active and Passive Grade Crossings:

- For railroad skew angles 30 degrees or greater from perpendicular, roadway approach curves, and intersections directly adjacent to crossings, consider using additional channelization techniques for the roadway alignment. Some channelization techniques include internally illuminated RPMs and tubular markers.
- Consider excluding the downstream dynamic envelope pattern when traffic queuing is not expected.

VEHICLE REFUGE AREA



LEGEND:

- Direction of Travel
- Entrance Gate
- Exit Gate

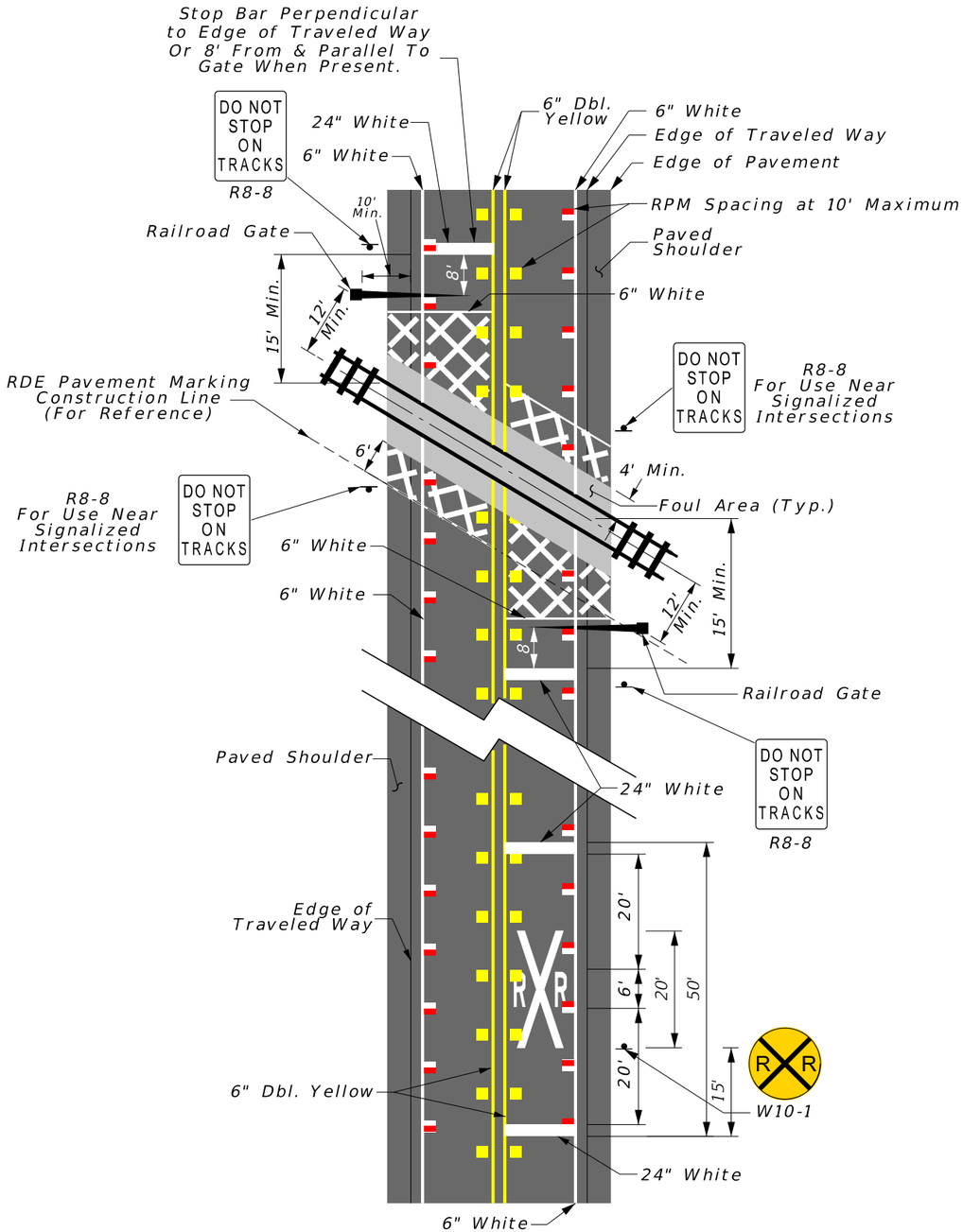
Notes:

1. Some pavement markings and other required traffic control devices have been omitted for clarity
2. If median present of at least 8 ft, include escape lane for inside lane(s) as well

NOT TO SCALE

EXHIBIT 220-1
01/01/2026

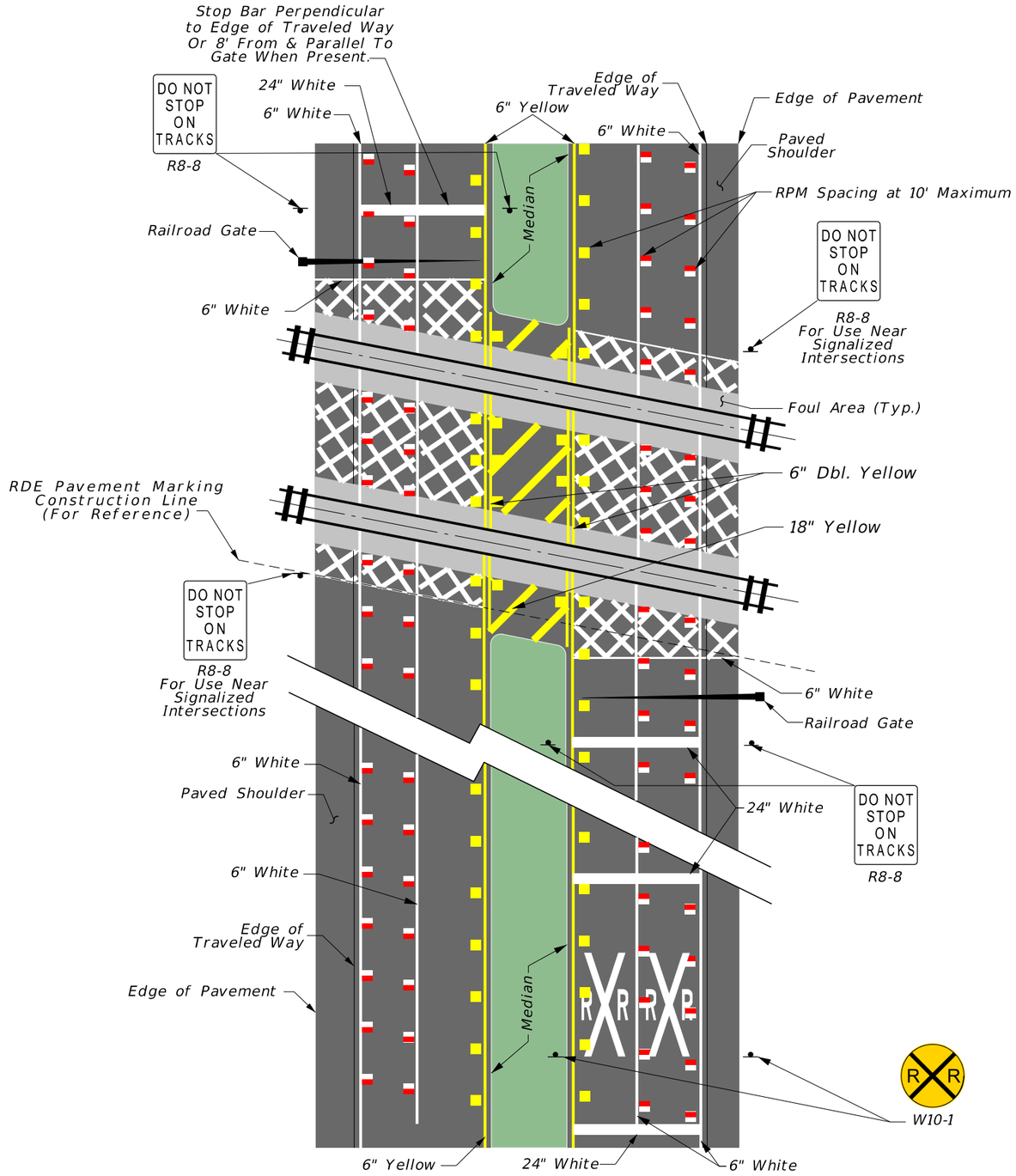
RAILROAD CROSSING AT TWO-LANE ROADWAY



NOT TO SCALE

EXHIBIT 220-2
01/01/2027

RAILROAD CROSSING AT MULTILANE ROADWAY

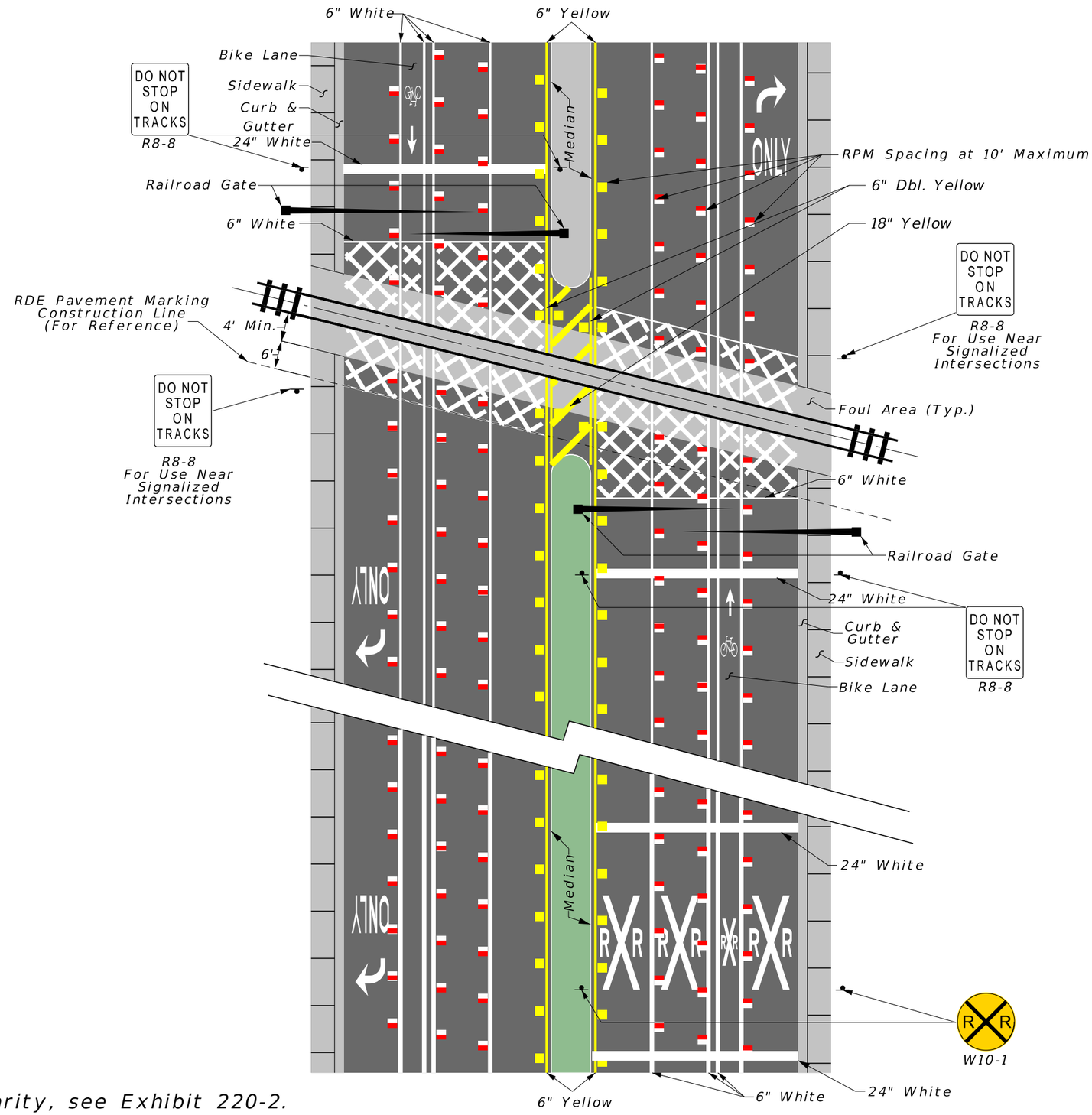


NOT TO SCALE

Dimensions not shown for clarity, see Exhibit 220-2.

EXHIBIT 220-3
01/01/2027

RAILROAD CROSSING AT URBAN MULTILANE ROADWAY WITH TURN LANE

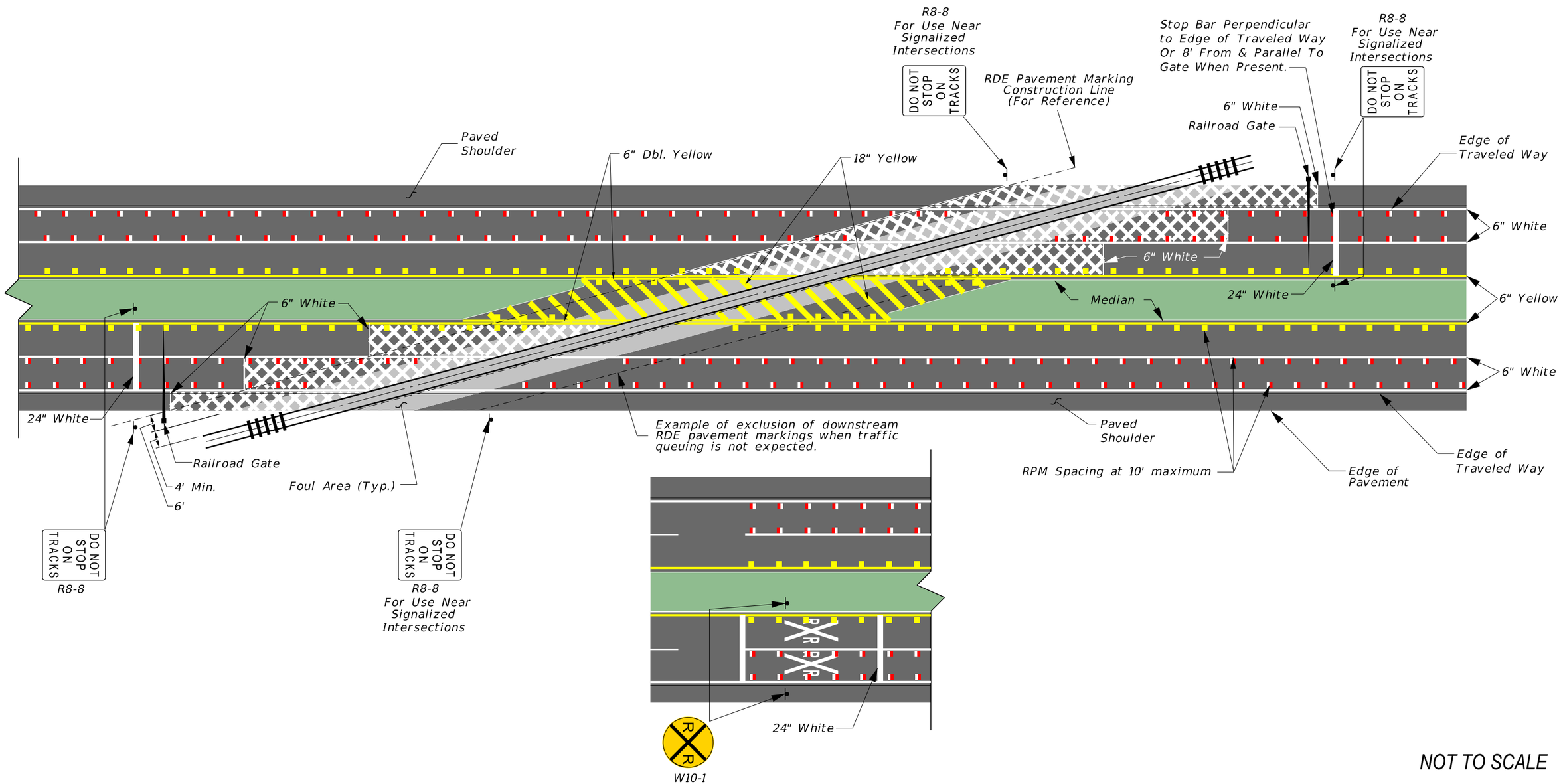


Dimensions not shown for clarity, see Exhibit 220-2.

NOT TO SCALE

EXHIBIT 220-4
01/01/2027

RAILROAD CROSSING WITH SIGNIFICANT SKEW TO THE ROADWAY



Dimensions not shown for clarity, see Exhibit 220-2.

NOT TO SCALE

EXHIBIT 220-5
01/01/2027

220.2.4 Flashing-Light Signals, Automatic Gates, and Traffic Control Signals

See ***Table 220.2.4*** for FDOT Modifications to ***MUTCD 11th Edition, Part 8D (Flashing-Light Signals, Automatic Gates, and Traffic Control Signals)***; and refer to the ***FDM 220 – MUTCD Part 8 Crosswalk*** for these FDOT Modifications incorporated into ***MUTCD Part 8*** as tracked changes, with some additional FDOT requirements.

Table 220.2.4 FDOT Modifications to the *MUTCD, Part 8D*

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8D.01	4	Option	Deleted	[In conflict with the Florida Administrative Code 14-57.013]
8D.01	6	Standard	Deleted	[See FDOT Standard Plans, Index 509-070]
8D.01	7	Standard	Deleted	[See FDOT Standard Plans, Index 509-070]
8D.01	8	Standard	Deleted	[See FDOT Standard Plans, Index 509-070]
8D.01	9	Standard	Deleted	[See FDOT Standard Plans, Index 509-070]
8D.01	10	Standard	Deleted	[See FDOT Standard Plans, Index 711-001]
8D.01	8D-1	Standard	Deleted	[See FDOT Standard Plans, Index 509-070]
8D.02	2	Standard	Standard	Delete "If used,". Change "(shown in Figure 8D-1)" to "(See FDOT Standard Plans, Index 509-070)".
8D.02	3	Guidance	Standard	Change "should" to "must" three times.

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8D.02	5	Option	Standard	Change "At highway-rail grade crossings," to "Include". Change "may be included in the assembly and may be operated in" to "in the assembly and operate in".
8D.02	7	Standard	Standard	Delete "If used,".
8D.02	8	Standard	Standard	Change "If used" to "When used".
8D.02	10	Standard	Standard	Delete "either 8-inch or".
8D.02	11	Guidance	Deleted	[FDOT only allows 12-inch lenses]
8D.02	12	Guidance	Standard	Change "If flashing-light" to "When flashing-light". Change "should" to "must".
8D.02	13	Guidance	Standard	Change "should" to "must".
8D.02	14	Guidance	Standard	Change "should" to "must". Change "8 feet and 9 feet" to "8.5 feet and 9.5 feet".
8D.02	15	Guidance	Standard	Change the first "should" to "must".
8D.02	18	Guidance	Standard	Change "should" to "must".
8D.02	19	Guidance	Standard	Change "should" to "must".
8D.03	16	Option	Option	Change "Channelizing devices" to "Tubular Markers". Add sentence "Where a raised median is used for this purpose, it must be a Type IV concrete traffic separator or a raised median bounded by Type F curb and gutter."

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8D.03	17	Guidance	Guidance	Change "should be at least 60 feet in length." to "and/or tubular markers should extend at least 100 feet in length from the gate arm. If there is an intersection within 100 feet of the gate, the median islands and/or tubular markers should extend at least 60 feet from the gate arm."
8D.04	5	Guidance	Standard	Change "should" to "must".
8D.05	1	Option	Standard	Change "a Diagnostic Team determines that less restrictive measures, such as automatic gates and median islands, are not effective." to "the Diagnostic Team determines an Exit Gate system is needed. At all higher-speed grade crossings, exit gate systems and Tubular markers and/or raised median islands in accordance with 8D.03, paragraph 17 must be installed to prevent vehicles from driving around the entrance gates."
8D.05	10	Standard	Standard	Change "median islands (see Figure 8D-2) shall" to "median islands (see Figure 8D-2) and/or tubular markers shall".
8D.05	13	Guidance	Deleted	[Timed Exit Gate Operating Mode is prohibited by FDOT]
8D.05	14	Guidance	Deleted	[Timed Exit Gate Operating Mode is prohibited by FDOT]

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8D.05	15	Guidance	Standard	Change "If the Dynamic Exit Gate Operation Mode is used, highway vehicle..." to "Use Dynamic Exit Gate Operating Mode with vehicle....". Change "motor vehicles" to "vehicles". [All vehicles must be detected, not only motor vehicles.] Change “should be installed to control” to “to control”. Change "should" to "must".
8D.05	16	Guidance	Standard	Replace paragraph with "The Exit Gate Clearance Time (see definition in MUTCD, Section 1C.02) must be considered when determining additional time requirements for the Minimum Warning Time."
8D.05	8D-2	Standard	Standard	[The figure applies to both median islands (as shown) and/or tubular markers]
8D.05	18	Guidance	Standard	Change "should be used unless the Diagnostic Team determines otherwise." to "must be used."
8D.05	19	Guidance	Standard	Change "should be considered for" to "must be used for". Change "circuitry should be installed" to "circuitry must be installed.".
8D.05	20	Guidance	Standard	Change "should" to "must".

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8D.05	22	Option	Option	Change "include median islands between" to "include median islands and/or tubular markers between".
8D.05	23	Guidance	Standard	Replace paragraph with "Where sufficient space is available, median islands and/or tubular markers must extend at least 100 feet from the gate arm. If there is an intersection within 100 feet of the gate, the median and/or tubular markers must extend at least 60 feet from the gate arm."
8D.06	1	Option	Standard	Change "may" to "must".
8D.06	3	Guidance	Standard	Change "should" to "must" three times.
8D.07	6	Guidance	Standard	Change "should" to "must" twice.
8D.09	3	Guidance	Standard	Change "should" to "must". Delete "unless otherwise determined by the Diagnostic Team."
8D.09	4	Guidance	Standard	Change "should" to "must" twice.
8D.09	5	Guidance	Standard	Change "highway agency or authority with jurisdiction" to "District Traffic Operations Engineer".
8D.09	6	Guidance	Standard	Change "should" to "must".
8D.09	7	Guidance	Standard	Change "should" to "must".
8D.09	8	Support	Support	Change "highway agency or authority with jurisdiction" to

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
				"District Traffic Operations Engineer".
8D.09	11	Standard	Standard	Add sentence "The preemption for the traffic signals must be provided according to the guidance of FDOT Traffic Engineering Manual (TEM) Section 3.8."
8D.09	14	Guidance	Standard	Change the first "should" to "must".
8D.09	24	Guidance	Standard	Change "should" to "must" twice.
8D.09	25	Guidance	Standard	Change "should" to "must".
8D.09	26	Guidance	Standard	Change "should" to "must" three times.
8D.09	29	Guidance	Standard	Change "should" to "must".
8D.09	30	Guidance	Standard	Change "should" to "must".
8D.09	31	Guidance	Standard	Change "should" to "must" twice.
8D.09	37	Guidance	Standard	Change "should" to "must".
8D.09	38	Guidance	Standard	Change "should" to "must".
8D.09	39	Guidance	Standard	Change "should" to "must" three times.
8D.10	1	Guidance	Standard	Change "should" to "must" four times. Change "100 feet" to "150 feet".
8D.10	2	Option	Option	Change "100 feet" to "150 feet".
8D.10	3	Support	Standard	Change "Including" to "Include". Change "sign informs" to "sign to inform".
8D.10	4	Support	Standard	Change "Rail operations can include" to "Include".

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8D.10	5	Guidance	Standard	Change "should" to "must".
8D.11	1	Guidance	Standard	Change "should" to "must".
8D.11	2	Guidance	Standard	Change "should" to "must be considered".
8D.11	4	Support	Standard	Change "could be considered" to "must be considered". Change "instead of or in addition to" to "in addition to".
8D.11	7	Guidance	Standard	Change "should" to "must".
8D.11	10	Guidance	Standard	Change "should" to "must".
8D.11	12	Guidance	Standard	Change "should" to "must".
8D.11	18	Guidance	Standard	Change "should" to "must".
8D.11	20	Option	Standard	Change "may" to "must".
8D.12	4	Support	Standard	Change "A non-actuated queue cutter signal is generally used where" to "Use a non-actuated queue cutter signal where". Change "An actuated queue cutter signal is generally used where" to "Use an actuated queue cutter signal where". Change "Section 8D.11 contains information for" to "See Section 8D.11 for requirements at".
8D.12	9	Guidance	Standard	Change "should" to "must".
8D.12	10	Option	Standard	Change "may" to "must".
8D.12	11	Guidance	Standard	Change "should" to "must".
8D.12	12	Guidance	Standard	Change "should" to "must".

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8D.12	13	Guidance	Standard	Change "should" to "must". Change "should be considered" to "must be used".
8D.12	14	Guidance	Standard	Change "should" to "must".
8D.12	23	Guidance	Standard	Change "should" to "must".
8D.13	7	Guidance	Standard	Change "should" to "must".
8D.13	8	Guidance	Standard	Change "should" to "must".
8D.14	4	Guidance	Standard	Change "should" to "must".
8D.14	5	Guidance	Standard	Change "should" to "must".
8D.14	12	Guidance	Standard	Change "should" to "must".
8D.15	1	Option	Standard	Change "may" to "must".
8D.15	2	Option	Standard	Change "may" to "must".
8D.15	5	Guidance	Standard	Delete "If a signal face used to control LRT movements cannot be positioned where the indications are not visible to road users," Change "should" to "must".
8D.15	6	Standard	Standard	Delete "If special LRT signal indications such as those shown in Figure 8D-3 are used,"
8D.15	7	Option	Option	Delete "If used,".

220.2.4.1 Preemption

Preemption controls the traffic signal of an intersection in close proximity of a highway-railroad grade crossing. The active warning system of the grade crossing must be interconnected with the traffic signal preempted to operate in a special control mode when trains are approaching.

Provide traffic signal preemption and perform an engineering study in accordance with ***FAC 14-57.013***. Include, as a minimum, the following as part of the engineering study:

- Evaluation of the potential of traffic queues from nearby signalized intersections to encroach the grade crossing.

- Evaluation of the potential of traffic queues at the grade crossing during the approach and passage of trains to interfere with signalized intersection operations.

Simultaneous preemption is the most common form of preemption and occurs when the traffic signal controller is preempted at the same time the railroad's active warning devices begin to flash. With high vehicle volumes, the track clearance time of simultaneous preemption may be too short to provide sufficient clearance time. As an alternative to the long activation times of the active warning devices, advance preemption can be utilized.

Advanced preemption is when the traffic signal controller unit receives a notification from the railroad warning equipment before the railroad warning system is activated. Advanced preemption provides additional time in addition to the normal traffic signal preemption. Advanced preemption requires longer railroad track circuitry, requiring the railroad to accept higher track maintenance costs beyond the maintenance requirements of simultaneous preemption. The benefits of advanced preemption are as follows:

- Additional crossing clearance time is provided.
- Provides adequate queue clearance time (the queue clearance time is determined by finding a cut-off point when the headway time between vehicles exceeds a threshold value, selected as a design time (in seconds) which is based on the actual observation of when the queue clears).

To implement advance preemption, trains must be detected prior to activating the crossing activation circuit. One common method is that instead of installing train detectors, existing preemptions at upstream crossings along a railway corridor can be used to trigger advance preemption at the target intersection(s). This does not require the installation of new devices or the application of new permissions from the railroad. Once a detection system identifies the train, a prediction algorithm will predict the train's arrival time enabling earlier initiation of the preemption phases, providing additional green time to clear the crossing.

For higher-speed grade crossings, preemption must be used where traffic queues have the potential for extending across the tracks regardless of the distance from a signalized intersection. If the existing downstream intersection is stop-controlled, the stop control condition must be eliminated downstream of the intersection, or the intersection must be upgraded to a signalized intersection along with the installation of preemption.

For higher-speed grade crossings, preemption must be used where highway traffic that is backed up from a nearby downstream railroad crossing could interfere with signalized highway intersections.

Other conditions warranting preemption for higher-speed grade crossings include, but are not limited to, track within roadway medians, steep grades, school bus routes, and the presence of trucks carrying hazardous materials.

Consult and coordinate with the appropriate railroad agency, the District Rail Office, and the DTOE before implementation.

220.2.4.2 Pre-Signals

Pre-Signals should be provided when a crossing is located within 250 feet of a signalized intersection and one or more of the following criteria are met:

(1) Downstream vehicle queues could back up onto the crossing.

(2) An engineering study indicates a history of crashes attributable to “Stopped on crossing” or “Did not Stop”.

(3) The crossing is in a Quiet Zone.

(4) Train frequency is greater than 30 trains per day.

220.2.4.3 Queue Cutter Signals

Queue cutter signals should be provided when a crossing is located with a clear storage distance (CSD) of more than 450 feet of a controlled intersection approach and one or more of the following criteria are met:

(1) The estimated maximum 15-minute arrival rate exceeds storage to accommodate the worst-case queue based on HCM methodology.

(2) An engineering study indicates a history of crashes attributable to “Stopped on crossing” or “Did not Stop”.

(3) The crossing is in a Quiet Zone.

(4) Train frequency is greater than 30 trains per day.

220.2.4.4 Constant Warning Time

Provide constant warning time detection for all higher-speed grade crossings.

Commentary: Constant Warning Time systems have the capability to activate warning equipment (crossing gates, lights, bells, etc.) with a uniform amount of warning time prior to the train's arrival, regardless of the train's speed and distance from the crossing. The technology senses a train approaching, measures its speed and distance, then determines when to activate the warning systems in place at the desired amount of time to minimize highway traffic delays. Constant Warning Time Track Circuits can also eliminate the activation of warning devices for stopped trains or switching operations that do not require the train to travel over the crossing. Traffic control systems inform road users of the approach or presence of rail traffic at grade crossings.

220.2.4.5 Barrier Gates

A barrier gate must be used at crossings with trains operating over 110 mph. Barrier gates must meet MASH attenuator standards.

Barrier gates may be equipped with monitoring devices to manage nighttime closures in partial Quiet Zones.

Commentary: A barrier gate is a dynamic, automatic gate specifically designed for a temporary closure of roadways at highway-rail crossings particularly where trains operate in excess of 110 mph. This safety device comprises a housing unit with electromechanical components that control the movement of the gate arm. The arm descends to block vehicle passage and is securely locked in place by a locking assembly anchored to a concrete foundation.

220.2.4.6 Advanced Obstacle Detection

For higher-speed grade crossings, use Advanced Obstacle Detection.

Advanced Obstacle Detection systems include the latest closed-circuit television camera (CCTV) surveillance and image processing technology to visually inspect gate conditions, identity objects in conflict with a train's dynamic envelope, and monitor the movements of the object in real-time. Except for higher-speed grade crossings, Advanced Obstacle Detection is suggested for use where there is a history of crashes and an AADT is greater than 5,000.

220.2.5 Pathway and Sidewalk Grade Crossings

See ***Table 220.2.5*** for FDOT Modifications to ***MUTCD 11th Edition, Part 8E (Pathway and Sidewalk Grade Crossings)***; and refer to the ***FDM 220 – MUTCD Part 8 Crosswalk*** for these FDOT Modifications incorporated into ***MUTCD Part 8*** as tracked changes, with some additional FDOT requirements.

Table 220.2.5 FDOT Modifications to the *MUTCD, Part 8E*

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8E.02	1	Guidance	Standard	Change "should" to "must".
8E.02	2	Guidance	Standard	Change "should" to "must".
8E.02	3	Guidance	Standard	Change "should" to "must".
8E.02	5	Support	Standard	[The first sentence of this paragraph remains Support] For the second sentence, change "Providing" to "For new sidewalk grade crossings in C2T, C3, C4, C5, and C6 Context Classifications, provide..." as a Standard.
8E.02	6	Support	Standard	Change "placing" to "place". Change "traffic is desirable" to "traffic".
8E.03	3	Guidance	Standard	Change "No portion" to "Ensure no portion". Change "support should protrude" to "support hardware protrudes". Change “should” to “must”.
8E.03	4	Guidance	Standard	Change "should" to "must".
8E.03	5	Guidance	Standard	Change "should" to "must".
8E.03	6	Guidance	Standard	Change "should" to "must".
8E.03	8	Guidance	Standard	Change "should" to "must".
8E.03	9	Guidance	Standard	Change "should" to "must".
8E.03	10	Option	Standard	Change "may be used at a skewed pathway or sidewalk grade crossing" to " must be used at a pathway or sidewalk grade crossing skewed 30 degrees or greater from

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
				perpendicular ". Add sentence "The Diagnostic Team must consider redesign of pathways or sidewalks skewed 30 degrees or greater from perpendicular."
8E.03	11	Option	Standard	Change "may" to "must".
8E.03	12	Guidance	Guidance	Change "If a LOOK (R15-8) sign is used at a pathway or sidewalk grade crossing, it should be mounted" to "The LOOK (R15-8) sign should be mounted".
8E.04	8	Guidance	Standard	Change "should" to "must".
8E.04	9	Guidance	Standard	Change "should" to "must" three times. Change "at least 2 feet upstream" to "at least 4 feet upstream". Change "at least 12 feet from the nearest rail" to "between 6 and 15 feet from the centerline of the nearest rail". [See Standard Plans, Index 522-002, Sheet 7 of 7]
8E.04	10	Guidance	Standard	Change "should" to "must".
8E.04	12	Guidance	Standard	Change "should be located at least 2 feet upstream" to "must be located at least 4 feet upstream". Change "at least 6 feet from the nearest rail, and in accordance with the requirements of the railroad company and/or transit agency, and regulatory agency with statutory authority (if applicable)." to "between 6 and 15 feet from the nearest rail."

MUTCD Section	Paragraph or Figure	MUTCD Status	FDOT Status	FDOT Requirement [Additional Information]
8E.06	7	Guidance	Standard	Change "should" to "must".
8E.10	1	Guidance	Standard	Change "should" to "must".

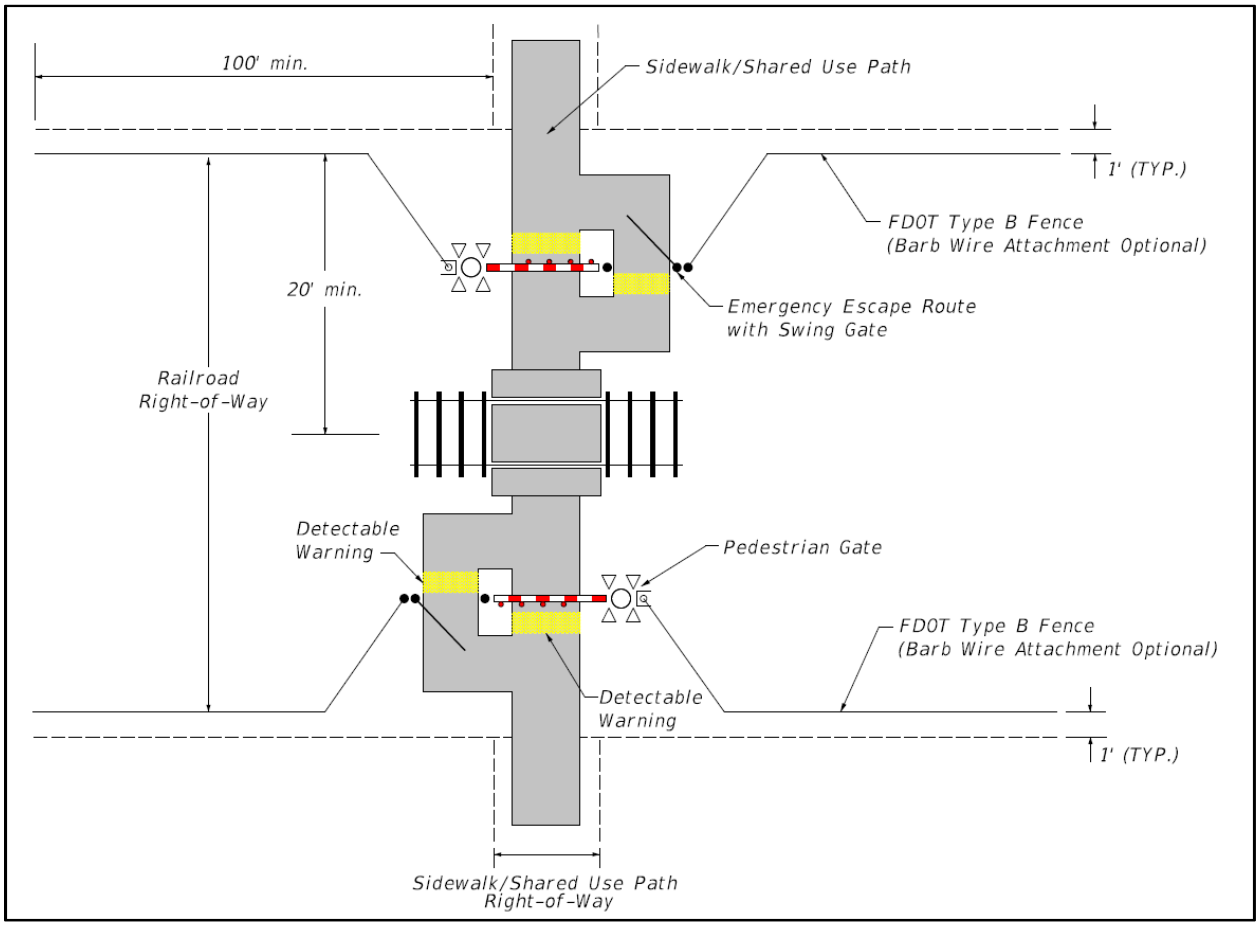
Extend proposed or existing pathways, sidewalks, bike lanes, or shared use paths through the rail crossing. See ***FDM 222.2.4*** for additional information.

When a new bicycle or pedestrian crossing is added to an existing roadway, it is considered a new crossing if it is separated from the roadway. It is considered to be separated when the nearest edge of the sidewalk or pathway grade crossings is located more than 25 feet from the center of the nearest traffic control warning device at the highway-rail grade crossing. See ***FDM 220.2.1.4*** for information on coordinating new crossings.

220.2.5.1 Higher-Speed Rail Corridor Pathway Crossings

Pathway crossings for higher-speed rail corridors must be grade separated when practicable. When a grade separated pathway crossing is not practicable, provide a sealed corridor with restrictive and channelized grade crossing access in accordance with ***Figure 220.2.1***.

Figure 220.2.1 Illustration of Pathway Grade Crossing at Fully-Gated Corridors



220.2.5.2 Anti-Trespass Panels

Anti-trespass panels restrict pedestrian access to the Railroad R/W from unintended entry points. They are comprised of materials and surface features which are difficult to traverse. Panels can have either a repetitive skewed profile or a raised pyramid design.

Anti-trespass panels provide visual and tactile deterrence and are more effective when used in combination with other physical and behavioral measures to support improved compliance. For example, when combined with channelizing devices or natural channelizers such as bridges and tunnels to prevent pedestrian access around the panels.

The Diagnostic Team must consider the use of anti-trespass panels at or near commuter stations and at non-motorist facilities, such as bicycle/walking trails, pedestrian only

facilities, and pedestrian malls where there is a history of crashes or instances of trespassing. Panels may be installed both along the outside of and between the tracks.

Determine the appropriate width of each installation based on the potential for individuals to attempt to jump over or otherwise bypass the panels.

Reflective paint may be used to increase the visibility of the panels.

Develop a maintenance strategy to remove dirt, fallen debris, and snow from the panels.

Minimize restricted access for railroad maintenance workers and first responders.

220.2.6 Innovative Technology Countermeasures

The Diagnostic Team must consider the following Innovative Technology Countermeasures. These countermeasures may be used where a Diagnostic Team determines they are appropriate.

220.2.6.1 In-Roadway Warning Lights

In-Roadway Warning Lights (IRWL) enhance compliance for stopping behavior at railroad crossings. When used in railroad applications, obtain an approved Request to Experiment from FHWA. Suggested for use where there is a history of crashes.

If used, install IRWLs upstream and downstream of grade crossings to warn drivers to not stop on the track or within the railroad dynamic envelope.

220.2.6.2 Red Light Running Cameras

Red light running camera systems identify violators traversing through the crossing after the gate has been activated.

Red light running cameras may be used by the Department where there have been reoccurring violations or a history of crashes. The Department may use red light running cameras to capture such behavior and share with the Diagnostic Team for their consideration of possible solutions.

220.2.6.3 Variable Message Warning System

In addition to Advanced Obstacle Detection in ***FDM 220.2.4.6***, railroad crossings may also include LED variable message signs displaying important information about approaching trains and potential delays. This can provide motorists and pedestrians the opportunity to make better decisions about either rerouting or remaining on the existing route. Suggested for use where AADT is greater than 5,000.

220.2.6.4 Warning Systems Integrated with Connected Vehicle (CV) Technologies

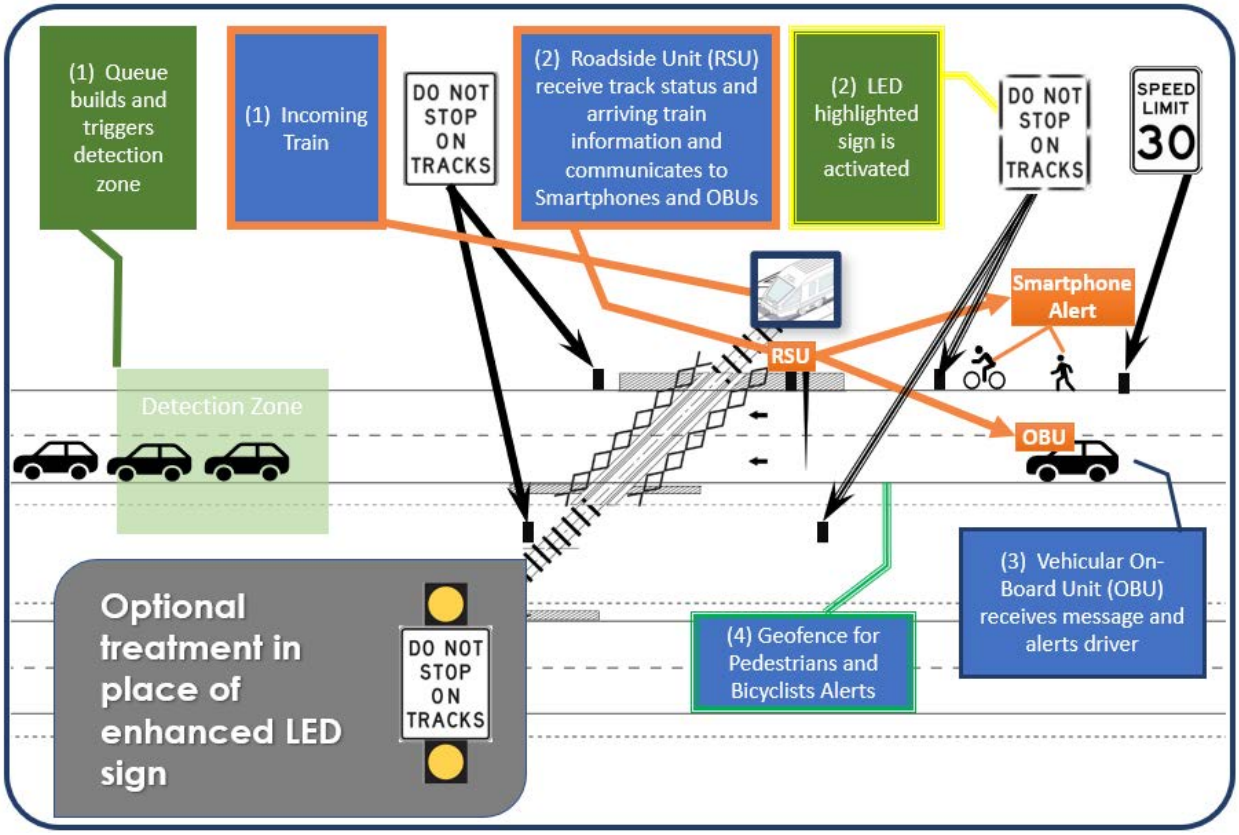
Warning systems integrated with connected vehicle technologies may be used to alert drivers not to stop on the railroad tracks when a queue is building. This will provide more awareness to drivers of the meaning and presence of the dynamic envelope markings. The expected response is that drivers will queue their vehicles on either side of the dynamic envelope. In addition, the purpose of the operational concepts is to alert pedestrians, cyclists, and motorists of oncoming trains and lowered railroad crossing gates via CV technology using roadside units (RSUs), on-board units (OBUs), and smartphones. Suggested for use where AADT is greater than 10,000.

For roadways with posted speeds of 35 miles per hour (mph) or less and crossing a single railroad track, a detection zone may be installed downstream of the railroad crossing. When a vehicle queues within the detection zone, a “DO NOT STOP ON TRACKS” (R8-8) sign(s) enhanced with a white LED border is activated. The sign(s) will be placed immediately downstream of the railroad right-of-way boundary. When used, the enhanced sign(s) will replace existing static R8-8 signs on the downstream side. As traffic queues over the detection zone, the system will monitor the downstream reference point and activate the enhanced sign if the reference point is occupied by a vehicle for five seconds or more.

Optional Roadside Units (RSUs) (wayside equipment) installed at railroad crossings can display track status and arriving train information. The optional RSUs can broadcast messages to on-board units in equipped vehicles to drivers of an oncoming train and deliver a railroad crossing warning. The RSUs may also notify pedestrians and cyclists of an oncoming train through a railroad crossing warning delivered to a smartphone. The RSU messages would be sent to the transportation management center. The Department can post railroad alert messages to FL 511. If RSUs are not present, a geofence may be used in combination with Wi-Fi, Bluetooth, or another appropriate communication method to alert pedestrians and bicyclists of the oncoming train. **Figure 220.2.2** shows the low-speed and single-track operational concept with vehicle detection and CV technology.

In addition to what is shown in **Figure 220.2.2**, turn restriction blank-out signs can be installed on side streets in close proximity to the railroad crossing to prevent traffic turning onto the roadway from being caught on the railroad tracks. The turn restriction blank-outs would activate at the same time as the mainline R8-8 enhanced sign activation.

Figure 220.2.2 Low-Speed Roadway and Single-Track Railroad Equipped with Warning System and Connected Vehicle (CV) Technologies

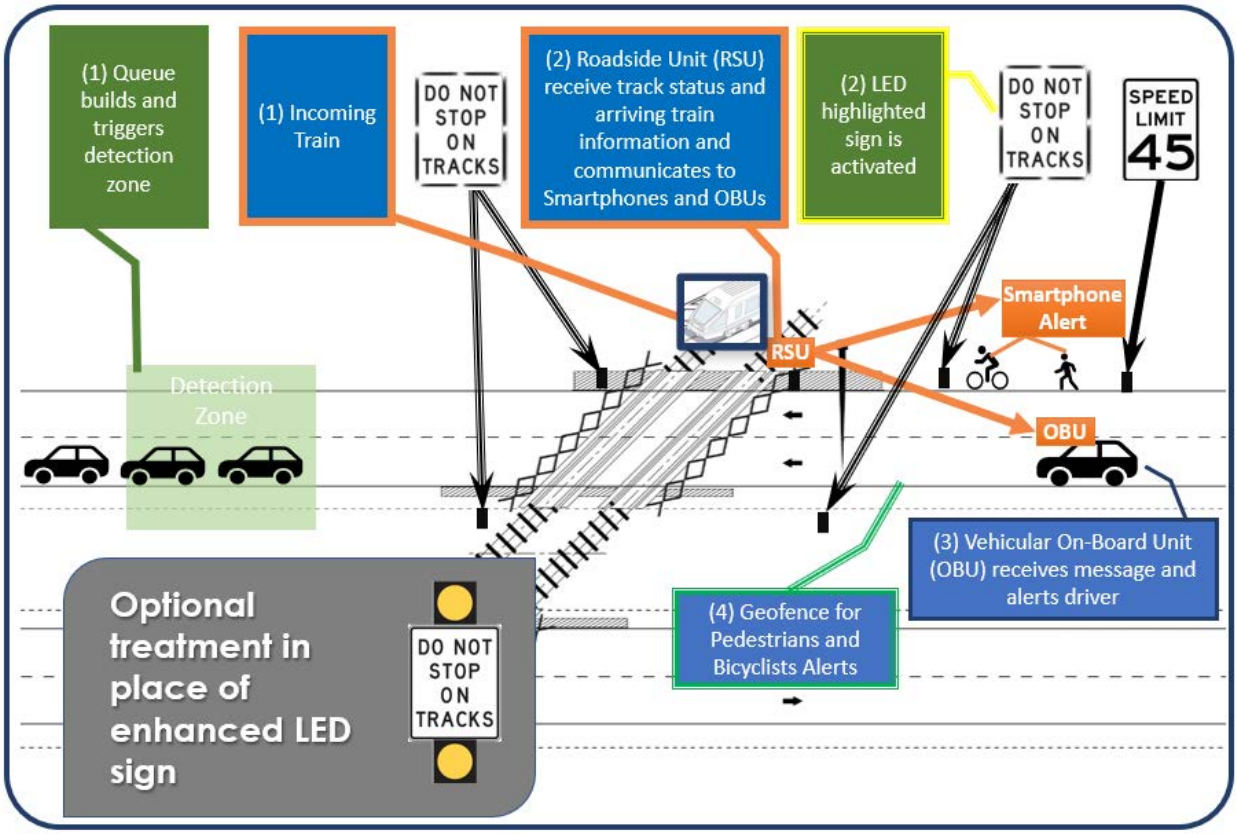


For roadways with posted speeds greater than 35 miles per hour (mph) and crossing a single railroad track, or for roadways with any posted speed and crossing multiple railroad tracks, a detection zone may be installed downstream of the railroad crossing. When a vehicle queues within the detection zone, “DO NOT STOP ON TRACKS” (R8-8) signs enhanced with a white LED border are activated. A minimum of four (4) enhanced signs are used, placed upstream and downstream of the crossing. The enhanced signs will replace existing static R8-8 signs. If a median is present, it is recommended that R8-8 enhanced signs are placed on the median, especially if multiple lanes are crossing the railroad in each direction. As traffic queues over the detection zone, the system will monitor the downstream reference point and activate the enhanced sign if it is occupied by a vehicle for five seconds.

Optional RSUs (wayside equipment) installed at railroad crossings can display track status and arriving train information. The optional RSUs can broadcast messages to OBUs in equipped vehicles to drivers of an oncoming train and deliver a railroad crossing warning. The RSUs may also notify pedestrians and cyclists through a smartphone of an oncoming train and deliver a railroad crossing warning. The RSU messages would be sent to the transportation management center. The Department can post railroad alert messages to FL 511. If RSUs are not present, a geofence may be used in combination with Wi-Fi, Bluetooth, or another appropriate communication method to alert pedestrians and bicyclists of the oncoming train. ***Figure 220.2.3*** shows the higher-speed and multi-track operational concept with vehicle detection and CV technology.

In addition to what is shown in ***Figures 220.2.2*** and ***220.2.3***, consider installing turn restriction blank-out signs on side streets which are in close proximity to the railroad crossing in order to prevent traffic turning onto the roadway from being caught on the railroad tracks. The turn restriction blank-outs would activate at the same time as the mainline R8-8 enhanced sign activation.

Figure 220.2.3 High-Speed Roadway or Multi-Track Railroad Equipped with Warning System and Connected Vehicle (CV) Technologies



220.3 Grade Separated Highway-Railroad Crossing

For a railroad crossing over a roadway, the bridge must be designed to carry railway loadings in conformance with the ***American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering***. See ***FDM 260.6*** for required vertical clearances between the facilities.

Coordinate the following with the governing railroad company:

- Clearances, geometrics, and utilities
- Provisions for future tracks
- Maintenance road requirements for off-track equipment
- Need for and location of crash walls

The railroad company's review and approval are based on the completed Bridge Development Report (BDR)/30% Structures Plans.

Prepare the Structures Plans in accordance with the criteria obtained from the railroad company, the ***Structures Manual***, the ***Standard Plans***, and this manual.

Figure 220.3.1 illustrates the dimensions that are to be obtained from or approved by the railroad company before preparing the BDR/30% Structures Plans.

220.3.1 Bridge Width

For a railroad over a roadway crossing, the railroad bridge typical section is based on project requirements. For a roadway over a railroad crossing, see ***FDM 210*** for information on highway typical sections.

220.3.2 Lateral Offset to Face of Structure

For a roadway over a railroad crossing, measure lateral offset in accordance with ***Figure 220.3.1*** and ***Table 220.3.1***. The railroad company may accept a waiver from standard lateral offset requirements for the widening or replacement of existing bridges.

Lateral offset is measured from the centerline of the outside track to the face of pier cap, bent cap, or any other adjacent structure. Minimum lateral offsets are shown in ***Table 220.3.1***.

Figure 220.3.1 Track Section

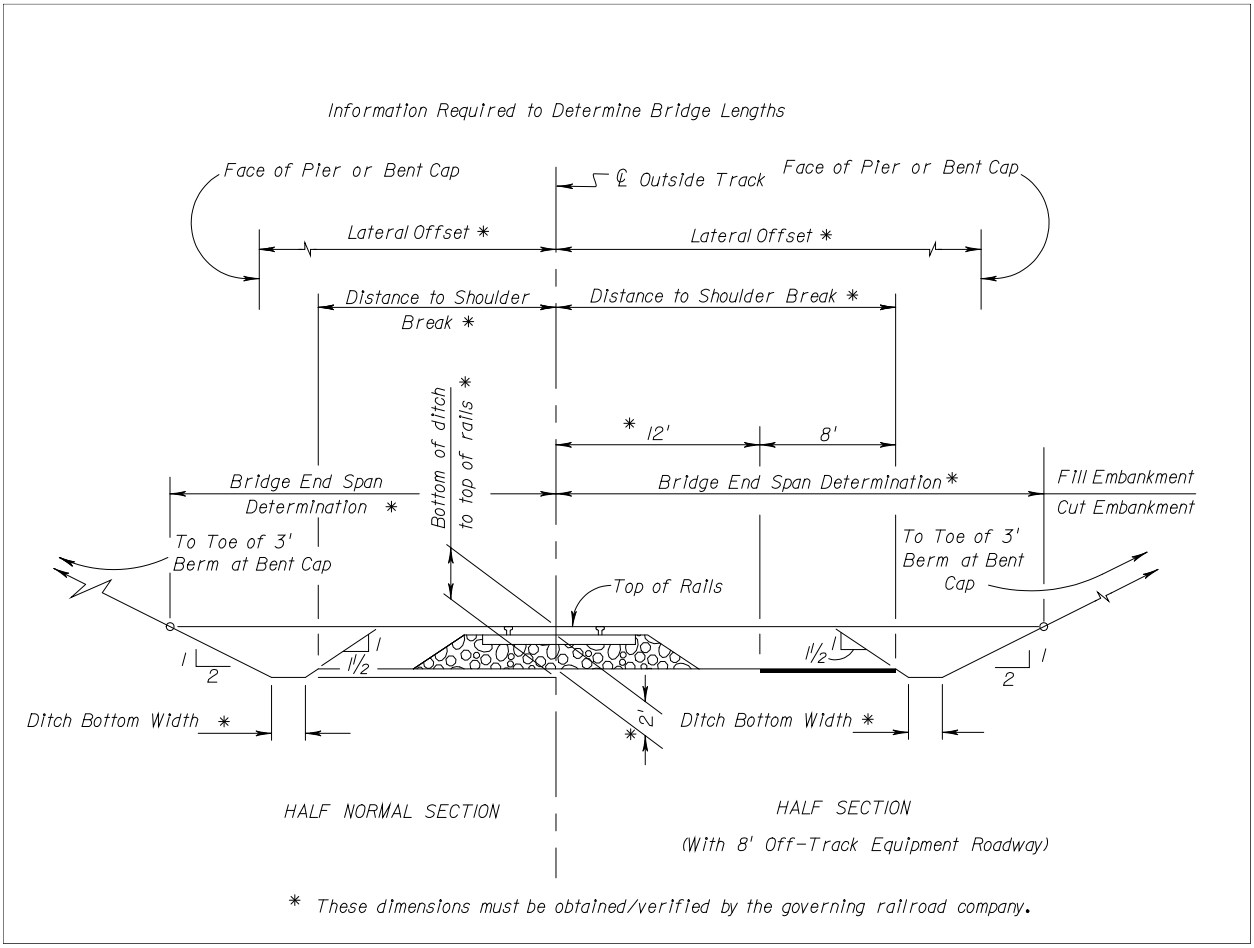


Table 220.3.1 Lateral Offsets for Railroads

Minimum Clearance Requirements	Normal Section	With 8 feet Required Clearance for Off-Track Equipment	Temporary Falsework Opening
With Crash Walls*	18 feet	22 feet	10 feet
Without Crash Walls	25 feet	25 feet	N/A

* See the ***Structures Design Guidelines, Section 2.6*** for crash wall requirements.

Provide an additional 8 feet of clearance for off-track equipment only when requested by the railroad company.

220.3.2.1 Adjustments for Track Geometry

Increase the minimum lateral offset by a rate of 1.5 inches for each degree of curvature when the track is on a curve.

Increase the minimum lateral offset on the inside of the curve by 3.5 inches horizontally per inch of superelevation when the track is superelevated.

Meet lateral offset requirements found in the ***AREMA Manual for Railway Engineering*** for extremely short radius curves.

220.3.2.2 Adjustments for Physical Obstructions

Columns or piles should be kept out of the ditch to prevent obstruction of drainage. Provide adequate lateral offset to avoid the need for crash walls unless extenuating circumstances dictate otherwise.

Figure 220.3.1 shows horizontal dimensions from the centerline of the track to the points of intersection of a horizontal plane at the rail elevation with the embankment slope. This criteria may be used to establish the preliminary bridge length which normally is also the length of bridge eligible for FHWA participation; however, surrounding topography, hydraulic conditions, and economic or structural considerations may warrant a decrease or an increase of these dimensions.

220.3.2.3 Required Foundation Clearances

Place edges of footings no closer than 11 feet from the centerline of the track to provide adequate room for sheeting.

220.3.3 Crash Walls

See the ***Structures Design Guidelines (SDG)*** for crash wall requirements.

220.3.4 Special Considerations

Projects may include any of the following special considerations:

(1) Shoring and cribbing requirements during construction should be accounted for in the preparation of the preliminary plans to assure compliance with required clearances. Anything within the railroad R/W (e.g., cofferdams, footings, excavation) requires coordination with the District Rail Coordinator for approval by the railroad company.

(2) Overpasses for electrified railroads may require protection screens.

(3) Substructure supports may be located between adjacent tracks or an outside track and the off-track equipment road.

(4) Convey drainage from the bridge above the railroad away from the railroad R/W. Open scuppers are to be no closer than 25 feet to the centerline of the nearest track.

(5) The District Rail Coordinator must be contacted to see if there are any other requirements when constructing in or near railroad R/W.

(6) Additional consideration should be given to any utilities that may be located within the railroad R/W.

220.3.5 Widening of Existing Bridge over Railroad

The requirements for widening an existing roadway or pedestrian bridge over a railroad are as follows:

(1) If existing horizontal or vertical clearances are less than those required for a new structure, the design of the new portion of the structure is not to encroach into the existing clearances.

(2) Minimum vertical clearance should take into account the track grade and the cross slope of the bridge superstructure. It is desirable to widen on the ascending side of the bridge cross slope.

(3) Minimum lateral offset should take into account future changes to track geometry, physical obstructions or foundation clearances.

(4) Temporary construction vertical clearances less than 22 feet and lateral offsets less than 10 feet must be approved by the railroad company. It may not be possible to reduce already restricted vertical clearances on high volume rail lines.

(5) Meet drainage design requirements for new bridges when widened approach fills are necessary.

(6) Evaluate the need for crash wall protection in accordance with the ***SDG***.

(7) If the existing railroad is in a cut section, special consideration should be given to the length, depth, and type of material of the existing cut section.

(8) In cases where demolition of the existing structure is required for attachment of the new structure over the railroad's tracks, a method of debris collection should be provided so as not to encroach within the railroad R/W.

Provide a cross section in the BDR/30% Structures Plans at a right angle to the centerline of the track where the centerline of the bridge intersects the centerline of the track. Where the substructure is not parallel to the track, or the track is curved, provide a section perpendicular to the centerline of the track at each substructure end.

Figure 220.3.2 Section Through Tracks

