

Rectangular Rapid Flashing Beacons (RRFBs)

APPLICATION GUIDE



Introduction

This guide illustrates the current industry recommendations for selecting and installing an RRFB crosswalk using information from the Federal Highway Administration (FHWA). RRFBs are included in the [11th Edition MUTCD](#) published in December 2023.

This guide will help explain (click to jump to the section):

- [Best practices for RRFBs: What road characteristics are conducive to RRFBs](#)
- [MUTCD Standards, Guidance, and Options for RRFB installation](#)
- [Installation examples and equipment options](#)

The content provided by Carmanah Technologies in this guide is for general informational purposes only. Please consult your local or state transportation department for recommendations and guidelines on RRFB crosswalk installations.

Proper engineering judgment should always be exercised in the selection, application, and installation of an RRFB.



Read this first

Before selecting a crosswalk treatment, municipalities should first seek to understand the unique safety issues facing each uncontrolled marked crossing. The Federal Highway Administration's (FHWA) [*Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*](#) is a good place to start.

1. Collect data and engage the public

- Gather pedestrian crash and safety data
- Review and evaluate local pedestrian safety plans and policies
- Review the selection of products on the agency's approved product list (APL)

2. Inventory conditions and prioritize locations

- Locate high-risk / high-crash areas
- Note the various roadway characteristics (average daily traffic, posted speed limit, number of lanes, etc.)
- Observe pedestrian crossing and overall traffic behavior

3. Analyze crash types and safety issues

- Perform a [Road Safety Audit \(RSA\)](#)
- Identify and diagram crash factors and addressable safety issues



Best Practices for Selecting an RRFB



Minimum MUTCD guidance for non-intersection crossings

MUTCD 3C.03.07

High visibility crosswalk markings and warning signs should be installed for all crosswalks at non-intersection locations.

MUTCD 3C.02.06

The installation of other traffic control devices and other measures designed to reduce traffic speeds, shorten crossing distances, enhance driver awareness of the crossing, and/or provide active warning of pedestrian presence, should be considered in addition to a new marked crosswalk and signs across an uncontrolled roadway where any of the following conditions exist:

- A. The roadway has 4+ lanes of travel without a raised median or pedestrian refuge island and an ADT of 12,000 vehicles per day or greater; or*
- B. The roadway has 4+ lanes of travel with a raised median or pedestrian refuge island and an ADT of 15,000 vehicles per day or greater, or*
- C. The posted speed limit is 40 mph or greater, or*
- D. A crash study reveals that multiple-threat crashes are the predominant crash type on a multi-lane approach, or*
- E. When adequate visibility cannot be provided by parking prohibitions*



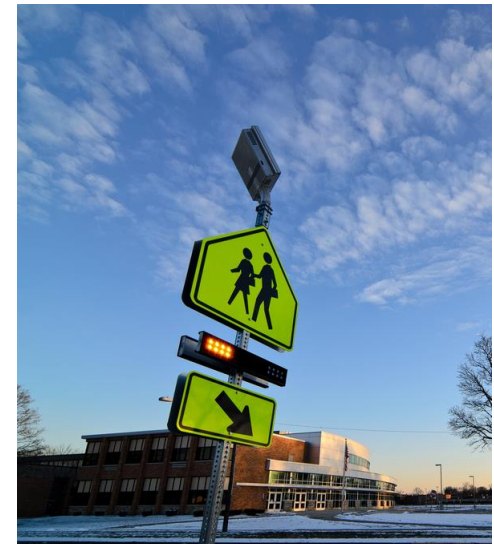
Minimum MUTCD guidance for school crossings

MUTCD 7C.01.01

Crosswalks should be marked at all intersections on established routes to a school where there is substantial conflict between motorists, bicyclists, and student movements; where students are encouraged to cross between intersections; where students would not otherwise recognize the proper place to cross; or where motorists or bicyclists might not expect students to cross.

MUTCD 7C.01.03

Because non-intersection school crossings are generally unexpected by the road user, warning signs should be installed for all marked school crosswalks at non-intersection locations. Adequate visibility of students by approaching motorists and of approaching motorists by students should be provided by parking prohibitions or other appropriate measures.



Marked crosswalks alone are compliant, but not enough to make drivers yield

While signs and road markings legally establish a crosswalk, they are often not enough to compel drivers to yield to pedestrians.

A study comparing the marked versus unmarked crosswalks at uncontrolled locations found:

- On two-lane and multilane roads with annual average daily traffic (AADT) of under 12,000, there were no significant differences in pedestrian crash rates
- On multilane roads with AADTs of 12,000+, sites with marked crosswalks had higher pedestrian crash rates than unmarked crosswalks, increasing significantly as ADT increased

A study evaluating RRFB effectiveness found:

- Driver yield rates before RRFB installation averaged between 18 – 28%, with some locations as low as 0%

Safety Recommendations

Municipalities should avoid using marked crosswalks **alone** on:

- Two-lane roads with AADTs of 12,000+
- Multilane roads with AADTs of 9,000+



RRFB effectiveness

A range of studies have found that RRFBs have a significant effect on increasing yield rates and pedestrian safety at uncontrolled crossings, such as mid-block crosswalks and roundabouts.

- Pedestrian crashes reduced by 47%
 - Crash modification factor (CMF) = 0.53
- Driver yield rates up to 98%
- \$22,250 USD average cost including installation, labor and materials



Sources: National Academies of Sciences, Engineering, and Medicine, NCHRP Report 841, [Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments](#)

Federal Highway Administration, "[Rectangular Rapid-Flashing Beacon \(RRFB\) Safe Transportation for Every Pedestrian Countermeasure Tech Sheet](#)"



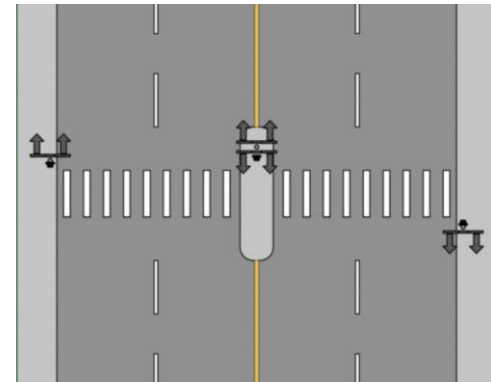
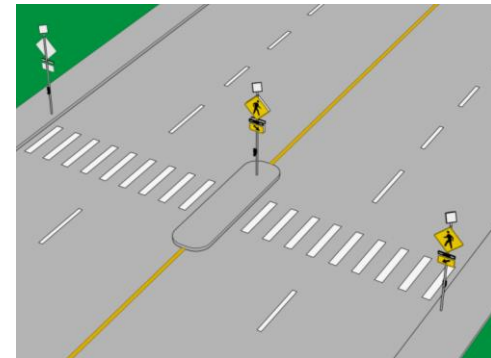
Road conditions associated with highest RRFB effectiveness

The following roadway and traffic control device conditions are associated with the highest RRFB driver yield rates:

- Where the crossing distance is shorter (i.e. the number of lanes a pedestrian needs to cross)
- Where a median/pedestrian refuge is present
- Where the crossing has only two legs (rather than four)

Safety Recommendations for High Yield Rates

- Consider shortening the crossing distance (e.g. with curb extensions or a pedestrian refuge island)
- For roads with 3+ lanes and AADTs above 12,000, consider installing median-mounted RRFBs together with roadside RRFBs for the best driver compliance



When to consider installing an RRFB

The following pages feature selection guides showing where RRFBs are recommended based on particular roadway and crossing conditions.

However, municipalities should always consider RRFBs for roadways 40 mph and under if an uncontrolled crosswalk is experiencing one or more of the following safety issues:



Drivers aren't yielding to pedestrians at the crosswalk



Previous conflicts and/or incidents have occurred at the crosswalk






Visibility of the crosswalk and/or pedestrians is poor



RRFB Selection Matrix

Legend

-  = RRFBs are not recommended but are an optional enhancement with or following engineering judgment
-  = RRFBs are a candidate treatment to improving crossing safety on this roadway
-  = RRFBs are an ideal treatment for this roadway

Use this chart to determine the roadway conditions where RRFBs are recommended or should be considered to maximize pedestrian safety.

Crossing distance (e.g. number of lanes)	Median presence	Posted Speed Limit (mph) and Annual Average Daily Traffic (AADT)								
		< 9,000 AADT			9,000 – 15,000 AADT			> 15,000 AADT		
		SPEED LIMIT ≤30	SPEED LIMIT 35	SPEED LIMIT 40	SPEED LIMIT ≤30	SPEED LIMIT 35	SPEED LIMIT 40	SPEED LIMIT ≤30	SPEED LIMIT 35	SPEED LIMIT 40
2 lanes (1 lane in each direction)	-	Engineering judgment	Consider	Recommended	Engineering judgment	Consider	Recommended	Consider	Consider	✗
3 lanes (1 lane in each direction with two-way left-turn lane)	Yes	Engineering judgment	Consider	Recommended	Consider	Recommended	Recommended	Consider	Recommended	✗
	No	Consider	Consider	✗	Consider	Recommended	✗	Consider	✗	✗
4+ lanes (2 or more in each direction)	Yes	Consider	Consider	✗	Consider	Recommended	✗	Recommended	✗	✗
	No	Consider	Consider	✗	Consider	Recommended	✗	Recommended	✗	✗

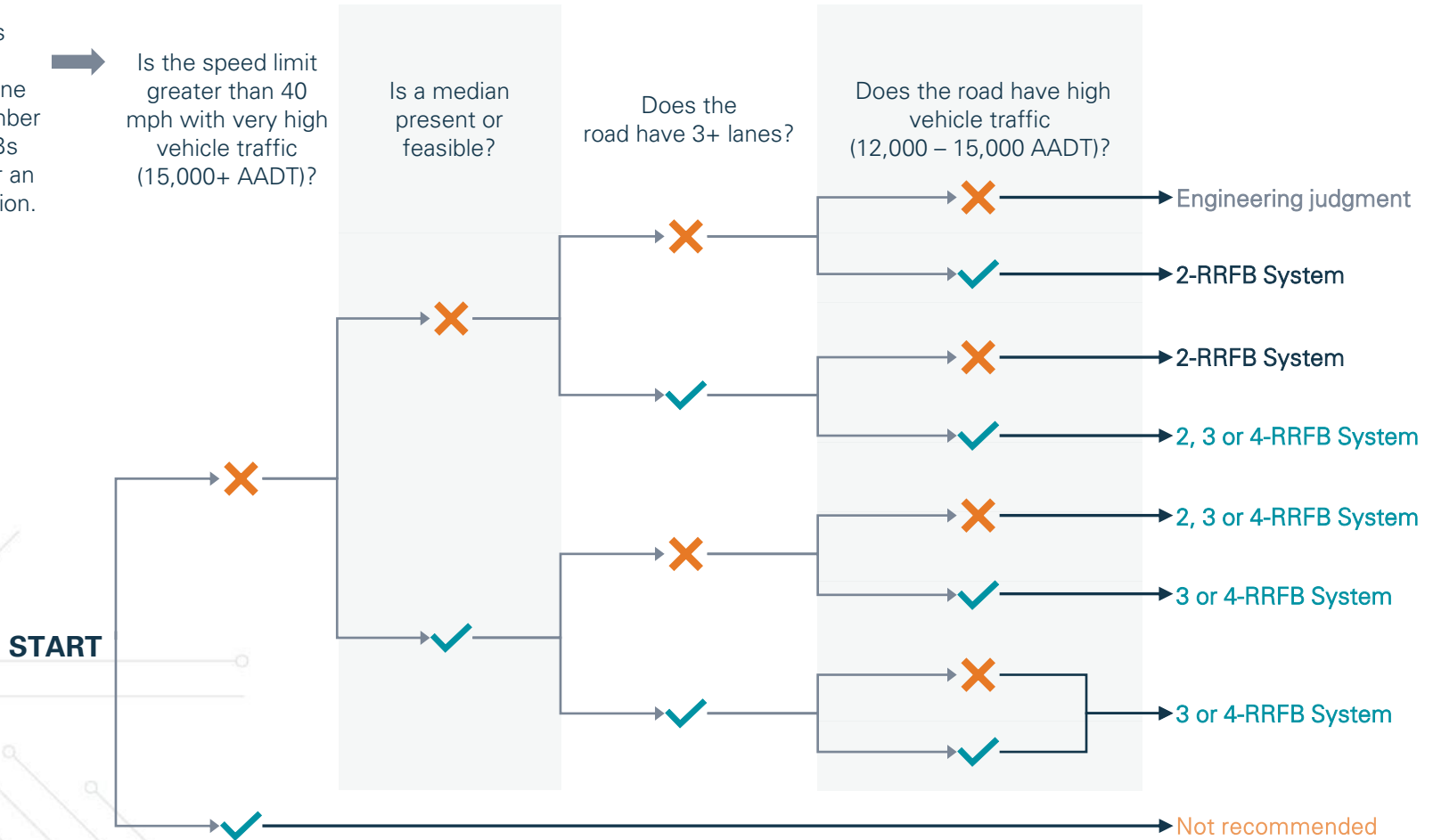


RRFB Selection Flowchart

Legend

- Engineering judgment = RRFBs are not recommended but are an optional enhancement with or following engineering judgment
- 2-RRFB System = Two RRFB units mounted at the roadside
- 3 or 4-RRFB System = Two RRFB units mounted at the roadside + one to two RRFB units mounted on the median refuge

Use this chart to determine the number of RRFBs ideal for an installation.



Complementary Treatments: Pedestrian Refuge Island

Pedestrian refuge islands reduce exposure to traffic by providing a refuge for pedestrians crossing a multilane road, allowing them to focus on one direction of traffic at a time.

- Can reduce pedestrian crashes by 32%
- RRFBs installed on the roadside and pedestrian refuge can increase driver yield rates to over 90%

Safety Recommendations

- Pedestrian refuges are recommended on RRFB crossings at 3+ lane roadways with 12,000 AADT and above



Complementary Treatments: Advance Stop / Yield Markings

Advance stop or yield lines encourage drivers to stop further back from the crosswalk, increasing pedestrian visibility and reducing multiple-threat collisions when crossing more than one lane in each direction.

- Can reduce pedestrian crashes by 25%

Yield/Stop Here for Pedestrians (R1-5/R1-5b) signs must be used if yield/stop lines are used in advance of a marked crosswalk only where it crosses an uncontrolled multi-lane approach. The Stop Here sign can only be used where the law specifically requires that a driver must stop for a pedestrian in a crosswalk

Safety Recommendations

- **Advance markings are recommended on RRFB crossings with 12,000 AADT and above.**



R1-5 yield here to pedestrians sign



R1-5b stop here for pedestrians sign



Complementary Treatments: Overhead Lighting

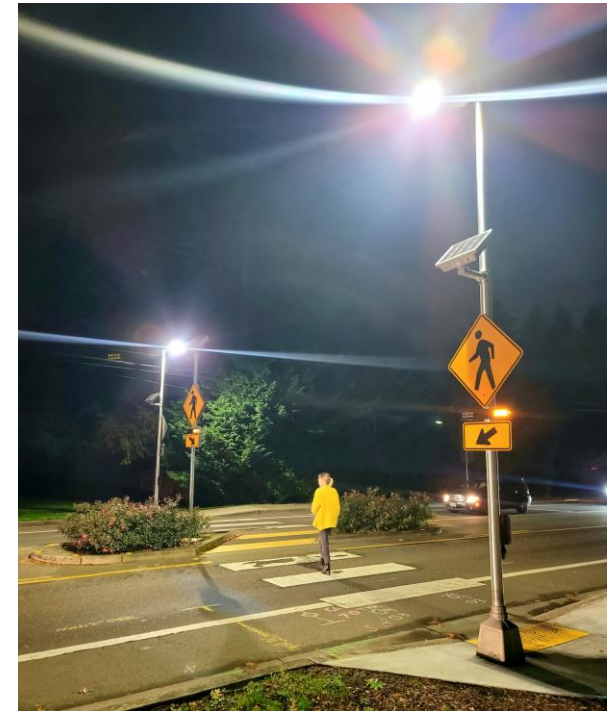
Overhead, pedestrian-scale lighting helps make crosswalks and pedestrians more visible at night. It is recommended to place lights in advance of a mid-block crosswalk on both approaches to illuminate the front of a crossing pedestrian.

- Crosswalk visibility enhancements (including lighting) can reduce pedestrian crashes by 23–48%

Safety Recommendations

- Overhead lighting is recommended for RRFB crossings where nighttime pedestrian visibility is poor (no street lighting present)

[Download the Overhead Lighting for Mid-block Crosswalk Industry Standards guide](#)



FHWA Guidelines and Compliance for RRFB Installation



MUTCD Chapter 4L. Rectangular Rapid Flashing Beacons

As of December 2023, RRFBs are an approved enhancement to marked crosswalks across uncontrolled approaches. Standards, Guidance, and Options can be found in the [MUTCD 11th Edition's Chapter 4L](#).

The information in this chapter effectively replaces FHWA Interim Approval 21 (IA-21) and Interim Approval 11 (IA-11), which previously contained the conditions for RRFB use.

- Existing RRFB units that use the flash pattern designated by IA-11 (which authorized RRFBs prior to IA-21) must be reprogrammed to the newly required wig-wag plus simultaneous (WW+S) flash pattern as part of an upgrading process



Allowable Signs

MUTCD Section 4L.01.03

An RRFB shall only be used to supplement the following post-mounted or overhead-mounted signage located at or immediately adjacent to an uncontrolled marked crosswalk:



W11-2 pedestrian crossing sign



S1-1 school zone crossing sign



W11-15 bicycle and pedestrian crossing sign

If post-mounted, these signs shall be paired with a W16-7P diagonal downward arrow plaque:



Prohibited Uses

MUTCD Section 4L.01.04

RRFBs shall not be used for crosswalks controlled by YIELD signs, STOP signs, traffic control signals, or pedestrian hybrid beacon, *except* for those at the approach to or egress from a roundabout *or* crossing free-flow turn lanes separated by a channelizing island



R1-1 stop sign



R1-2 yield sign



Above: Pedestrian hybrid beacon

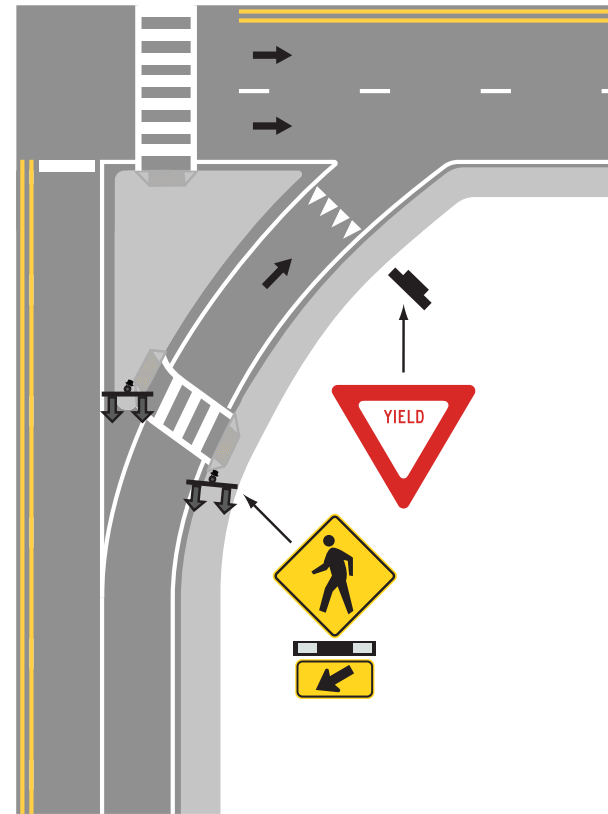


Yield-Controlled Intersections

MUTCD Section 2C.41.01

Because RRFBs shall not be used for crosswalks controlled by YIELD signs, they shall not be installed in the same area nor after the yield-controlled intersection, such as a yield-controlled, right-hand merge.

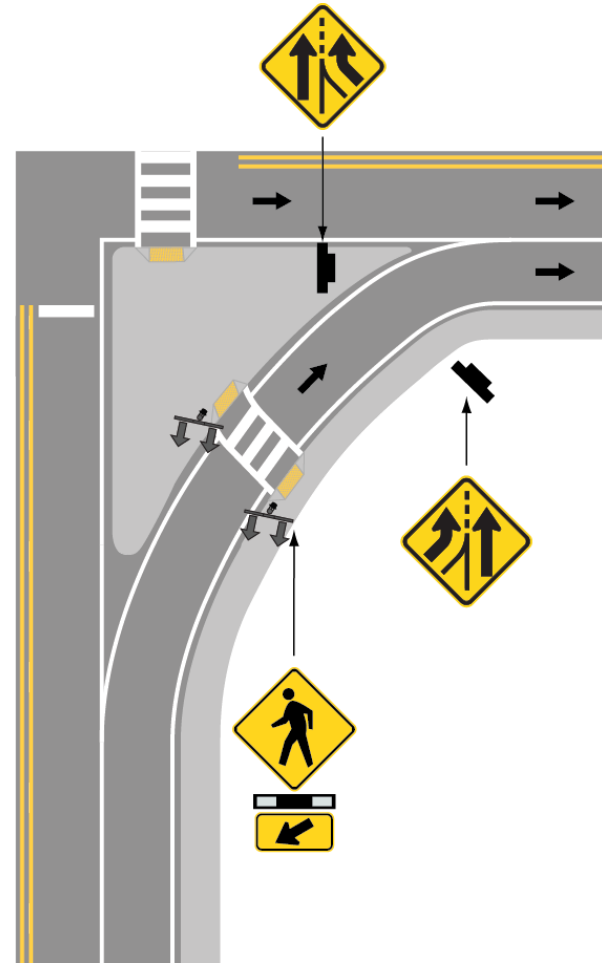
It is recommended to install the RRFB crosswalk before the yield area.



Added Lanes

On an added lane / channelized right turn without a yield (where merging movements are not required), an RRFB crosswalk may be used.

An W4-3 added lane sign should be installed in advance of the point the two roadways converge.



Minimum Crosswalk Sight Distance

MUTCD Section 4L.01.05-0.6

If driver sight distance approaching the crosswalk is low, **an additional RRFB may be installed on that approach in advance of the crosswalk.** This advance RRFB is supplemental and cannot replace the RRFBs at the crosswalk. The advance RRFB system should communicate with the RRFB crossing.

This table suggests the minimum recommended sight distances (in feet) that a crosswalk should be visible to drivers on all approaches per the road's posted speed limit.

If the crosswalk is not visible within the recommended sight distances, [see the next page for guidance on where to install an advance RRFB system.](#)

Recommended stopping sight distance for crosswalks

Posted speed limit (MPH)	Stopping sight distance (ft)*
20	115
25	155
30	200
35	250
40**	305

* Stopping sight distance may vary based on road grade.

** RRFBs may not be sufficient on roads with speeds 40 mph and greater.



Advance RRFB Location

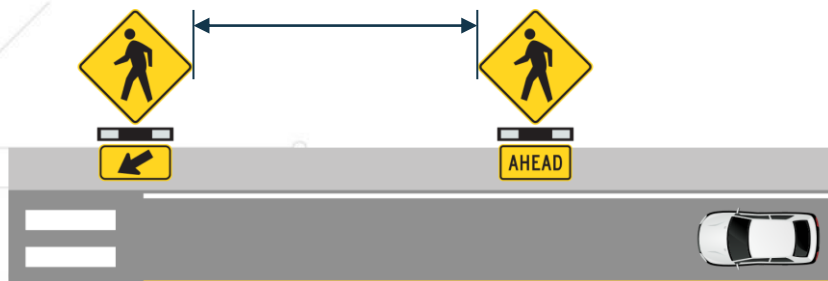
MUTCD Table 2C-3

The distances provided in this table are for guidance purposes and should be applied with engineering judgment. MUTCD guidance recommends warning signs be placed so they provide adequate driver perception-response and stopping sight distance. They should also not be placed too far in advance of the crosswalk such that drivers forget the warning because of other driving distractions.

Guidelines for advance placement of warning signs

Posted speed limit (MPH)	Advance RRFB placement distance (ft)
20	115
25	155
30	200
35	250
40*	305

* RRFBs may not be sufficient on roads with speeds 40 mph and greater.



Advance Signs

MUTCD 4L.01.05

An additional RRFB may be installed on that approach in advance of the crosswalk, as a Warning Beacon to supplement a W11-2 (Pedestrian), S1-1 (School), or W11-15 (Trail) crossing warning sign with an AHEAD (W16-9P) or distance (W16-2P or W16-2aP) plaque.



W16-9P AHEAD
plaque



W16-2P distance
plaque

MUTCD 4L.01.06

If an additional RRFB is installed on the approach in advance of the crosswalk, it shall be supplemental to and not a replacement for the RRFB at the crosswalk itself.



Advance Stop / Yield Markings

MUTCD Chapter 3B.19

Stop / yield lines may be used to indicate the point behind which vehicles are required to stop / yield at a crosswalk.

This table summarizes the current MUTCD guidance for determining advance stop / yield use depending on the type of road / approach.

State law determines whether drivers are required to either stop or yield to pedestrians. Refer to local state laws to confirm which type of sign should be used.

Guidance for determining advance stop / yield marking and sign use

Type of road / approach	Stop / yield markings	R1-5 signs 
Single-lane	Optional	Not recommended
Multi-lane	Recommended	Recommended
Roundabout	Not recommended	Not recommended

R1-5 signs (post-mounted)*



R1-5



R1-5a



R1-5b



R1-5c

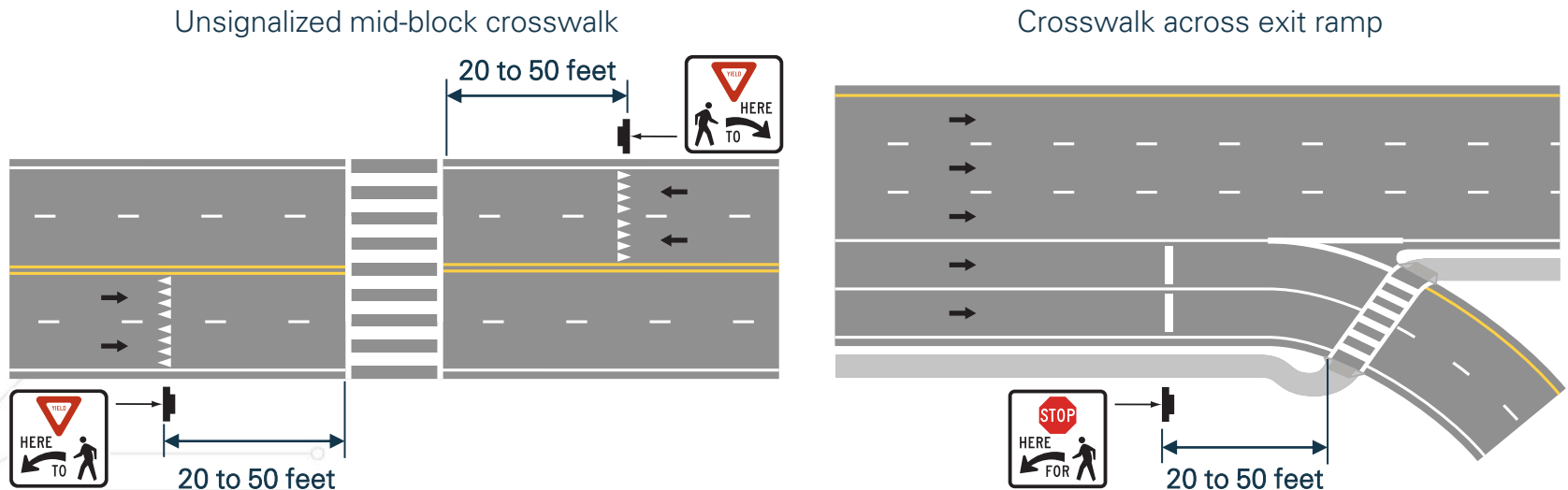
* The legend STATE LAW may be displayed at the top of these signs (if applicable).



Advance Stop / Yield Marking Placement

MUTCD Chapter 3B.19

If used at an uncontrolled multi-lane approach, stop / yield lines should be placed 20 to 50 feet in advance of the nearest crosswalk line. Yield / Stop Here for Pedestrians (R1-5 series) signs shall be used.



Refer to MUTCD [Chapter 2B.11](#) and [Chapter 3B.16](#) for more information on stop / yield signs and markings.

Sources: FHWA Manual of Uniform Traffic Control Devices, Section 3B; Graphics adapted from FHWA MUTCD



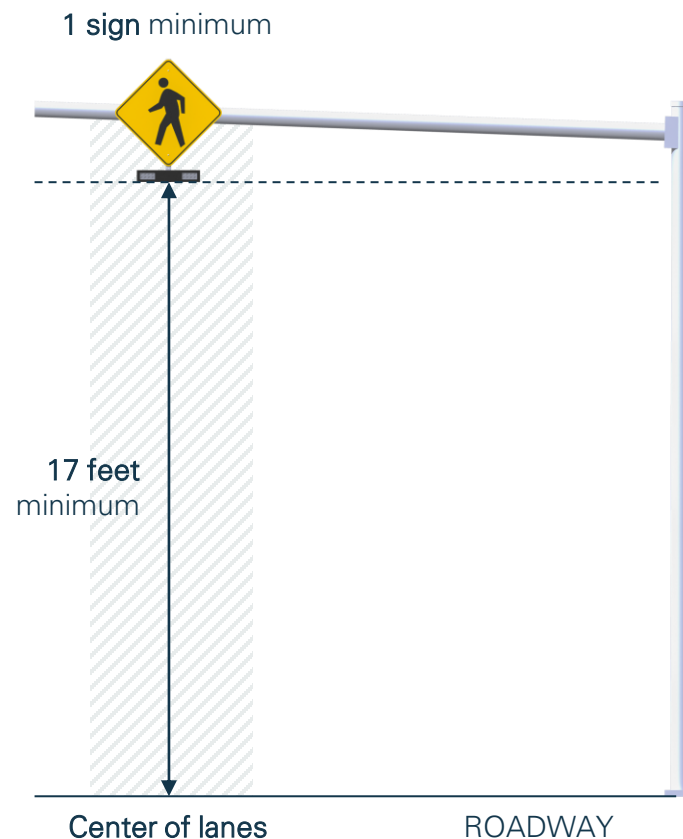
Overhead Signs

MUTCD 2A.15.16

Overhead signs shall provide a vertical clearance of not less than **17 feet to the sign, light fixture, or sign bridge** over the entire width of the pavement and shoulders except where the structure on which the overhead signs are to be mounted or other structures along the roadway near the sign structure have a lesser vertical clearance.

MUTCD 4L.02

- A minimum of one overhead sign and RRFB system per approach is required.
- The sign and RRFB unit should be located over the approximate center of the lanes or where optimum visibility can be achieved.
- No diagonal arrow plaque is required.

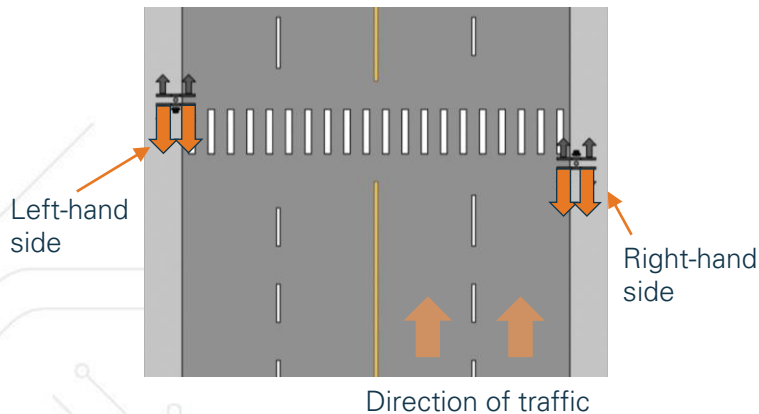


Sign and Beacon Assembly Locations

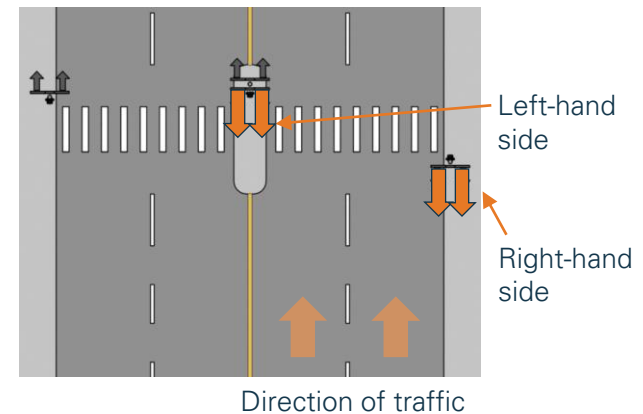
MUTCD 4L.02.06

For any approach where RRFBs are used to supplement post-mounted signs, at least two W11-2, S1-1, or W11-15 crossing signs (each with an RRFB unit and a W16-7P plaque) shall be installed at the crosswalk.

For non-divided roadways, one shall be installed on the right-hand side of the roadway and one on the left-hand side.



For divided roadways, the left-hand side should be installed on the median if practical.



Sign and Beacon Assembly Locations

MUTCD 4L.02.03

An RRFB unit shall not be installed independent of the crossing warning signs for the approach that the RRFB faces.

For post-mounted signs, they should be installed on the same support as the crossing warning signage.



For overhead-mounted sign, they should be mounted directly below the bottom of the sign.

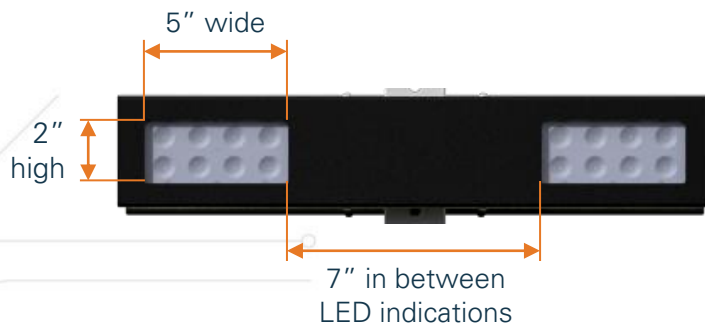


Beacon Dimensions

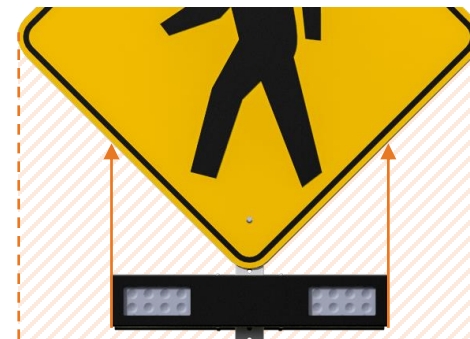
MUTCD 4L.02.01

Each RRFB shall consist of two rectangular-shaped yellow indications each with an LED-array-based light source.

Each RRFB indication shall be a minimum of 5 inches wide by 2 inches high and aligned horizontally with a minimum space of 7 inches in between.



The outside edges of the RRFB indications shall not project beyond the outside edges of the crossing warning sign it supplements.



Outside edges must remain within edges of warning sign



Beacon Mounting

MUTCD 4L.02.04

The RRFB unit associated with a post-mounted sign and plaque may be located between and immediately adjacent to the bottom of the crossing warning sign and the top of the supplemental downward diagonal arrow plaque OR within 12 inches above the crossing warning sign.

Evidence:

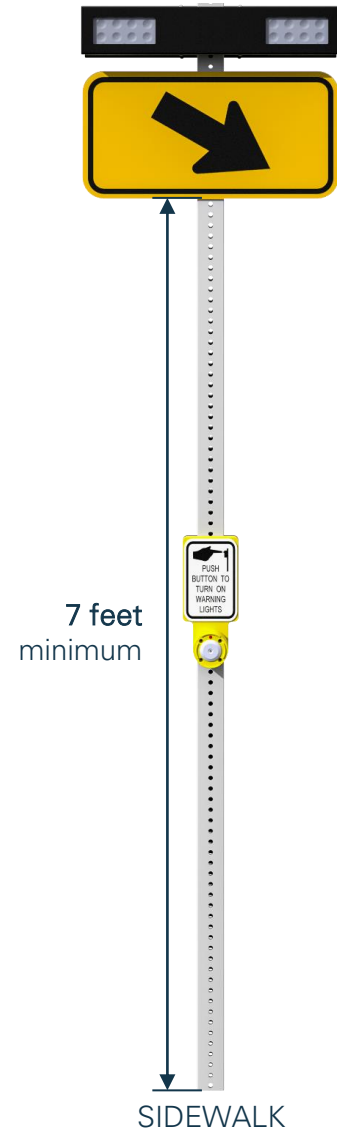
- [FHWA-HRT-16-040](#)
 - Open-road study investigating driver yielding when the beacons were located above and below the warning sign at 13 sites
 - Results indicated that any differences between the above and below positions were minor and statistically insignificant.
 - “The position of the yellow RRFB did not have an impact on whether a driver decided to yield to the waiting pedestrians.”



Sign Mounting

MUTCD 2A.15.05

The W16-7P plaque shall be mounted below the crossing sign and the RRFB light bar at a minimum of 7 feet from the bottom of the plaque to the sidewalk.



Beacon Flashing

MUTCD 4L.03.02

All RRFB units associated with a given crosswalk (including those with an advance crossing sign, if used) shall, when activated, simultaneously commence operation of their rapid flashing indications and shall cease operation simultaneously.

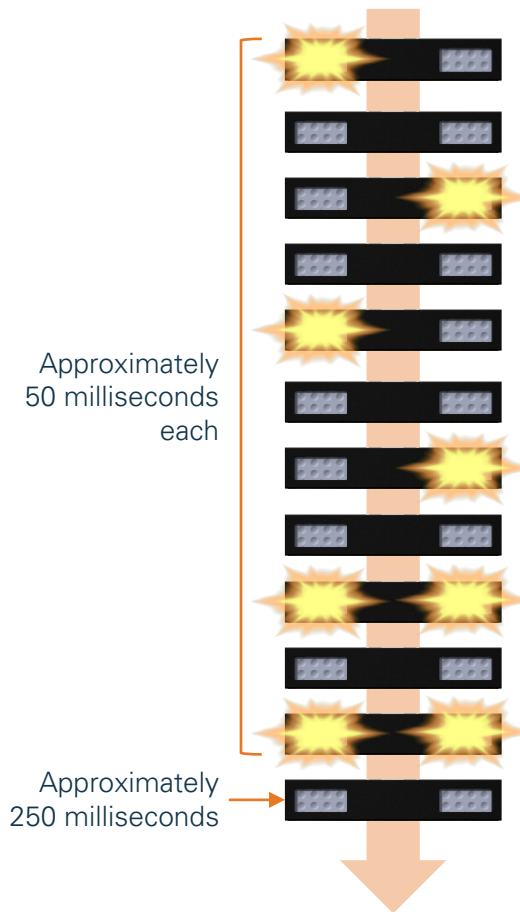
MUTCD 4L.02.12

Daytime light intensity shall meet the minimum specifications for **Class 1 yellow peak luminous intensity in the Society of Automotive Engineers (SAE) Standard J595:**

- 600 candela (cd) minimum measured at horizontal and vertical angle of 0 degrees

An automatic signal dimming device may be used to reduce the brilliance of the RRFB indications at night to reduce excessive glare.

WW+S flash pattern order



Beacon Flashing Length

MUTCD 4L.03.03

The duration of the predetermined flash period should be based on the procedures of Section 4I.06 of the MUTCD.

MUTCD 4I.06.14

The total of the walk interval and pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the pedestrian detector to travel at a walking speed of 3 feet per second to the far side of the traveled way being crossed.

MUTCD 4I.06.10

Where pedestrians who walk slower than 3.5 feet per second or who use wheelchairs routinely use the crosswalk, a walking speed of less than 3.5 feet per second should be considered in determining the pedestrian clearance time.

Beacons should flash at the duration of a pedestrian walking speed of approximately 3 ft/s crossing the length of the crosswalk



Beacon Operation

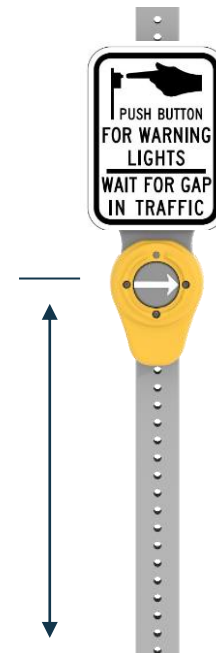
MUTCD 4L.02.14

If pedestrian push button detectors (rather than passive detection) are used to actuate the RRFB, a PUSH BUTTON FOR WARNING LIGHTS/WAIT FOR GAP IN TRAFFIC (R10-25) sign shall be installed explaining the purpose and use of the pedestrian push button detector.

For ADA compliance, the pushbutton shall be installed at a height of approximately 3.5 feet and no higher than 4 feet.



R10-25 pushbutton sign



ADA Compliance:
3.5 feet
(no higher than 4 feet)



Pedestrian Detection

Various pedestrian detection methods are available for RRFBs.

Standard push button detector (audible tone and LED indicator)



Audible Information Device (AID)



MUTCD 4L.03.10

If an audible information device is used, the audible message should be a speech message that says, "Warning lights are flashing." It should be spoken twice. Cannot have vibrotactile indications (to differentiate from APS used at intersections).

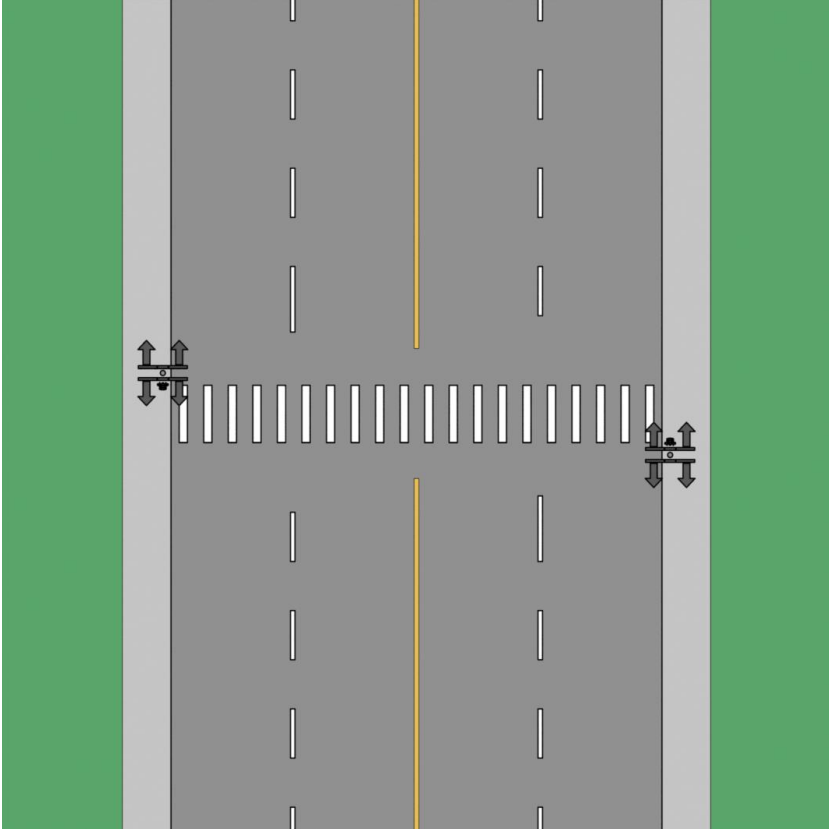
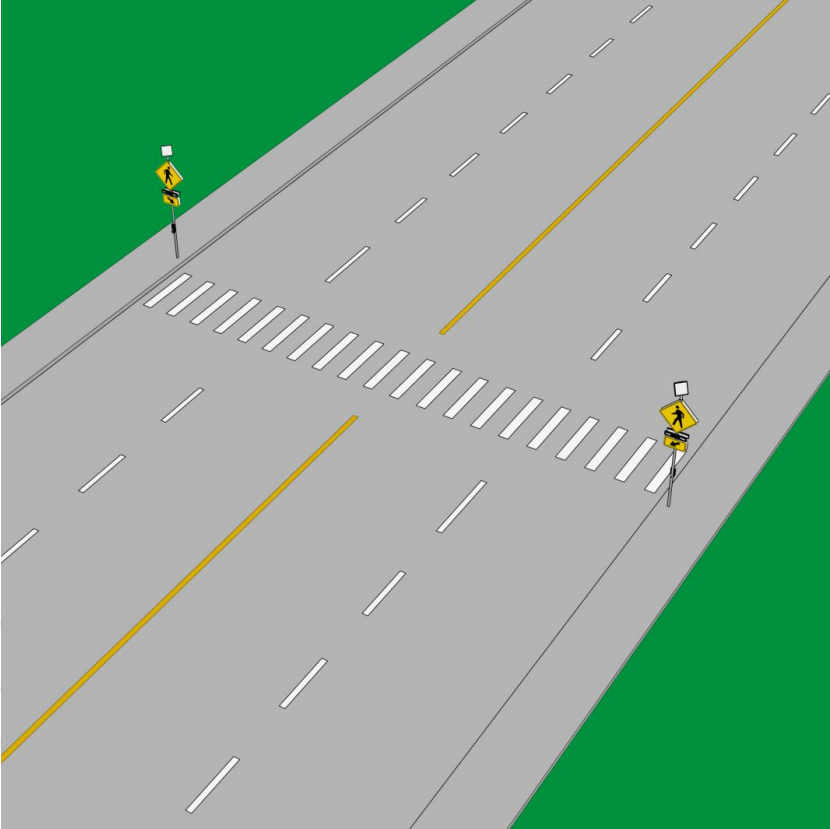
Passive pedestrian microwave detector



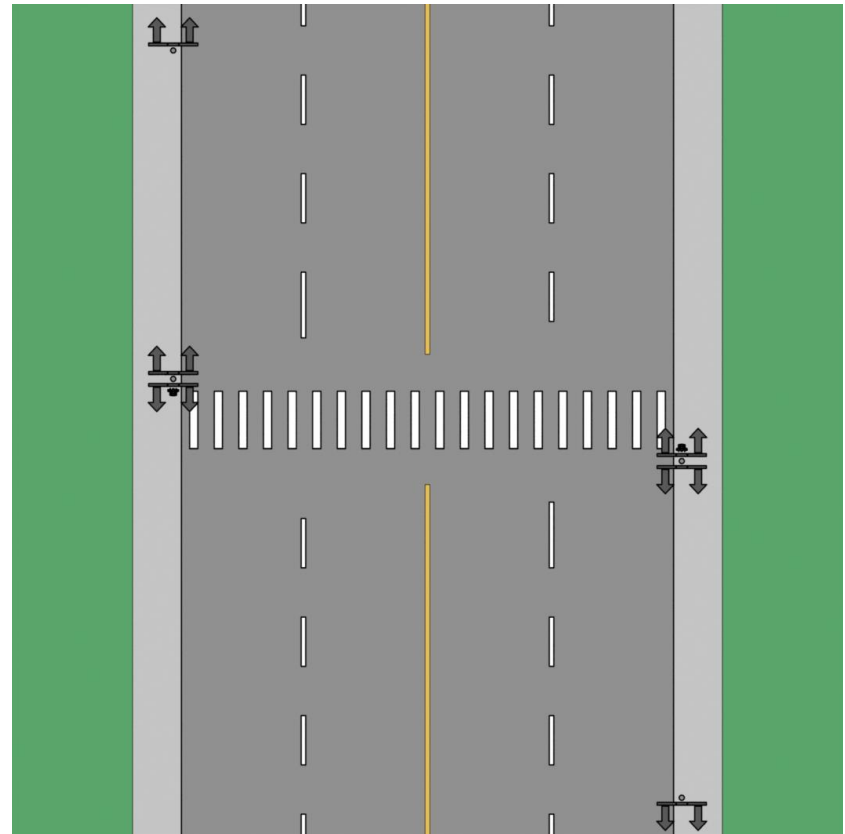
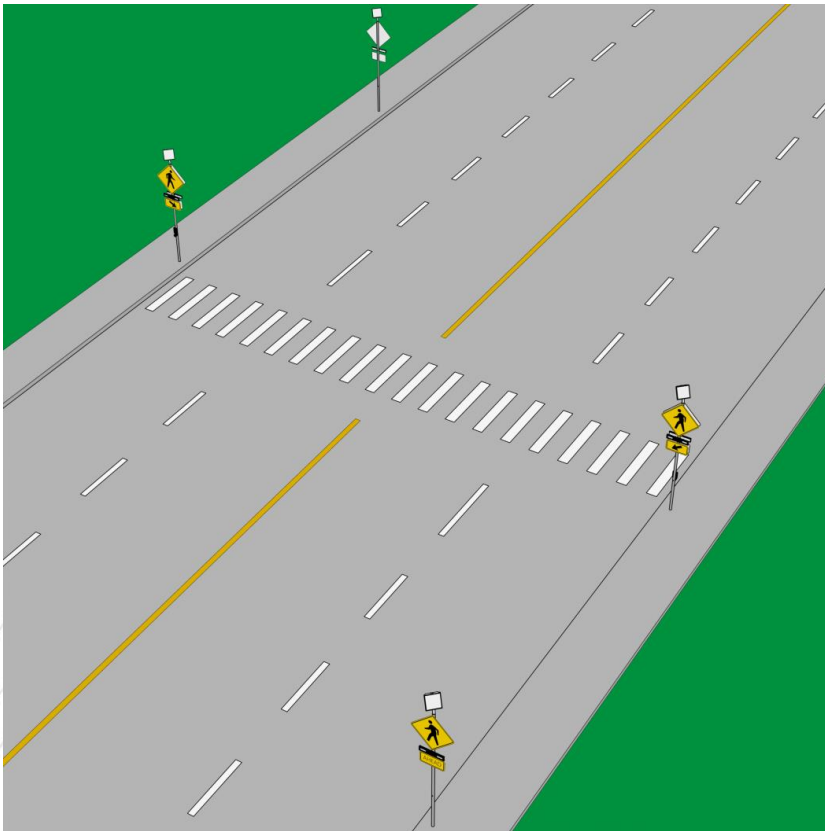
RRFB Installation Examples



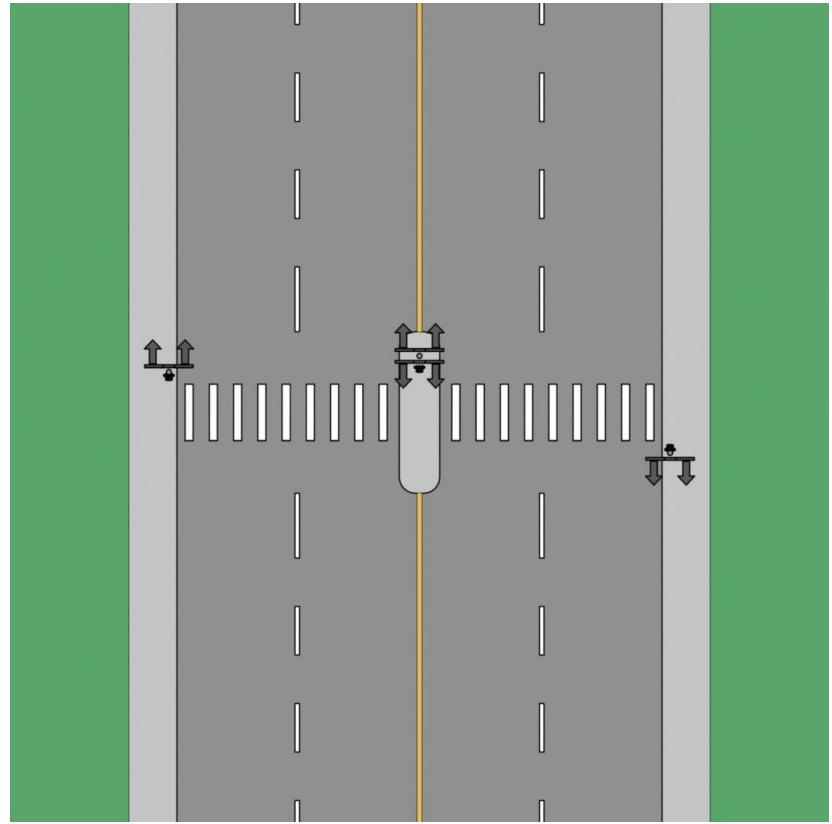
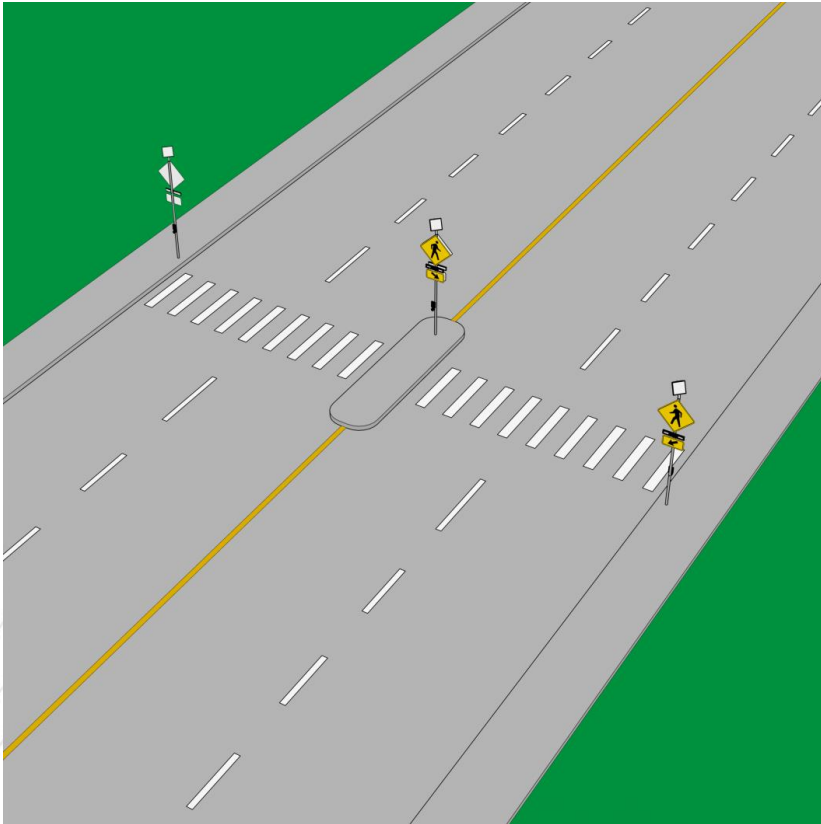
Standard Two-Way Road



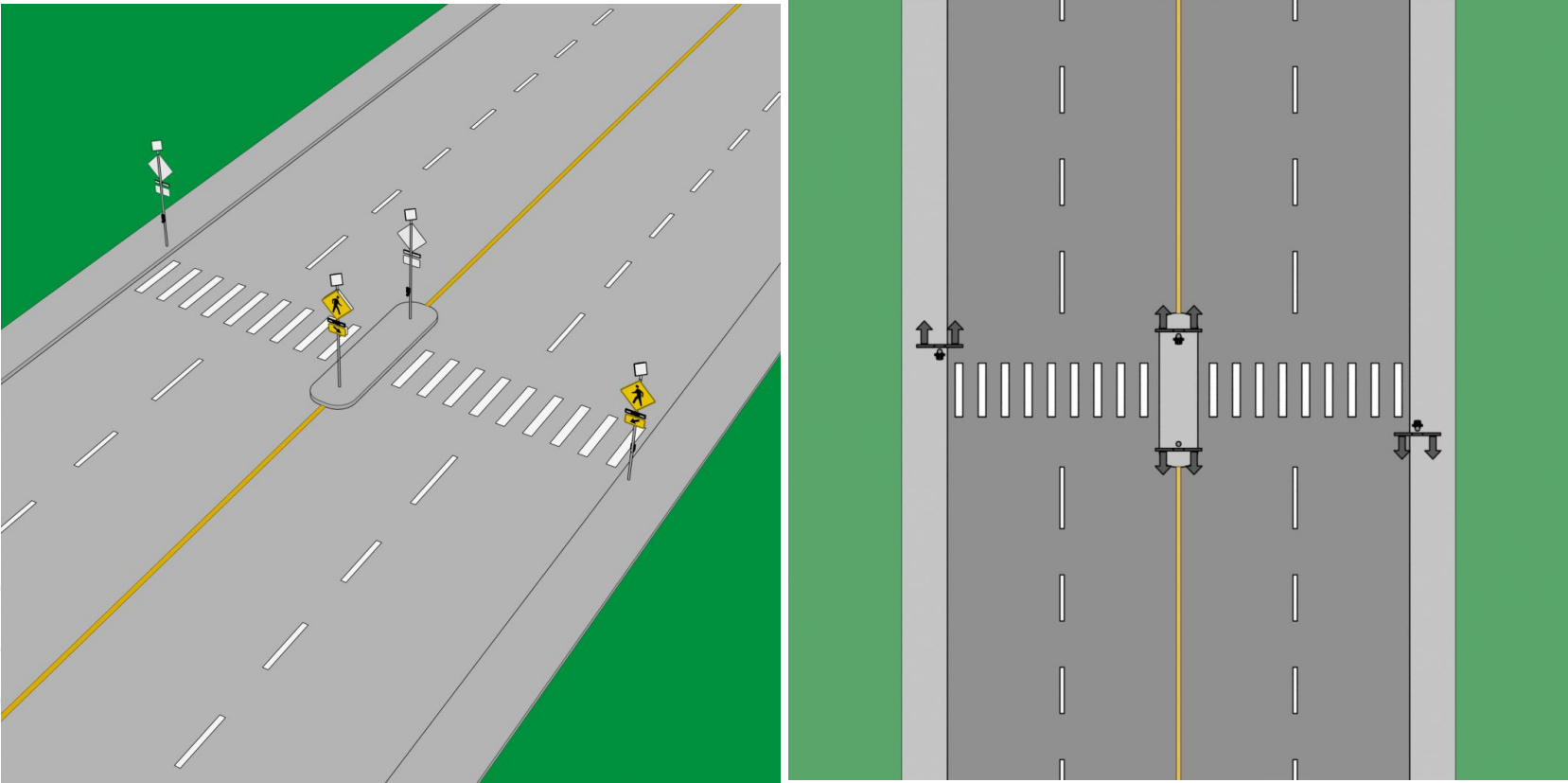
Advance Two-Way Road



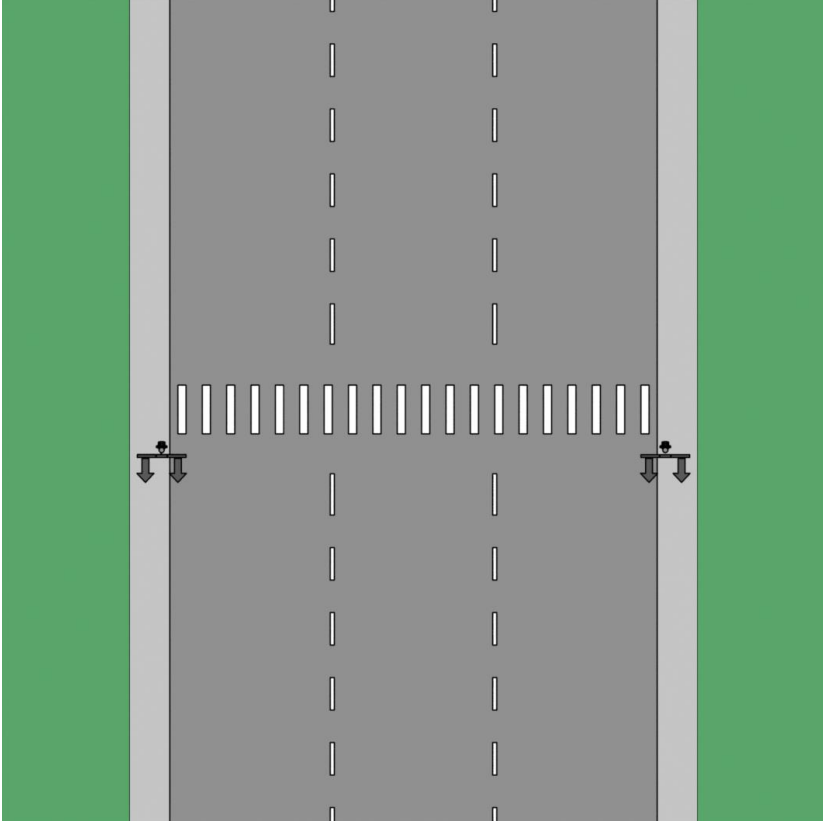
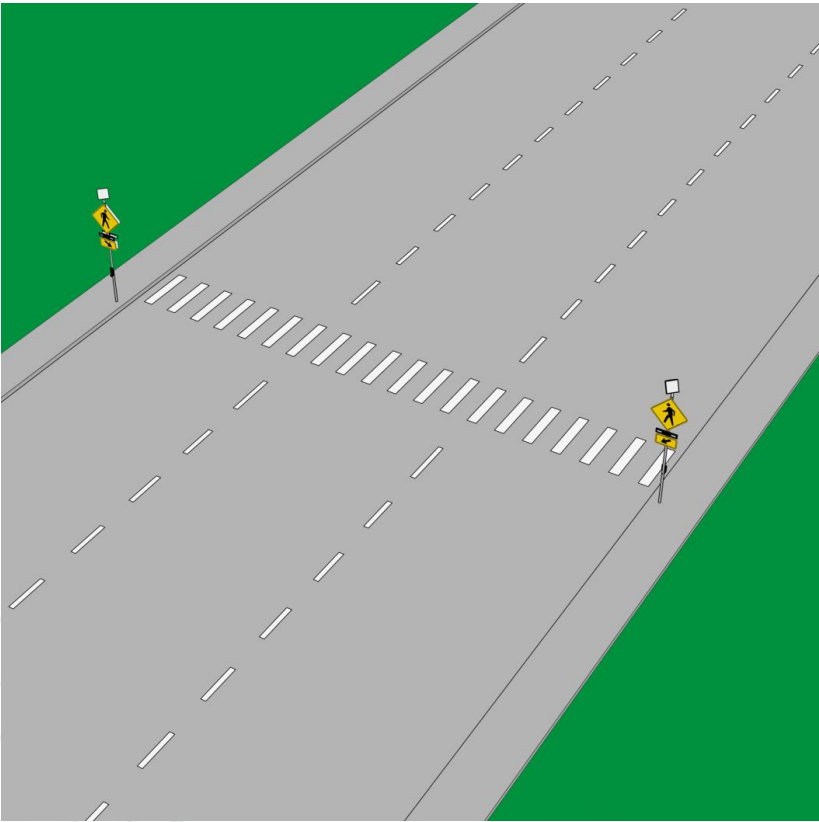
Median Two-Way Road



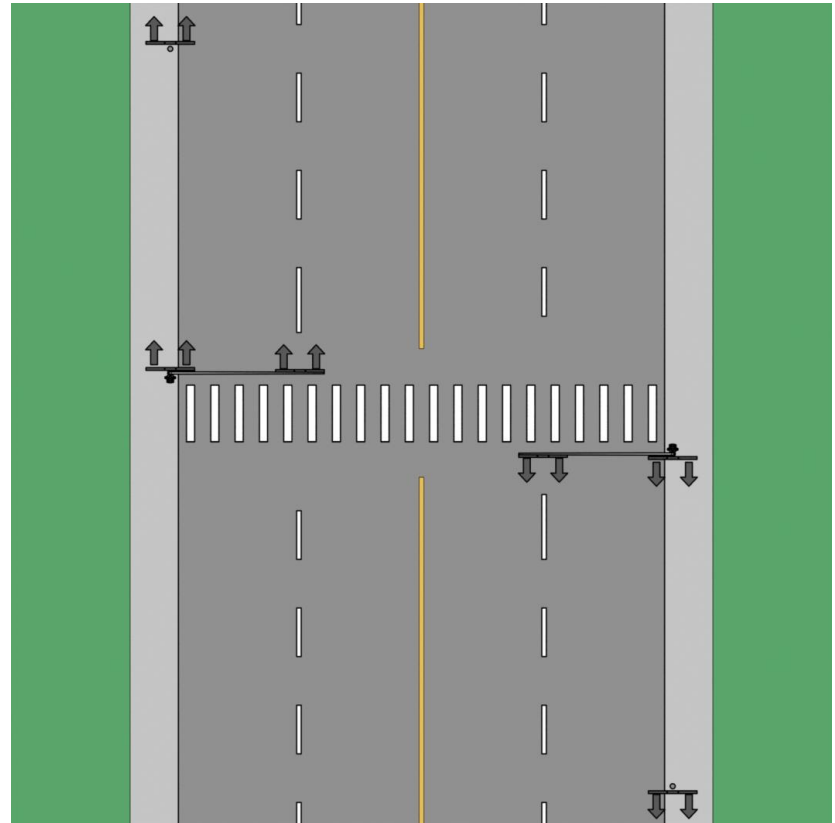
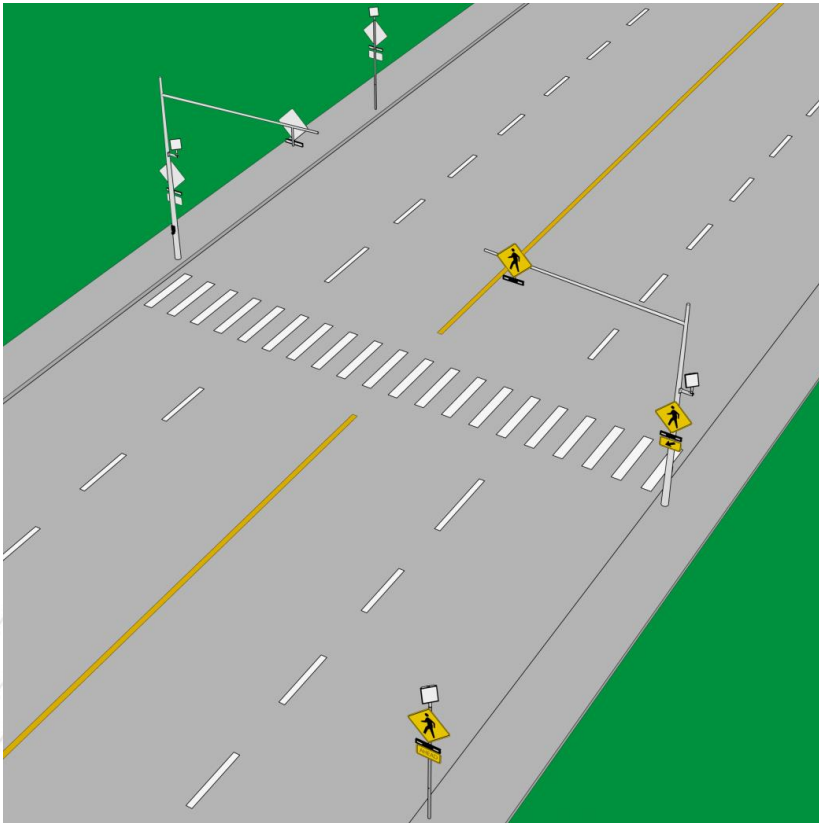
Two-Pole Median Two-Way Road



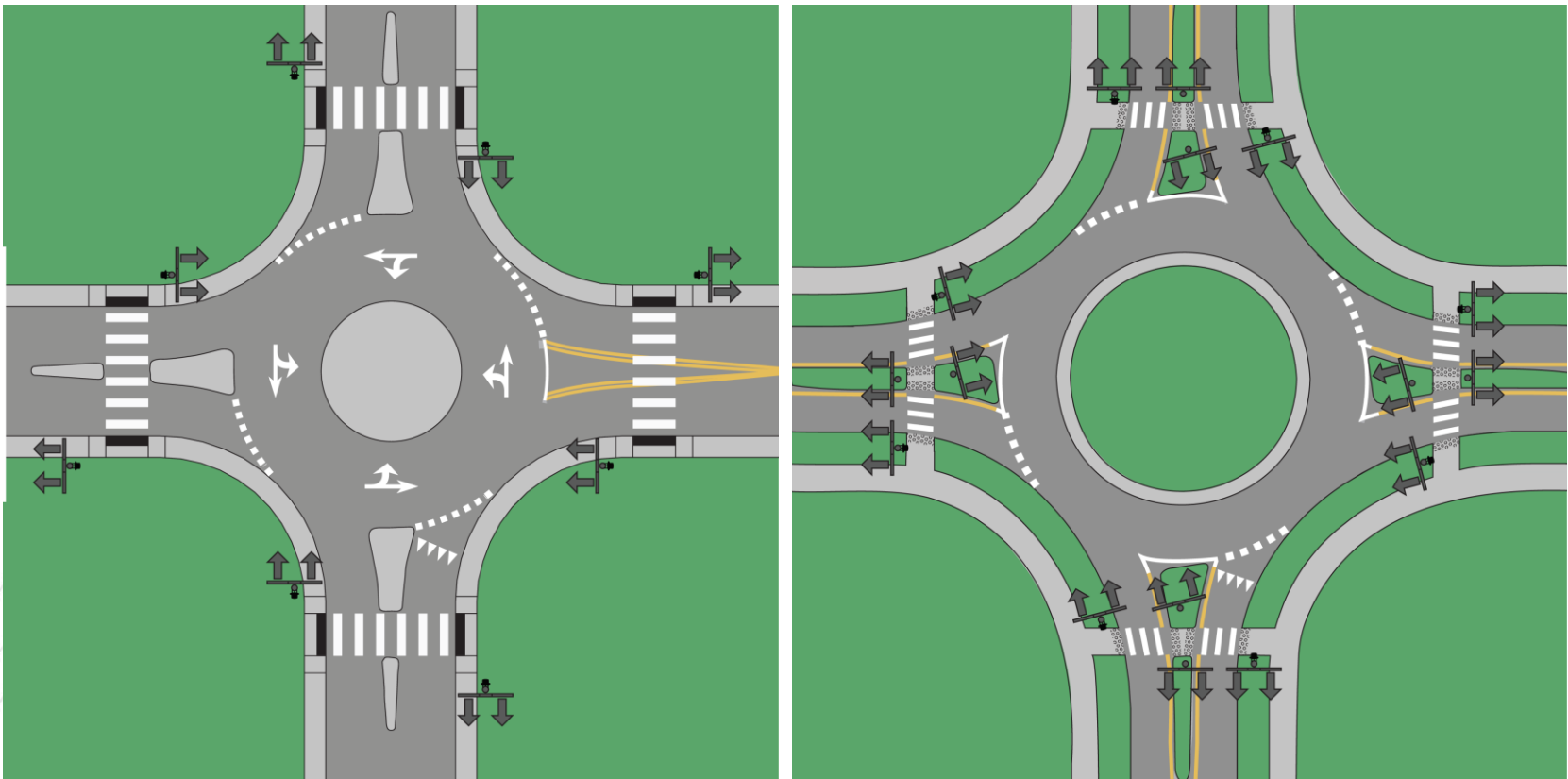
Standard One-Way Road



Overhead Two-Way Road



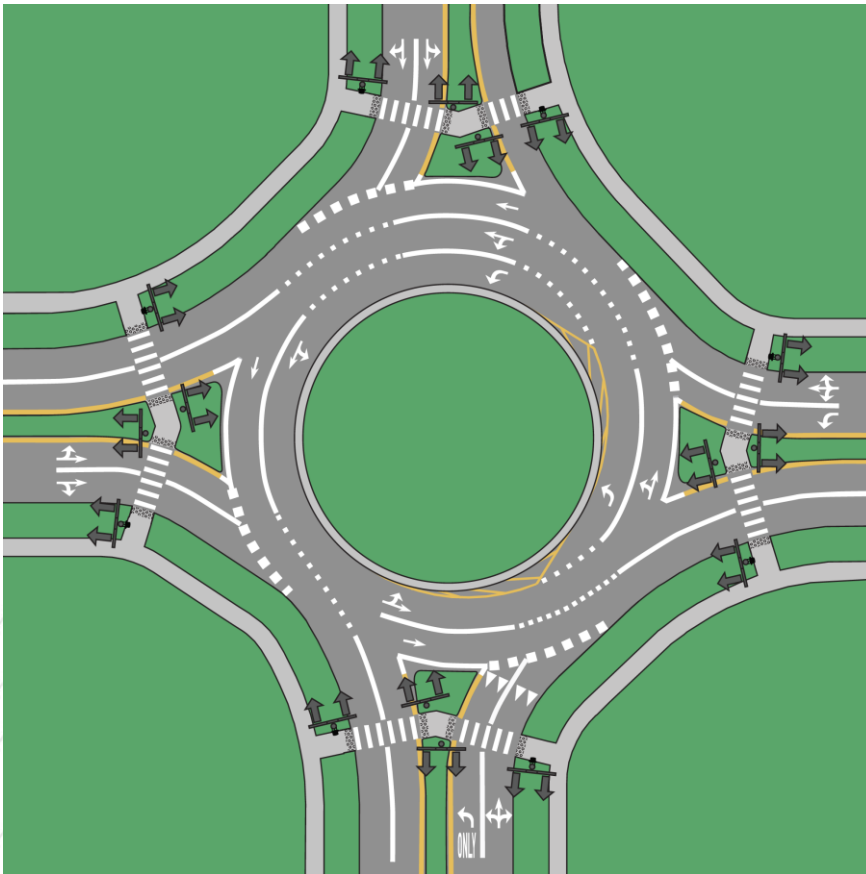
Roundabout (One-Lane)



Sources: Graphics adapted from FHWA MUTCD, Figure 2B-21 & 2B-22



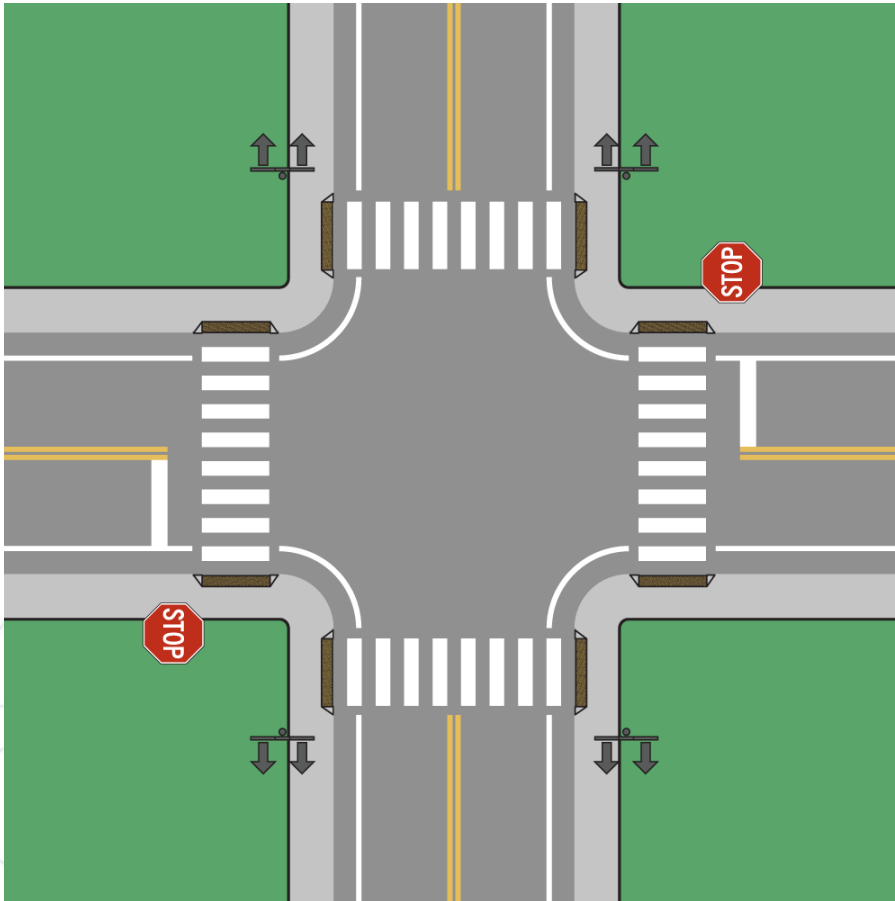
Roundabout (Two-Lane)



Sources: Graphic adapted from FHWA MUTCD Figure 2B-23



Four-Pole Parallel Crosswalk



Sources: Graphic adapted from FHWA MUTCD Figure 4L-1



RRFB Equipment Options



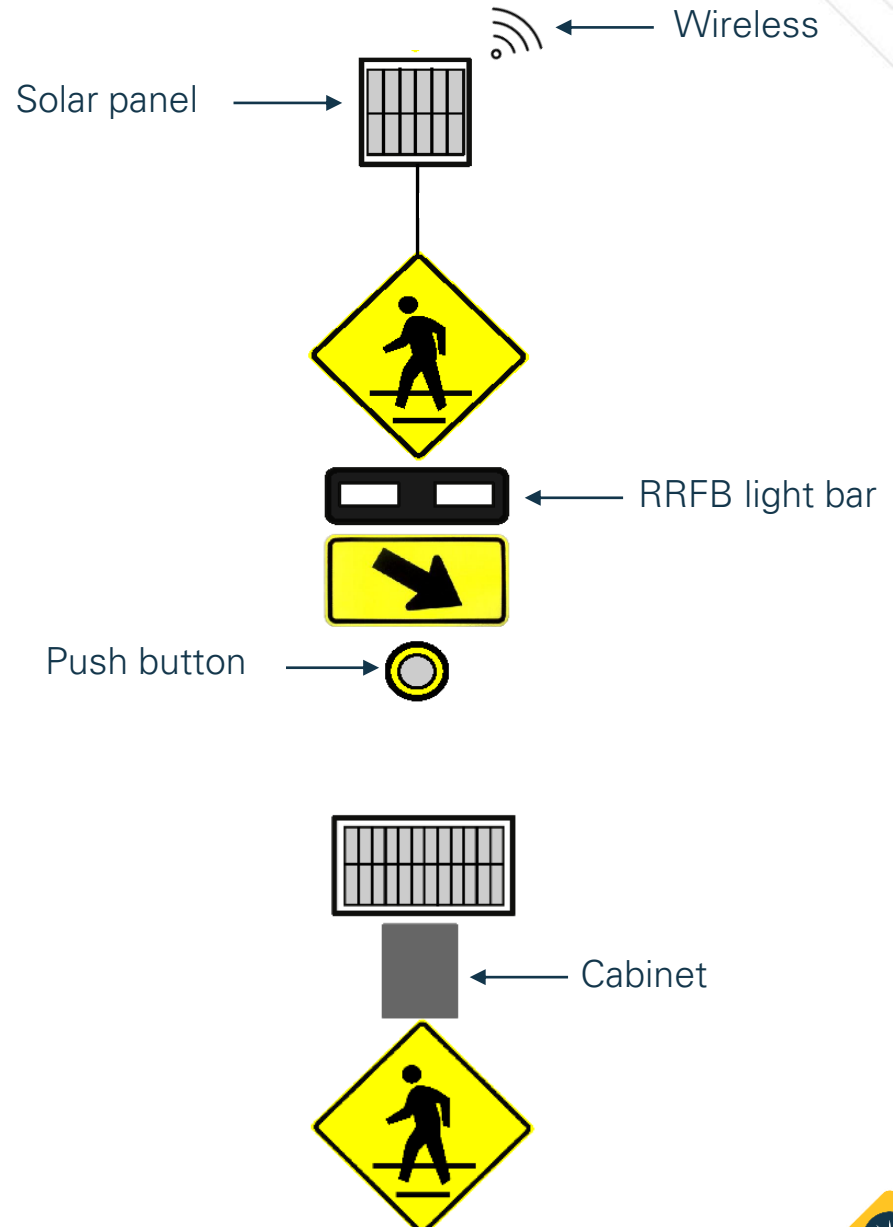
Equipment Options

Based on Carmanah RRFB models:

- [R920-MX](#)
- [R920-E \(Gen 3\)](#)
- [R920-F \(Gen 3\)](#)
- [SC315-G \(Gen 3\)](#)

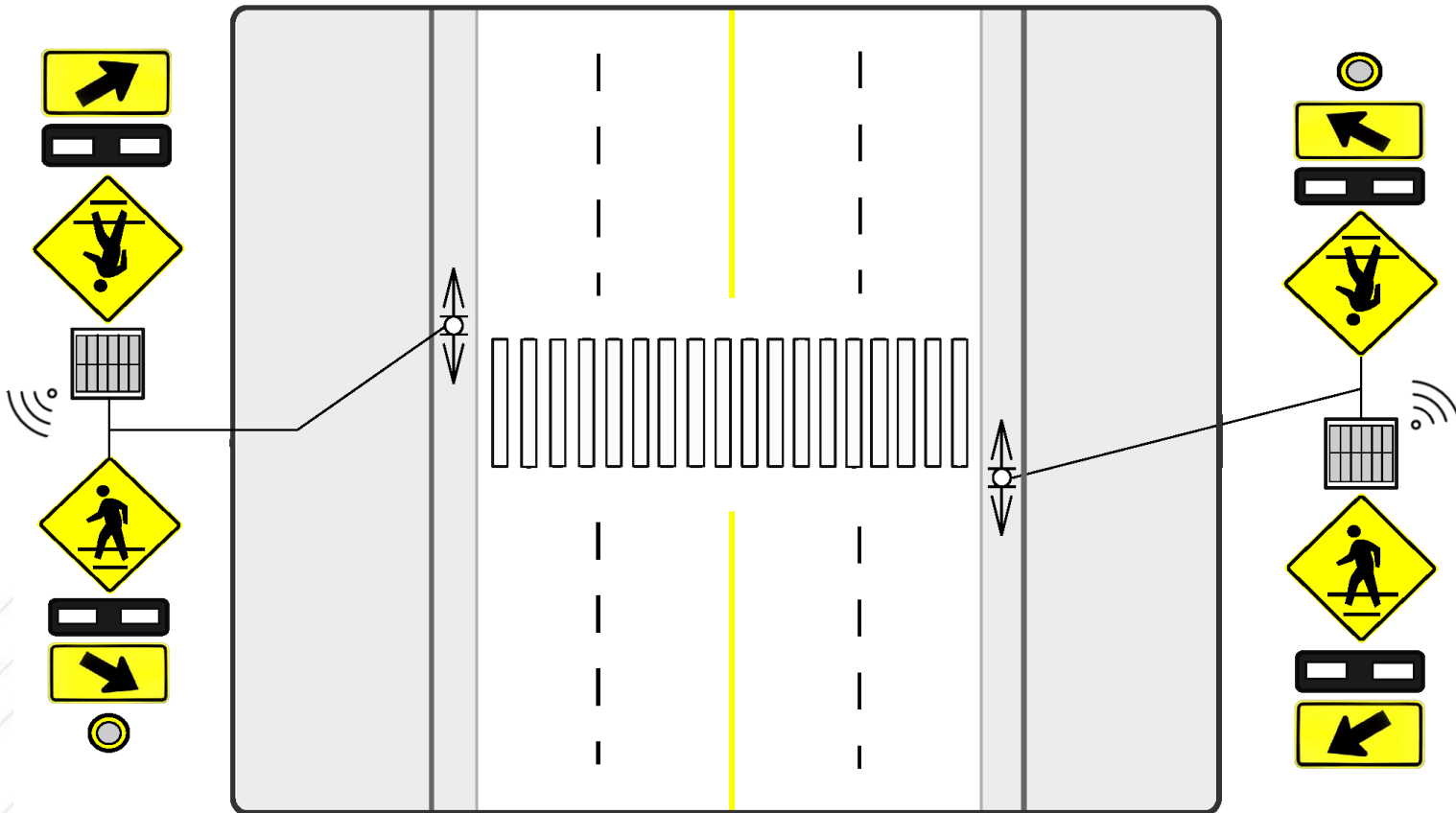
Provides options for:

- Built-in wireless functionality, or
- Trenching some or all of wiring



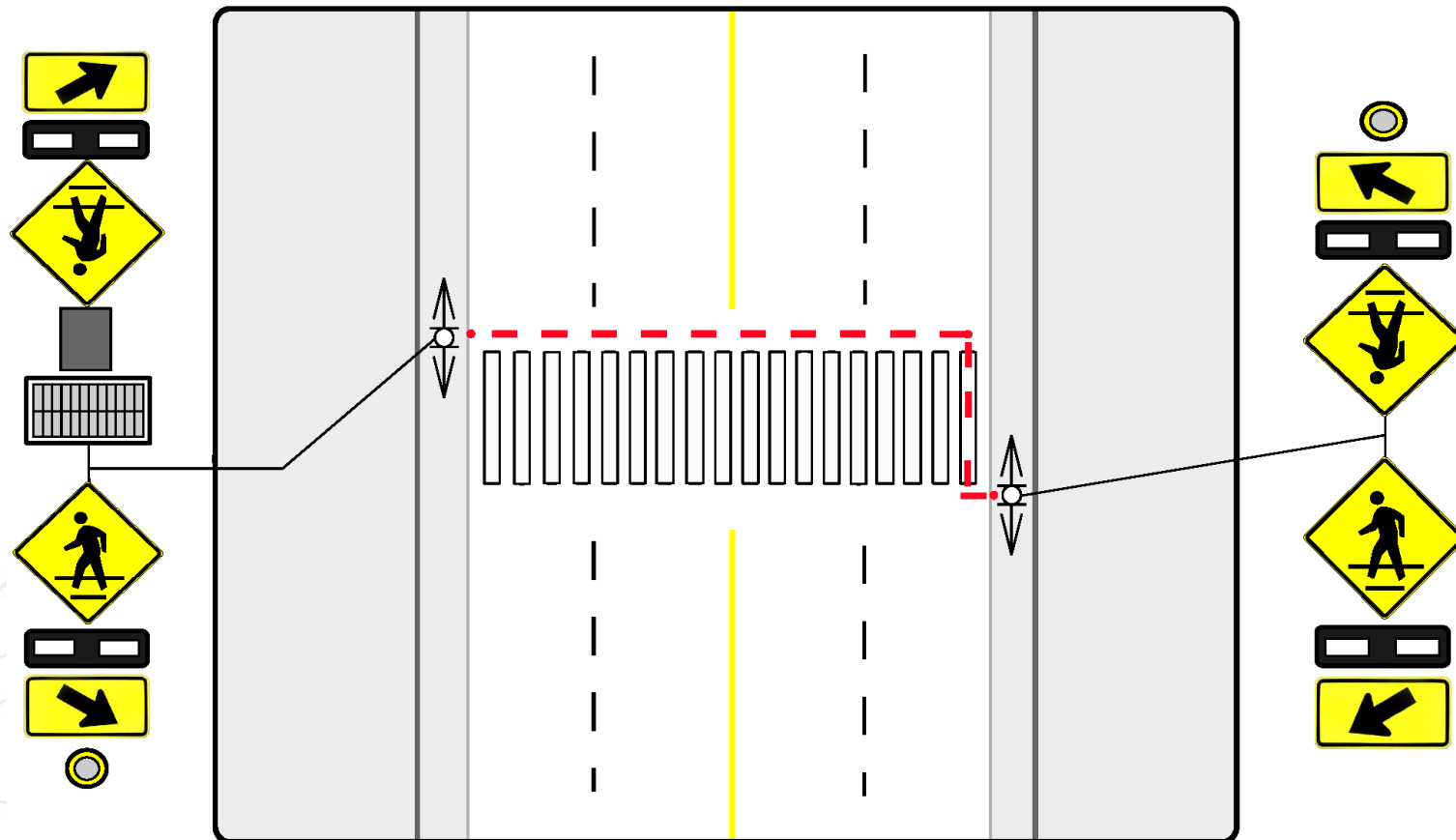
Standard Two-Way Road

Solar-powered with wireless communication



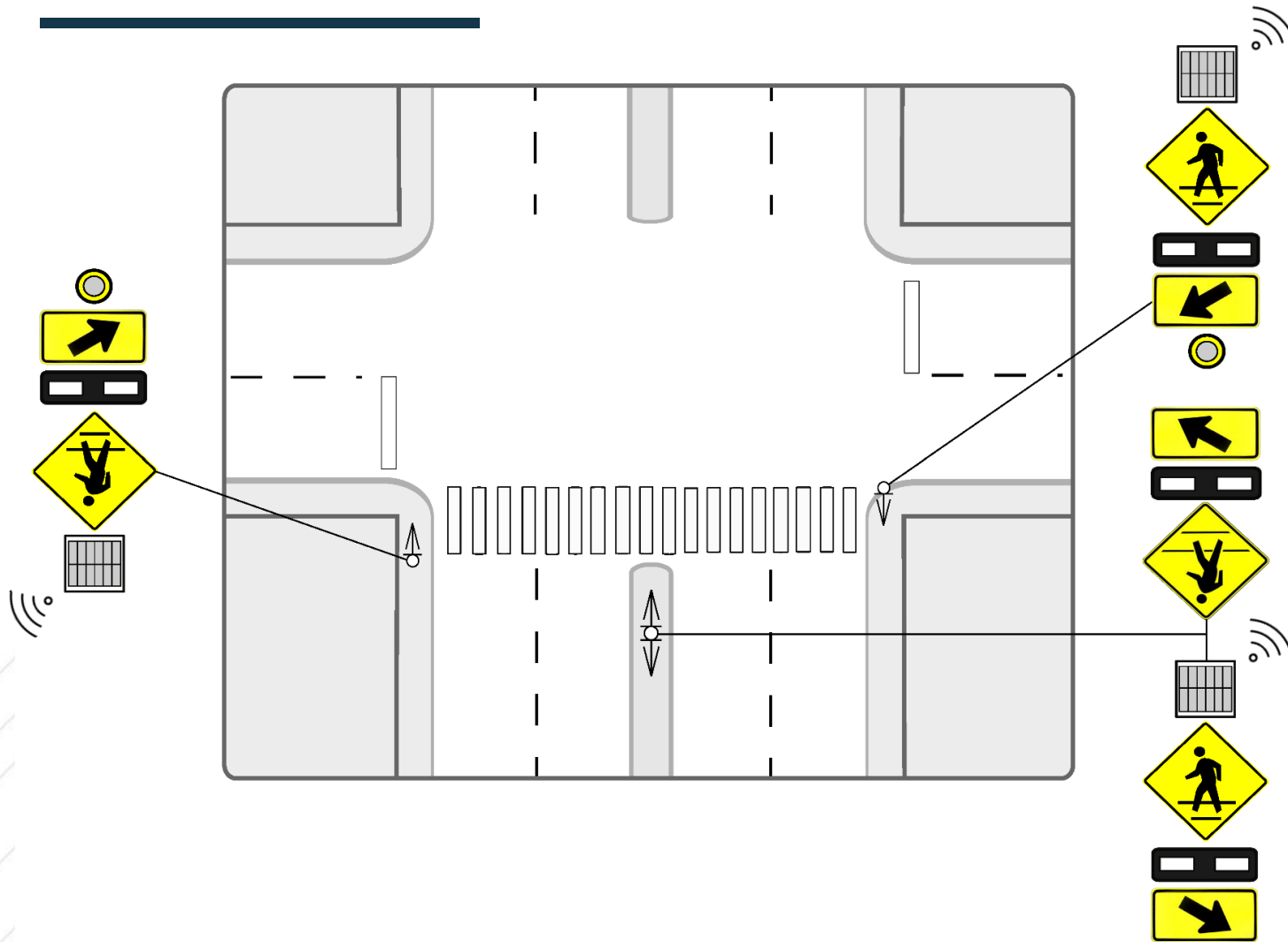
Standard Two-Way Road

Solar-powered with hardwiring



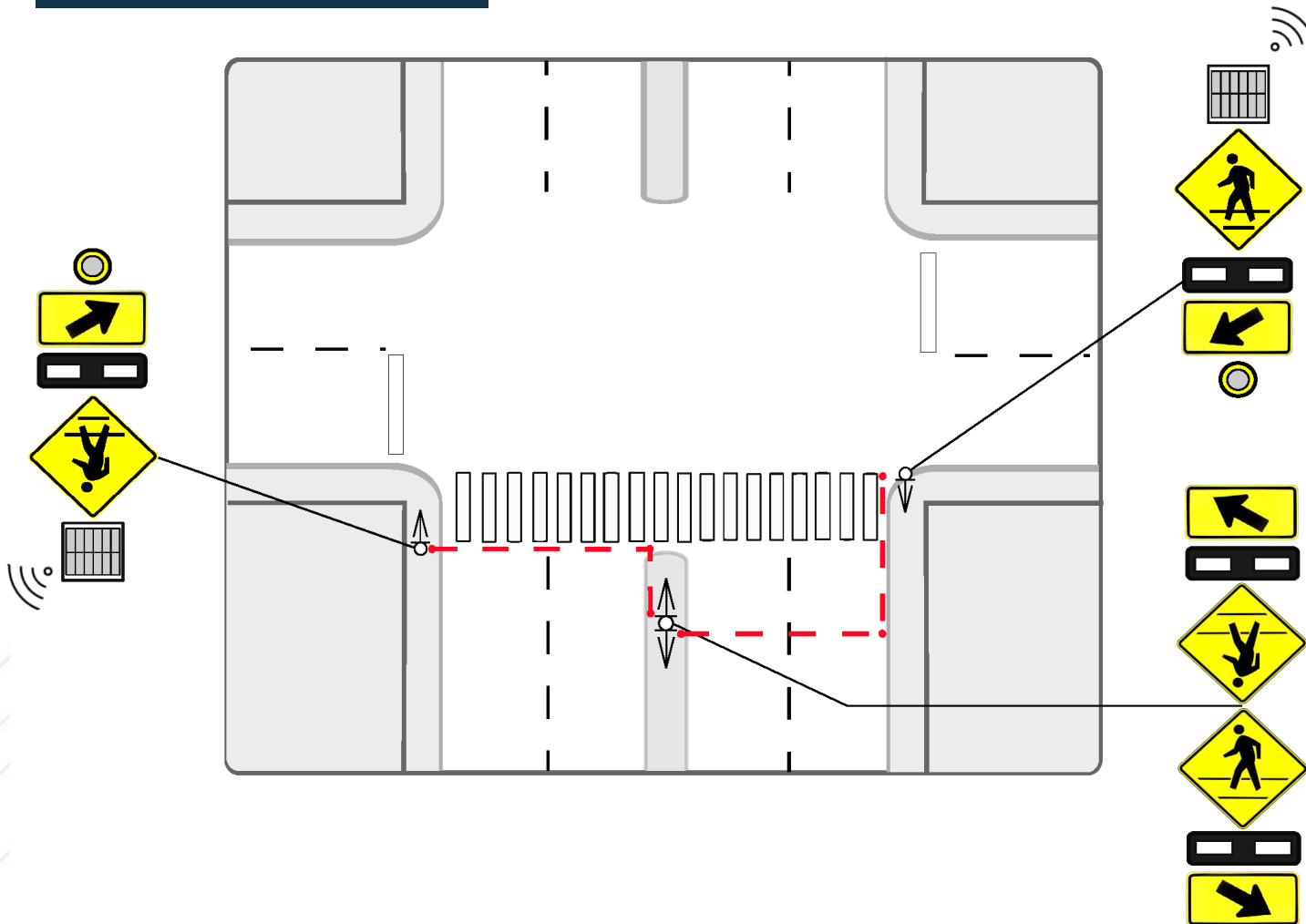
Median Two-Way Road

Solar-powered with wireless communication



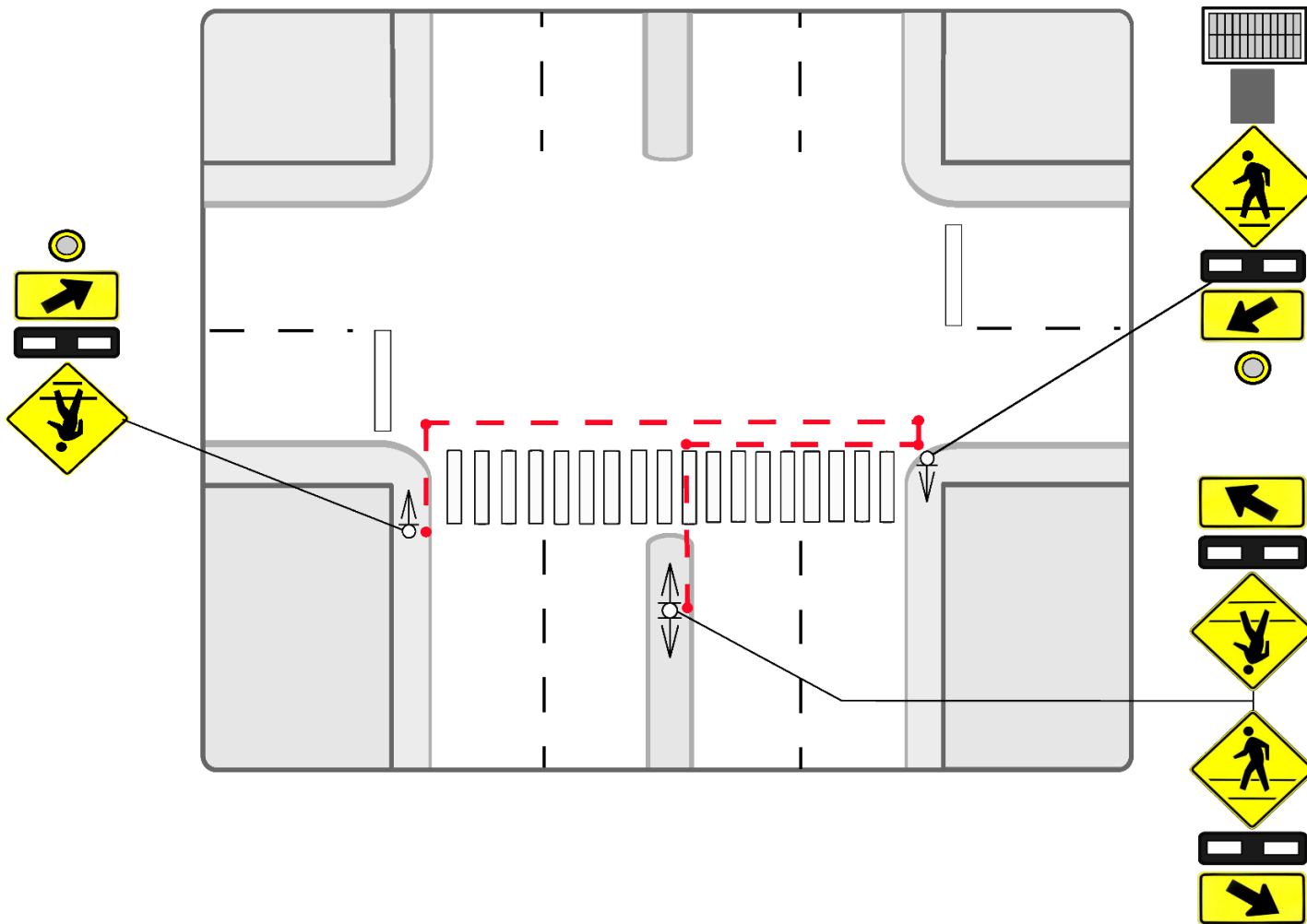
Median Two-Way Road

Solar-powered with wireless and partial hardwiring



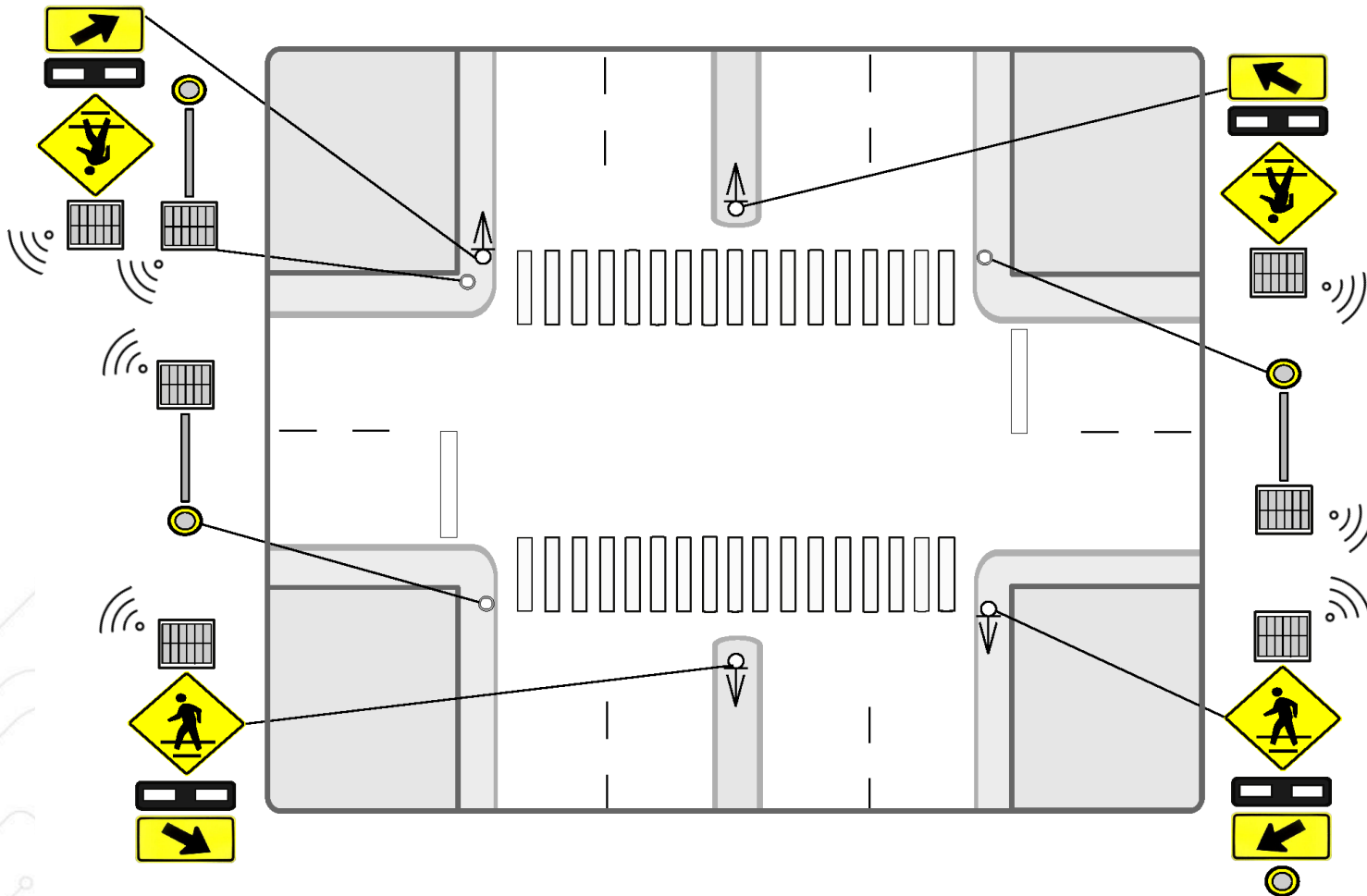
Median Two-Way Road

Solar-powered with hardwiring



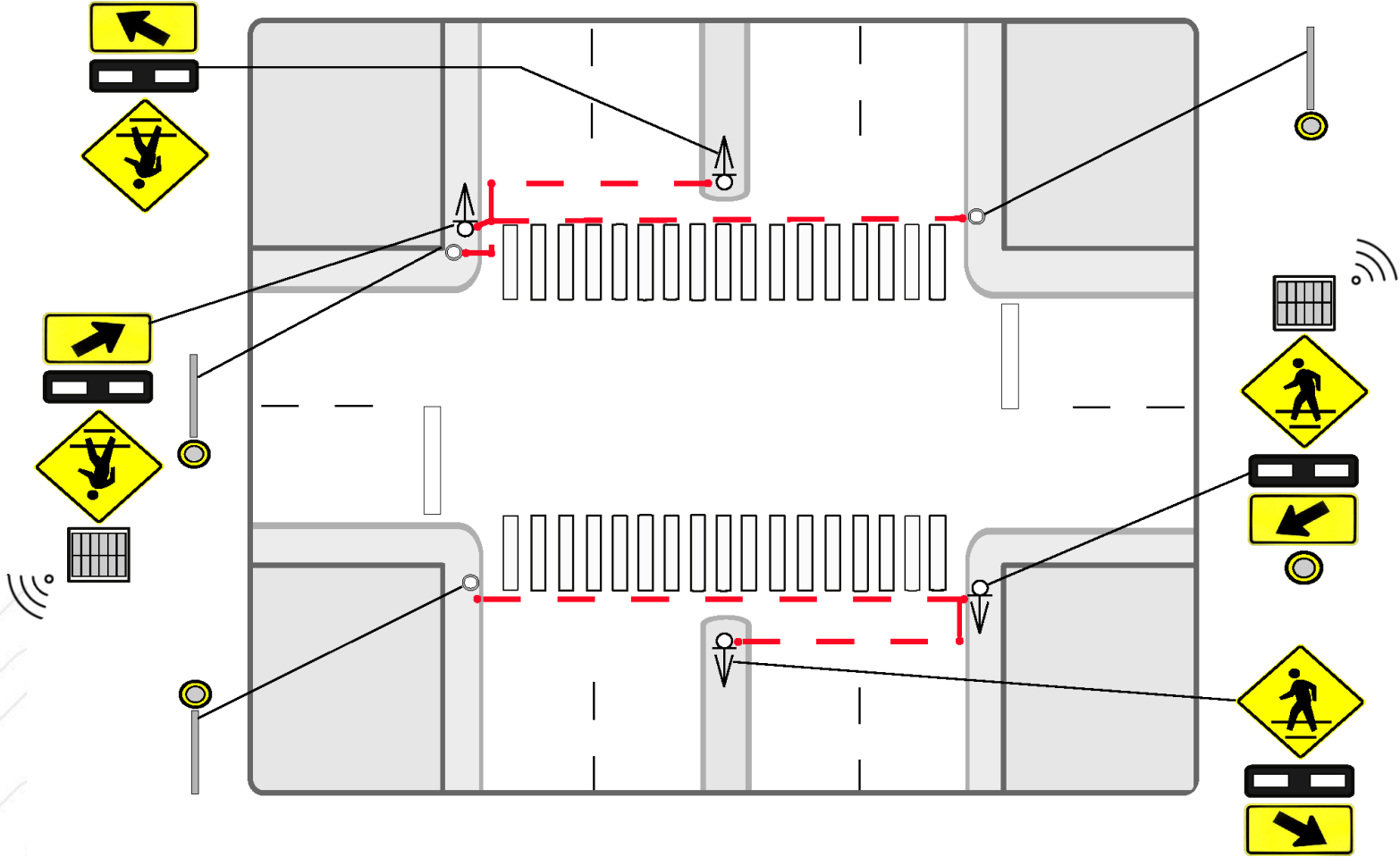
Parallel Crosswalk with Median

Solar-powered with wireless communication



Parallel Crosswalk with Median

Solar-powered with wireless and partial hardwiring



Resources

Learn more:

- [Rectangular Rapid Flashing Beacons](#)
- [School Zone Safety: Rectangular Rapid Flashing Beacons](#)
(6 min. video)

Stay connected with us!



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