Chapter 12

Contents

12 Flashing Beacon Plan

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12.1 Operational and Design Approval

There are several different types of flashing beacons which require different levels of operational and design approval. Each type of flashing beacon is discussed in more detail in the following sections of this chapter.

	Type of Flashing Beacon	Operational Approval Required	Design Approval Required
WARNING BEACONS	Warning beacon for obstructions	RTE approval	NO if ground mounted using solar power (plan sheet still required)
			YES if mounted overhead OR using commercial power
	Warning beacon for standard warning signs (continuous operation)	RTE approval	NO if ground mounted using solar power (plan sheet still required)
			YES if mounted overhead OR using commercial power
	Warning beacon for ramp meter signs	RTE approval	YES – shown on the RAMP METER plan sheet. See chapter 13.
	BE PREPARED TO STOP WHEN FLASHING & PREPARE TO STOP WHEN LIGHTS FLASH actuated systems	STE approval	YES
	Actuated system for bridges	STE approval	YES
	Actuated system for tunnels	STE approval	YES
	Actuated system for emergency vehicles	STE approval	YES
	Through route activated warning signs (TRAWS)	STE approval	YES
	Rectangular rapid flashing beacon (RRFB)	STE approval (Exceptions apply as per ODOT Traffic Manual section 310.3)	YES
	Speed limit sign beacon (school speed zones only)	STE approval (for the school zone itself). Region traffic decides if beacon is used.	NO if ground mounted using solar power (plan sheet still required)
			YES if mounted overhead OR using commercial power
	Stop sign beacon	RTE approval	NO if using solar power (plan sheet still required)
			YES if using commercial power
	Intersection control beacon	RTE approval	YES
	Pedestrian hybrid beacon	STE approval	YES

12.2 Design Information at a Glance

The following table summarizes the major design feature options and associated references for each type of flashing beacon. Each type of flashing beacon in the table is covered under specification 00990 and paid for as a flashing beacon installation. See the individual sections in this chapter for more detailed information and examples. Note: Speed feedback signs shown in the following table are part of an integrated system with the flashing beacon and are listed in the green sheets. Unintegrated speed feedback signs (stand alone, without a flashing beacon) are not considered a "beacon" but are covered in this chapter and in the green sheets as a separate, unique item. See section 12.3 for more info on unintegrated speed feedback signs.

Coordination with the sign designer will be needed when installing the flashing beacon types listed in table or the unintegrated speed feedback sign in order to specify the appropriate sign design and/or sign size information. The standard details for each beacon type provide instructions for using the hex star sign reference bubble note. The signal designer will use the appropriate standard detail and create a plan sheet that is named as follows:

- For all beacon types listed in the following table, the plan sheet title shall be "flashing beacon plan"
- For all unintegrated speed feedback assemblies (DET4456), the plan sheet title shall be "unintegrated speed feedback assembly" and it will be filed under miscellaneous in filenet.

Type of Flashing Beacon (hyperlink to more info)	Std Dwg/ Detail Reference	Ops	Green Sheet Beacon Assembly*	Power Options	Mounting
Warning beacon for obstructions	DET4457	24/7	N/A – BMCF	Commercial only	Pedestal or custom (If used on a bridge)
Warning beacon for standard warning signs	DET4670, DET4681, DET4450	24/7	24/7 flashing beacon assembly: yellow	Solar	PSST or wood post
			N/A - BMCF	Commercial	Pedestal or mast arm
Curve warning sign beacon **with speed feedback**	DET4451	24/7	24/7 flashing beacon assembly: yellow + speed feedback	Solar	Pedestal or mast arm
				Commercial	
Warning beacon for ramp meter signs	TM492 & chapter 13	Time of day/day of week	N/A - custom control system	Commercial only	Pedestal
PREPARE TO STOP WHEN LIGHTS FLASH (OR 15-14) system (overhead only)	None	Actuated	N/A - custom control system	Commercial only	Mast arm
BE PREPARED TO STOP (W3-4) WHEN FLASHING (W16-13P) system	DET4558	Actuated	N/A - custom control system	Commercial only	Pedestal
Actuated system for bridges	DET4453	Actuated	Actuated flashing beacon assembly: ped/bike	Solar	Pedestal
				Commercial	
Actuated system for tunnels	None	Actuated	N/A – custom control system	Commercial only	Custom (typical) or mast arm
Actuated system for emergency vehicles	DET4459	Actuated	N/A – custom control system	Commercial only	Pedestal or mast arm
Through route activated warning signs (TRAWS)	None	Actuated	N/A – custom control system	Commercial only	Pedestal
Rectangular rapid flashing beacon (RRFB)	TM493	Actuated	RRFB assembly	Solar	Pedestal or mast arm
				Commercial	
School speed limit sign beacon	DET4454	Time of day/day of week	Actuated flashing beacon assembly: school	Solar	Pedestal or mast arm
				Commercial	
School speed limit sign beacon **with speed feedback**	DET4455	Time of day/day of week	Actuated flashing beacon assembly: school + speed feedback (small or large)	Solar	Pedestal or mast arm
				Commercial	
Stop sign beacon	DET4670, DET4681, DET4452	24/7	24/7 flashing beacon assembly: red	Solar	PSST or wood post
			N/A - BMCF	Commercial	Pedestal
Intersection control beacon	None	24/7	N/A – BMCF	Commercial only	Mast arm
Pedestrian hybrid beacon (PHB)	None	Actuated	N/A – custom control system	Commercial only	Mast arm

*Only beacon types that require a BMCF service for power AND a control system are listed and shown in red. Use a BMC for all other flashing beacons when using commercial power.

12.3 Speed Feedback Signs (Unintegrated)

Unintegrated speed feedback signs are a stand-alone electrical device (e.g., not integrated with a flashing beacon system). There are only two situations where an unintegrated speed feedback sign is used in conjunction with another sign:

1. Speed limit sign (R2-1)
2. Curve warning sign (W1-1 thru W1-5, W1-11, W1-15)

An unintegrated speed feedback sign shall be mounted on the same support with the appropriate accompanying sign. Do not install a speed feedback sign alone on a separate support.

Solar power is the only option for this device.

It is a green sheet item: unintegrated speed feedback assembly. Use standard detail DET4456 and special provision 00991. DET4456 also contains additional design information and how to properly detail this device on a plan sheet.

See the ODOT Traffic Manual for more information on the proper application and required approvals for speed feedback signs.

12.4 Power Source

Certain flashing beacons can be powered either by commercial power or solar power. Beacons that require a custom control system (as opposed to a turn-key control system listed on the green sheets) require commercial power. See section 12.2. If the beacon installation can be either commercial or solar, the decision on which one to use should be made in conjunction with the region electrical crew. There are pros and cons to each one, shown below.

COMMERCIAL POWER	
Pros	**Cons**
Reliable	Monthly power bill
Easy access and cost effective installation in urban areas	May not be available or cost effective in rural areas
SOLAR POWER	
Pros	**Cons**
Good performance with unimpeded view of the sun	More costly initial installation
No monthly power bill	Requires maintenance/replacement of solar system in the future (array and batteries)
Good option where use of commercial power is impractical	Locations with impeded views will require larger (or additional) arrays/batteries
	May be subject to theft or vandalism

Standard solar power systems are designed for an unimpeded view of sun during daylight hours. If solar power is going to be used in a location that has an impeded view during the daylight hours (blocked by trees, buildings, etc.) contact the state traffic signal engineer to correctly size the array and number of batteries. If solar power is an acceptable option for the type of beacon, it will be shown in the applicable standard detail (see table in section 12.2 for power options of all beacon types and the associated standard drawing/standard detail reference).

If commercial power is used, the support post shall be a pedestal. Standard sign supports such as wood posts and PSST are NOT allowed for mounting a flashing beacon when commercial power is used due to the necessity of conduit and wiring along the length of the support which negatively affects the break-away characteristics of the post. A separate base mounted flasher cabinet (BMCF) is required to power AND provide the control system for all 24/7 flashing beacons, with the exception of the curve warning beacon + speed feedback that requires a standard BMC. All other flashing beacon types require a standard BMC for power only. See table in section 12.2 and standard drawing TM485.

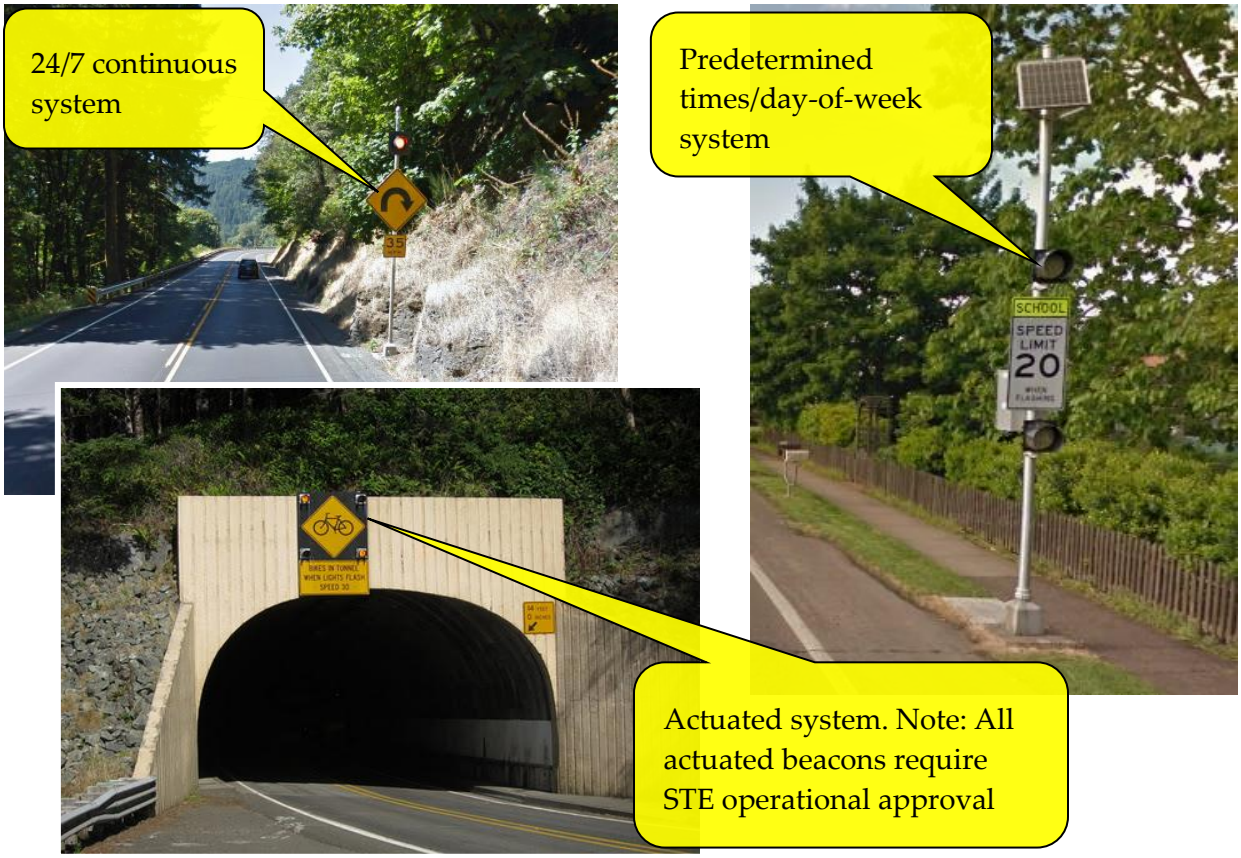
Design approval is required if commercial power is used.

12.5 Beacon Operation

Depending on the application of the flashing beacon, they may operate in the following ways (see Figure 12-1):

- **Continuously.** This operation is used when the condition or regulation exists at all times, for example, obstructions in or near the roadway, "signal ahead" and "curve ahead" warning signs.
- **Only during certain times/day-of-week.** This operation is used when the condition or regulation exists for a predetermined duration, for example, school speed zone regulatory signs and ramp meter warning signs. This type of operation typically includes the phrase, "WHEN FLASHING" in the sign legend.
- **Actuated (either passive or pushbutton).** This operation is used when the condition or regulation exists only when there is actual demand, for example, peds using a mid-block crossing, bikes/peds using a tunnel or bridge, and BE PREPARED TO STOP WHEN FLASHING systems. This type of operation also usually includes the phase, "WHEN FLASHING" in the sign legend (one major exception is mid-block crosswalk signing, which does not use the phrase "WHEN FLASHING").

Figure 12-1 | Beacon Operation Examples



12.6 Sight Distance Considerations

Flashing beacons should meet requirements stated in MUTCD chapter 4L, which includes the provisions of chapter 4D, and therefore the sight distance for visibility to the flashing beacon should strive to meet the requirements in Table 4D-2 if possible. However, many of the flashing beacon assemblies are associated with a regulatory or warning sign that requires placement of the sign in a particular location as per chapter 2 of the MUTCD (e.g., Table 2C-4). As long as the MUTCD sign placement requirements are satisfied (visibility, legibility, and perception/reaction time to the sign message), the visibility to the associated flashing beacon should also be adequate.

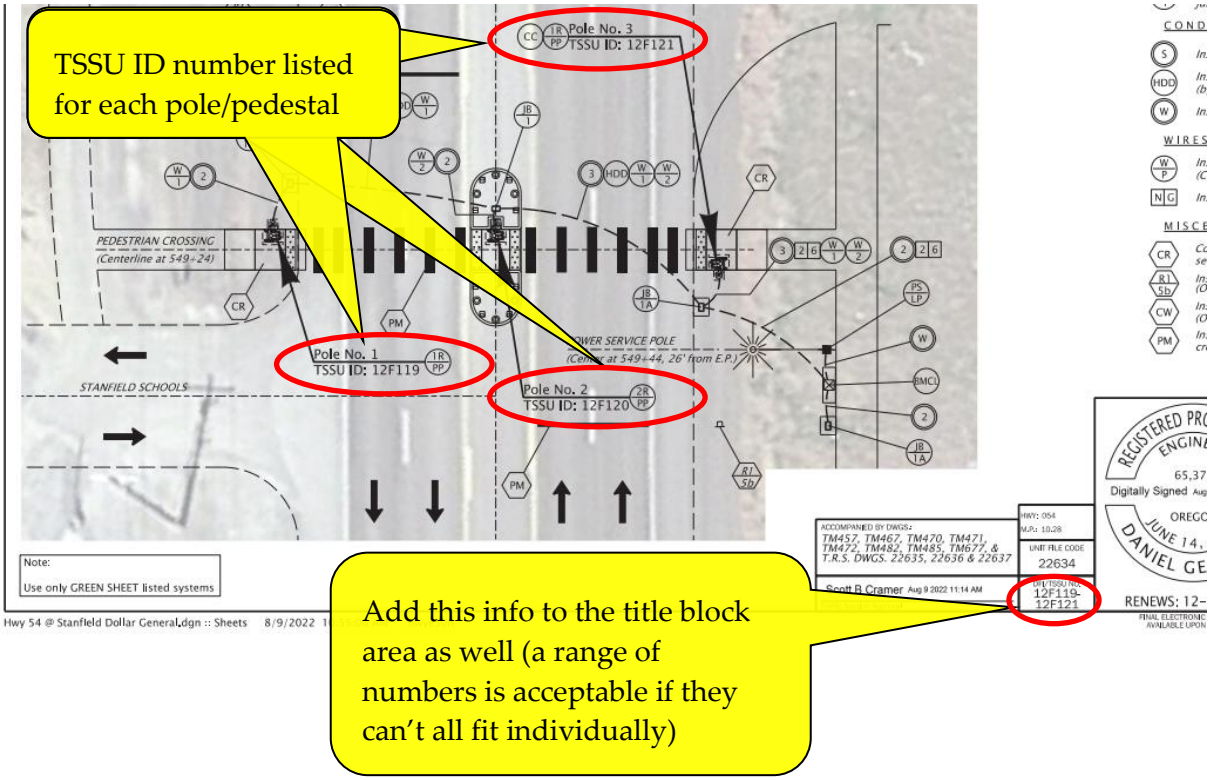
It is also important to be aware of obstructions that may partially or fully block the sign and/or flashing beacon as a vehicle approaches it, such as a closely spaced sign immediately prior to the flashing beacon assembly. See Figure 12-2 for example. The possible solutions will vary depending on the site-specific conditions but could include removing a sign, laterally offsetting the signs, adding more spacing between the signs, adjusting the signs mounting height, or using an overhead mount.

Figure 12-2 | Sight Distance Considerations – Closely Spaced Sign Can Obstruct the Flashing Beacon

12.7 TSSU ID Numbers for Flashing Beacon Installations

Flashing beacon installations are now being tracked and evaluated as part of the traffic signal asset management program. This requires a unique TSSU ID number for each pole/pedestal that is used for a flashing beacon installation. The TSSU ID number is assigned by the traffic engineering section. See chapter 2 for more information about obtaining the TSSU ID number. Showing the TSSU ID number(s) on the plan sheet for a flashing beacon installation should be done as per Figure 12-3.

Figure 12-3 | Showing TSSU ID Numbers for Flashing Beacon Installations on Plan Sheets



12.8 Warning Beacon

A warning beacon provides supplemental emphasis for warning signs, regulatory signs, or markers. See MUTCD Section 4L.03 for more information. The following subsections list the common types of warning beacons used on the state highway.

Warning beacons are generally ground mounted, but they may be mounted overhead for greater conspicuity.

12.8.1 Warning Beacons for Obstructions

On the state highway, warning beacons are typically only used to emphasize one type of obstruction: impact attenuators located within the gore area of highway bifurcations. See Figure 12-4 and Figure 12-5 for examples.

This type of flashing beacon is NOT a green sheet item.

For this application, two vertically oriented, 12-inch circular yellow indications (custom signal head type) are mounted on a pedestal. A BMCF is used for both the power and control system. See standard detail DET4457 for more design information and how to properly detail this type of flashing beacon on a plan sheet.

Figure 12-4 | Warning Beacon for an Obstruction, Example 1

Figure 12-5 | Warning Beacon for an Obstruction, Example 2

12.8.2 Warning Beacons for Warning Signs (Continuous Operation)

The common signs where warning beacons are used include:

- Signal ahead signs
- Curve signs
- Intersection ahead signs

This type of flashing beacon is a green sheet item and has two categories:

- 24/7 flashing beacon assembly: yellow FOR SOLAR ONLY (note: if this beacon is using commercial power, it is NOT a green sheet item and will require a BMCF for the power and the control system).
- 24/7 flashing beacon assembly: yellow + speed feedback assembly (integrated system)

For ground mounted applications, one type 1Y signal head is mounted directly above the sign on the support post. If solar power is used, the support post may be either a standard wood post or a perforated steel square tube (PSST). There are two standard details, DET4681 (PSST) and DET4670 (wood post) that should be used. See Figure 12-6 for an example. If commercial power is used, the support post is required to be a pedestal. See standard detail DET4450

(pedestal support, without speed feedback assembly). See standard detail DET4551 for a pedestal support, with speed feedback sign (integrated system) – note that this detail is only applicable for curve warning signs. Both standard details DET4450 and DET4451 also contain additional design information and how to properly detail these types of flashing beacons on a plan sheet.

For overhead mounted applications, two type 1Y signal heads are mounted on either side of the sign. A mast arm should always be used if feasible. Clearances above the pavement are the same as for traffic signal heads, 18 feet minimum to 19 feet maximum. See Figure 12-7 for an example.

Figure 12-6 | Warning Beacon for a Warning Sign, Post Mounted

Figure 12-7 | Warning Beacon for a Warning Sign, Overhead

12.8.3 Warning Beacons for Ramp Meter Signs

Ramp meter signs with warning beacons are part of the standard installation for a ramp meter and are shown on the "RAMP METER" plan sheet, not a "FLASHING BEACON" plan sheet. See chapter 13 for information on ramp meter plan sheets.

12.8.4 Actuated Warning Beacons – Bridges

Actuated warning beacons for bridges consist of one type 1Y signal head located above the warning sign. The warning sign legend should contain "WHEN FLASHING" text to inform the motorist of when the condition is applicable.

This type of flashing beacon is a green sheet item: actuated flashing beacon assembly: ped.

For ground mounted applications, one type 1Y signal head is mounted directly above the sign on the support post. See Figure 12-8 for an example. The support post is required to be a pedestal. See standard detail DET4453 for more design information and how to properly detail this type of flashing beacon on a plan sheet.

For overhead mounted applications, two type 1Y signal heads are mounted on either side of the sign. A mast arm should always be used if feasible. Clearances above the pavement are the same as for traffic signal heads, 18 feet minimum to 19 feet maximum.

A pushbutton is the standard form of detection. Pushbuttons shall be located according to the requirements stated in chapter 5 and where they are easily accessible for all intended users (pedestrians and/or cyclists).

Bridges are usually illuminated and therefore, commercial power for the actuated warning beacon system can typically be obtained from the illumination service cabinet. Work with the ODOT bridge section if any conduit or wiring for the actuated warning system needs to go across the structure.

Figure 12-8 | Warning Beacon for a Warning Sign, Actuated Operation, Post Mounted

12.8.5 Actuated Warning Beacon – Tunnels

Actuated warning beacons for tunnels consists of an Oregon specific sign (OBW1-8) which has four 8-inch circular yellow indications within the sign boarder. See Figure 12-9 which shows sign OBW1-8 from the ODOT Sign Policy and Guidelines, chapter 8. This sign assembly should be mounted overhead on the tunnel entrance, centered over the tunnel entrance. Ground mounted installations are not allowed. See Figure 12-10 and Figure 12-11 for examples.

A pushbutton is the standard form of detection. Pushbuttons shall be located according to the requirements stated in chapter 5, and where they are easily accessible for all intended users (pedestrians and/or cyclists).

This type of flashing beacon is NOT a green sheet item. A custom control system using time-delay relays is used for these systems. Contact the state traffic signal engineer for assistance in designing the proper control system.

Tunnels are always illuminated and therefore, commercial power for the actuated warning beacon system can typically be obtained from the illumination service cabinet.

Figure 12-9 | Actuated Warning Beacon – Tunnel Signing

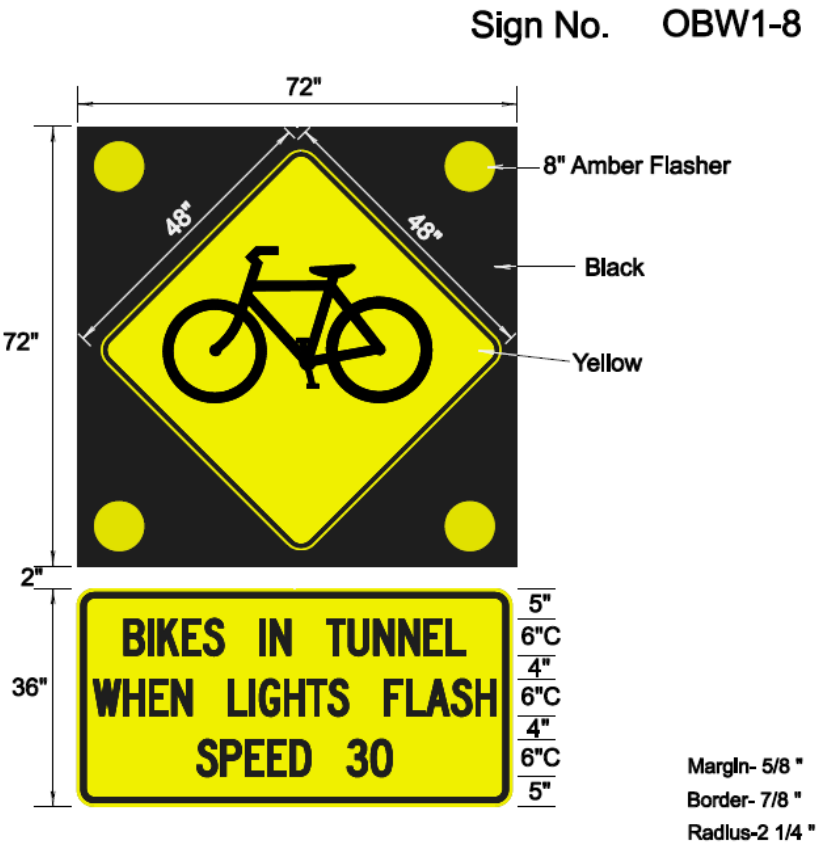


Figure 12-10 | Actuated Warning Beacon – Tunnel, Example 1

Figure 12-11 | Actuated Warning Beacon – Tunnel, Example 2

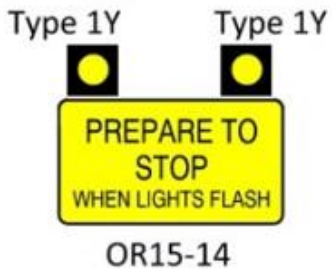
12.8.6 Actuated Warning Beacon – PREPARE TO STOP WHEN LIGHTS FLASH

PREPARE TO STOP WHEN LIGHTS FLASH warning beacons are typically used in advance of a traffic signal, or a special application thereof, such as for a location of roadway that has poor sight distance and experiences frequent back-ups. They are also commonly used for moveable bridges (see chapter 23 for more information on movable bridges) and for railroad crossings (see chapter 16, section 16.9 for more information on how this device is used at a railroad crossing).

This type of flashing beacon is NOT a green sheet item.

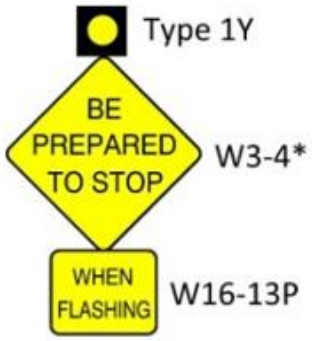
PREPARE TO STOP WHEN LIGHTS FLASH warning beacons consist of an Oregon specific sign (OW15-14) with two type 1Y signal heads located above the sign. See Figure 12-12 which shows sign OW15-14 from the ODOT Sign Policy and Guidelines, chapter 4. This assembly should be mounted overhead centered over the travel lane(s). See Figure 12-14 for an example.

Figure 12-12 | Actuated Warning Beacon – Overhead Application



If this message doesn't need to be displayed overhead based on engineering judgment, the ground mounted version consisting of a BE PREPARED TO STOP sign (W3-4) with a WHEN FLASHING sign rider (W16-13P) mounted on a pedestal may be used. See Figure 12-13.

Figure 12-13 | Actuated Warning Beacon – Ground Mounted Application



Radar detection is the standard. The location of the detection and sign is critical to the proper operation of the beacons and is determined by an engineering study and documented in the STE operational approval. A stand-alone pole or pedestal may be required to mount the radar detector unit in the proper location.

If this type of system is used in advance of a traffic signal, it needs to be connected to the traffic signal controller.

If this type of system is NOT used in advance of a traffic signal, a custom control system using time-delay relays is used. Contact the state traffic signal engineer for assistance in designing the proper control system.

Figure 12-14 | Warning Beacon Supplementing a Warning Sign, Passive Activation Operation, Overhead

12.8.7 Actuated Warning Beacon – Mid-block Crosswalks

Actuated warning beacons for mid-block crosswalks were used in the past at marked crosswalks before rectangular rapid flashing beacons (RRFB). See Figure 12-15 for an example. They are no longer installed and existing installations should be replaced with an RRFB. See Section 12.9 for information on RRFB design.

Figure 12-15 | Warning Beacon for a Warning Sign, Actuated Operation, Ground Mounted

12.8.8 Actuated Warning Beacon – Emergency Vehicles

Actuated warning beacons for emergency vehicles are a good alternative to traditional fire signals (described in chapter 17). They are less expensive and provide an accurate, advance warning to drivers that they need to yield to an emergency vehicle accessing the roadway.

This type of flashing beacon is NOT a green sheet item.

For ground mounted applications, one type 1Y signal head is mounted directly above the sign on the support post. See Figure 12-16. The support post is required to be a pedestal. See standard detail DET4459 for more design information and how to properly detail this type of flashing beacon on a plan sheet.

One assembly is required per approach, located on the right side of the roadway.

For overhead mounted applications, two type 1Y signal heads are mounted on either side of the sign. A mast arm should always be used if feasible. Clearances above the pavement are the same as for traffic signal heads, 18 feet minimum to 19 feet maximum.

Contact the state traffic signal engineer for assistance in designing the proper control system.

Figure 12-16 | Warning Beacon for an Emergency Vehicle Sign, Actuated Operation, Ground Mounted

12.8.9 Actuated Warning Beacon – TRAWS

Through route activated warning signs (TRAWS) are used to help reduce the potential and severity of right-angle collisions at stop-controlled intersections.

This type of flashing beacon is NOT a green sheet item.

Detection for the side street (stop controlled approach) activates flashing beacons on the mainline to alert drivers to watch for entering vehicles.

One assembly is required per approach, located on the right side of the roadway. However, a supplemental assembly on the left side of the roadway is recommended for added conspicuity/emphasis or if there are concerns about sign occlusion. See Figure 12-17. They are located 500 to 1000 feet from the intersection. This allows the needed flexibility to work around other conflicts (such as signing, environmental, drainage, etc.) while still providing adequate warning time to the motorist. Work with region traffic to determine the best location based on the site specifics.

For ground mounted applications, one type 1Y signal head is mounted directly above the sign and one below the sign on the support post (typically a pedestal). See Figure 12-18. They operate in a wig-wag pattern.

Other design requirements:

- The controller cabinet is a 334 with and ATC controller
- The service cabinet is a BMC
- Three No. 12 AWG THWN wires required for each assembly. See Figure 12-19.
- Near range radar detector unit mounted on a pedestal or pole to provide a detection zone at least 75 feet in length from the stop line.

For overhead mounted applications, two type 1Y signal heads are mounted on either side of the sign. A mast arm should always be used if feasible. Clearances above the pavement are the same as for traffic signal heads, 18 feet minimum to 19 feet maximum.

Figure 12-17 | TRAWS Location and Placement Example

Figure 12-18 | TRAWS Assembly Example

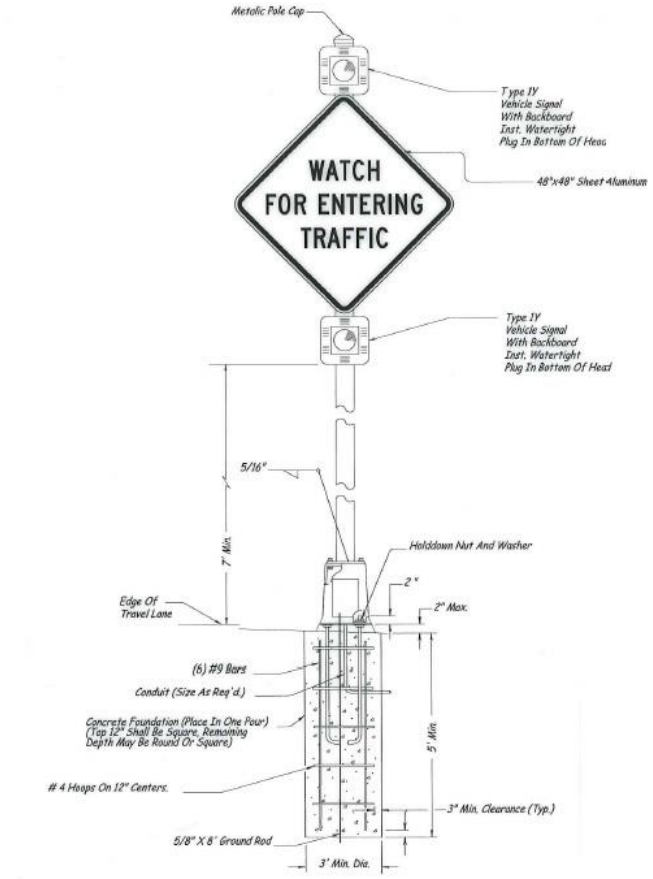
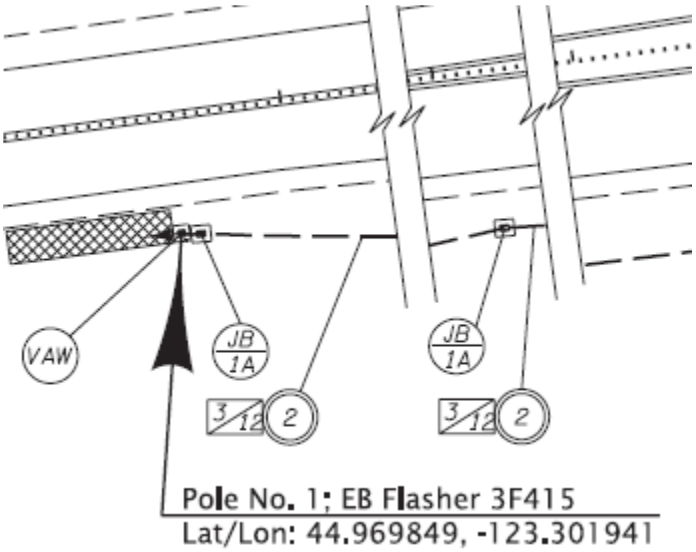


Figure 12-19 | TRAWS Wiring Example



12.9 Rectangular Rapid Flashing Beacon (RRFB)

A rectangular rapid flashing beacon is different from an actuated warning beacon for mid-block crosswalk discussed in section 12.8.7. The RRFB operation is the same, but it uses a unique shape and flash pattern to supplement a W11-2 (pedestrian), W11-15 (trail) or S1-1 (school) crossing warning sign with a diagonal downward arrow (W16-7p) plaque only. It has been proven as an effective device and is now the only option for an actuated warning beacon for a mid-block crosswalk.

12.9.1 MUTCD Interim Approval

The RRFB was granted interim approval by FHWA for the 2009 version of the MUTCD. It has now been incorporated into the 11th edition of the MUTCD in chapter 4L. The signal designer should follow the guidance in MUTCD chapter 4L in addition to the guidance presented in this manual. The ODOT Traffic Manual also contains additional information about the use of RRFBs.

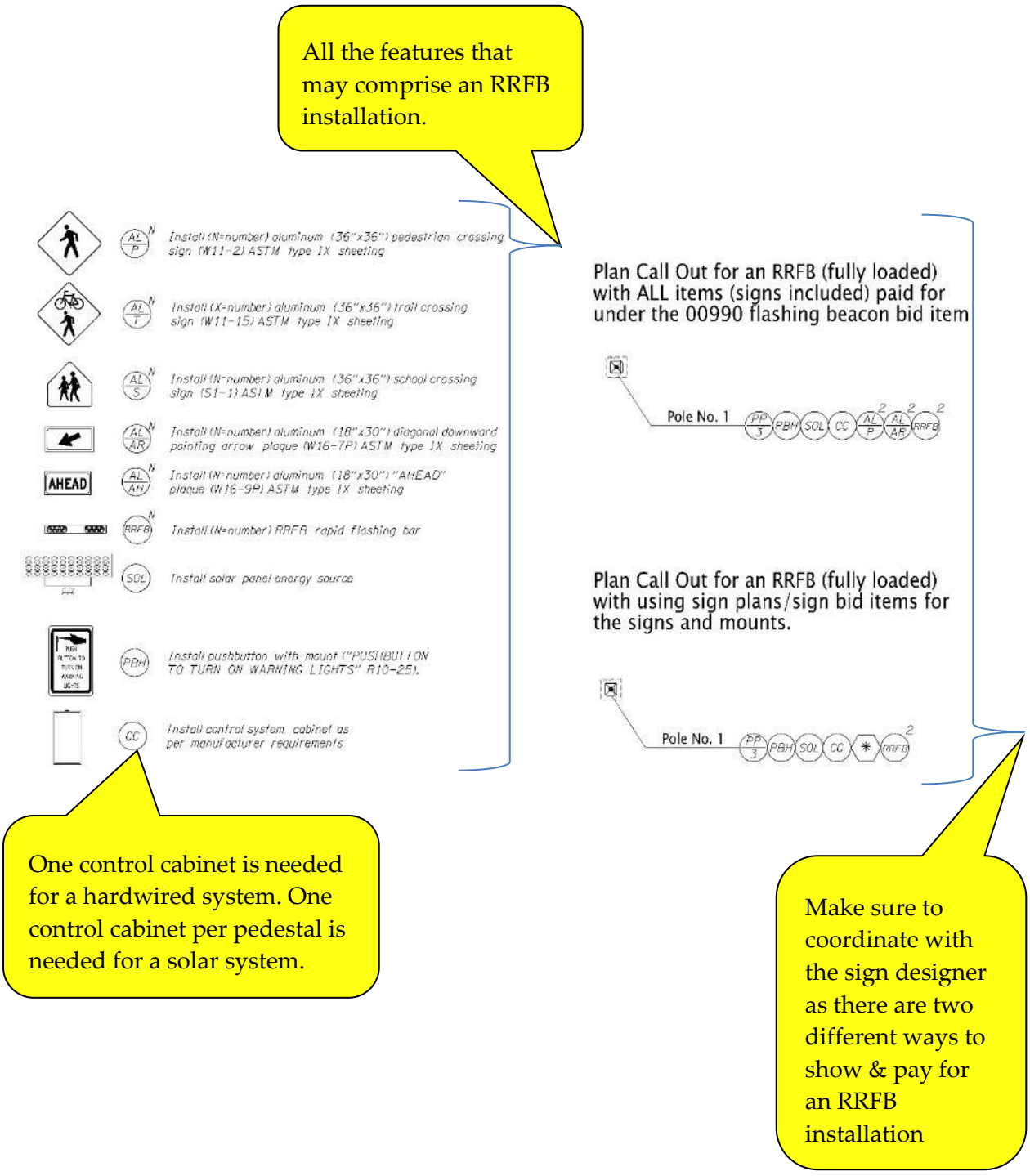
12.9.2 Device Assembly Requirements

The traffic engineering section has prequalified RRFB assemblies that meet the MUTCD device requirements and listed them on the green sheets (see chapter 20 for more information on the green sheets).

Use the most current microstation workspace for the new RRFB bubble notes and plan call out structure. Note there are two different ways to show/pay for an RRFB installation (coordinate with the sign designer). See Figure 12-20.

Use standard drawing TM493 for RRFB assemblies. The drawing contains the basic installation details for mounting an RRFB to a pedestal, signal pole, or mast arm.

Figure 12-20 | RRFB Bubble Notes and Plan Call Out Structure



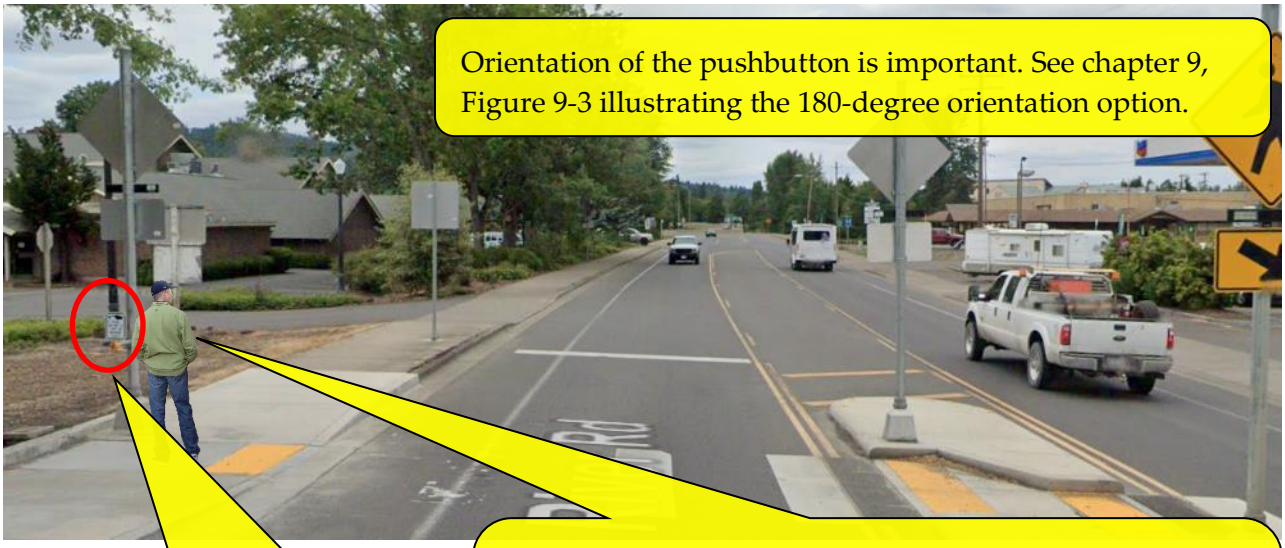
12.9.3 Pushbutton Requirements

Pushbuttons shall be provided according to the requirements stated in chapter 5. The Additional guidance presented below only applies only to RRFB installations.

General:

- See standard details DET 1770 and DET 1771 for the typical layout/geometry of a mid-block crossing and pushbutton locations.
- When possible, combining the pushbutton with the RRFB assembly is preferred to avoid installation of multiple support structures.
- When possible, the pushbutton should be located in such a way that when the pedestrian pushes the pushbutton, they will be facing oncoming traffic. In general, pedestrians will tend to face the pushbutton sign (so they can read it) when they push the pushbutton. See Figure 12-21.

Figure 12-21 | Preferred Pushbutton Placement to Provide Line of Sight to Oncoming Traffic



Pedestrian refuge islands:

Section 5.1.5 raised median islands and crosswalk alignment does not apply to RRFB installations. This is because an RRFB is only a warning device and does not assign right-of-way to the pedestrian or the vehicle (e.g., a pedestrian is not required to activate the RRFB to legally enter the crosswalk and vehicles must still stop for a pedestrian legally entering the crosswalk). Pushbuttons in median islands as discussed in section 5.1.5 applies only to pushbuttons that assign right-of-way (e.g., require activation to legally enter the crosswalk via a pedestrian phase).

A refuge island is common for an RRFB installation (see ODOT Traffic Manual). The design and operation of a typical RRFB will allow for the majority of pedestrians to traverse the entire crosswalk without needing to take refuge and re-activate the RRFB via a pushbutton in the refuge island. Typically the refuge island is small, crosswalk alignment is straight, and the RRFB indications for both directions of traffic activate simultaneously and are timed for the entire crossing upon any pushbutton activation. However, this is not true for all design configurations or all potential users and therefore it is important to consider providing a way to re-activate the RRFB when there is higher likelihood that users will desire or need to take refuge in the island. As such, a pushbutton should be installed in the refuge island in any of the following conditions:

- The RRFB is installed at a roundabout. Locate the pushbutton in the splitter island separating the entry and exit vehicles. See Figure 12-22. Additional roundabout specific considerations are shown in Figure 12-23.
- The total motor vehicle lanes crossed by the pedestrian is 4 or greater. See Figure 12-24.
- The refuge island is wide and/or requires pedestrians to walk a significant distance due to a staggered crosswalk alignment. See Figure 12-25 and Figure 12-26. These configurations may be good candidates to operate as a two-stage crossing.
- A CQCR request has been made.

A pushbutton shall be installed in refuge island when:

- The RRFB devices operate as a two-stage crossing (i.e., RRFBs for each direction of vehicle travel are activated independently).

The operational approval will state the requirements for the RRFB operation and crosswalk location(s).

Figure 12-22 | Refuge Island Pushbutton Recommended: RRFB Installed at a Roundabout

RRFB indications are typically required for multi-lane pedestrian crossings at roundabouts.

Note: A single entry or exit lane is considered a part of the entire crosswalk and will require RRFB indications if there is a multi-lane crossing on the same approach leg.

The roadway alignment for vehicles entering and exiting a roundabout makes it much harder for a pedestrian to judge when a vehicle will stop, especially for pedestrians with visual impairments. The roadway alignment also makes it difficult to place the RRFB indications that are in the driver's line of sight at all times. Based on these conditions, a pushbutton in the splitter island is recommended. It allows a pedestrian to take extra time in the refuge island to ensure vehicles have time to perceive and react to them and the RRFB indications.

A two-stage crossing operation at a roundabout may be an option, but given the roadway alignment issues, a one-stage crossing operation may be desirable to provide a longer duration of flashing time to improve the odds of drivers seeing the activated RRFB device BEFORE the pedestrian even reaches the splitter island.

Figure 12-23 | Roundabout Specific Considerations: By-Pass Lane

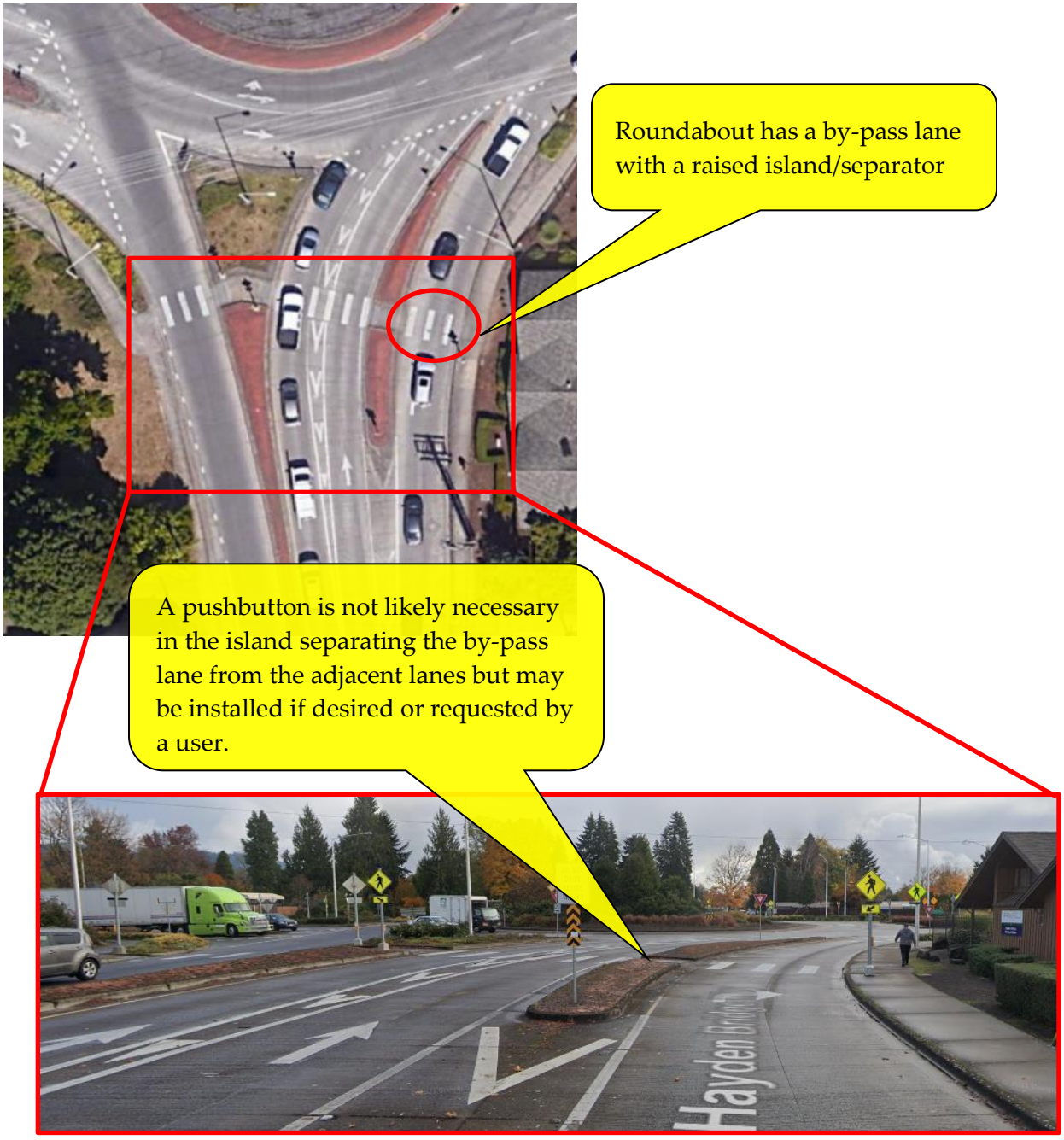


Figure 12-24 | Refuge Island Pushbutton Recommended: Total Number of Lanes Crossed by the Pedestrian is Greater Than Four

Figure 12-25 | Refuge Island Pushbutton Recommended: Wide Refuge Island

Wide refuge island requires pedestrians to walk a significant distance: Refuge island pushbutton is recommended.

Note: In this example, two pushbuttons are likely required to meet section 5.4.2 requirements. A two-stage crossing operation is also an option.

Figure 12-26 | Refuge Island Pushbutton Recommended: Staggered Crosswalks Requiring Pedestrians to Walk a Significant Distance

Staggered crosswalks require pedestrians to walk a significant distance: Refuge island pushbutton is recommended.

Note: In this example, two pushbuttons are likely required to meet section 5.4.2 requirements. A two-stage crossing operation is also an option.

A one-stage crossing operation will activate all RRFB devices simultaneously upon activating any pushbutton (the most common type). This requires only one pushbutton in the refuge island to properly activate the RRFB devices. It should be placed in the center of the refuge

island to provide the best access for both directions of pedestrian travel and to lessen the chance of being struck by an errant vehicle. For really wide refuge islands or refuge islands with crosswalks staggered by a large distance, two pushbuttons may be required to meet the 15-foot maximum path of travel from the pushbutton to the curb ramp edge (see section 5.4.2).

A two-stage crossing operation will activate the RRFB devices for each direction of travel independently (for each stage of the crossing). This requires two pushbuttons in the refuge island to properly activate the RRFB devices. Adequate separation/staggering of each crossing is required to clearly indicate to all users that the entire crossing is always traversed in two distinct, independent stages. See Figure 12-25 and Figure 12-26 for examples where two-stage crossing operation may be a good solution.

A pushbutton is not recommended in a raised median, refuge island, or splitter island that is not wide enough to accommodate a single user with a standard mobility device (e.g., a 5-foot wide or smaller). See Figure 12-27. In these cases, it is best to discourage all pedestrians from taking refuge in the median/island by omitting the pushbutton. If a pushbutton is requested or desired at a location where the median/island is not ideal for all pedestrians to take refuge, the median/island and roadway cross section should be re-designed accordingly.

Figure 12-27 | Omit Pushbutton in Small Raised Medians

If the pushbutton is omitted from any refuge island, the refuge island shall still be designed to allow an ADA compliant installation of the pushbutton in the future (e.g., in the event of a CQCR request). Conduit for future use shall be installed with a junction box located where the future pushbutton pedestal foundation should be located. Alternatively, if an RRFB assembly is placed in the refuge island, locate it in such way that a pushbutton could easily be added to the pole.

12.9.4 Location of Assemblies

RRFBs are located at or immediately adjacent to an uncontrolled, marked crosswalk. For each approach on which RRFBs are used, two assemblies are required, one on the right side of the roadway and one on the left side of the roadway. On a divided highway or a roadway with a median island pedestrian refuge, the left side assembly should be installed in the median. See the ODOT Traffic Manual for additional information.

12.9.5 Advance Sign Assemblies

Advance warning signs with an RRFB may be required if sight distance is not adequate to the crosswalk where the RRFBs are used. This requirement, if necessary, will be contained in the operational approval. The RRFBs on the advance warning signs shall be activated and cease operation simultaneously with the RRFBs at the crosswalk location.

12.9.6 Illumination

Illumination (front-lighting the pedestrian) is the standard for RRFB installations. This will often result in one luminaire at each end of the crosswalk, located in front of the crosswalk for each direction of approaching vehicle traffic. See Figure 12-28. Refer to the ODOT Traffic Manual and the Traffic Lighting Design Manual for additional information.

Figure 12-28 | RRFB Illumination Example

12.9.7 Service Cabinet and Wiring to RRFB Controller Cabinet

When commercial power is used for an RRFB, a BMC or a BMCL (as appropriate) should be used. The wiring from the service cabinet to the RRFB controller cabinet is two No. 10 AWG XHHW wires.

Note that No. 10 AWG wires are smaller than the No. 6 AWG XHHW wires used from the service cabinet to a traffic signal controller cabinet, as the No. 6 AWG wires can be too big to terminate easily (or at all) in the RRFB controller cabinet. As such, TM485 contains a note requiring a 20A circuit breaker for the RRFB (appropriately sized for using smaller No. 10 AWG wire) vs. the 60A circuit breaker for the traffic signal (appropriately sized for using the larger No. 6 AWG wire). Appropriately sizing the circuit breaker and the wires is important for the circuit breaker to function appropriately and avoid a fire hazard.

12.10 Speed Limit Sign Beacon

The only speed limit sign beacon that is allowed on the state highway system is for school speed zones, in accordance with Oregon Revised Statute 811.111.

This type of flashing beacon is a green sheet item and has two categories:

- Actuated flashing beacon assembly: school
- Actuated flashing beacon assembly: school + speed feedback (integrated system)

See standard detail DET4454 (school) and DET 4455 (school + speed feedback) for more design information and how to properly detail these types of flashing beacons on a plan sheet.

Beacons for school speed zones (without a speed feedback sign) consist of two type 1Y signal heads (one mounted above the sign and one mounted below the sign) on a pedestal as shown in standard detail DET4454. See Figure 12-29 for an example. Beacons for school speed zones with a speed feedback sign (integrated system) consist of one type 1Y signal head mounted above the sign with the speed feedback sign mounted below the sign as shown in standard detail DET4455.

The location of this sign is determined as per the requirements shown in the ODOT Sign Policy and Guidelines, chapter 7. Work with the sign designer and region traffic to ensure this sign is located correctly.

One option to be aware of for the school zone warning beacon is the use of a rear-facing type 1Y signal head. The rear-facing beacon should be used in the situation where side road traffic (that DOES NOT have a warning beacon) enters from within the designated school zone.

Figure 12-29 | Speed Limit Beacon for School Speed Zone

12.11 Stop Sign Beacon

Stop sign beacons are installed above the STOP sign and can be an effective and less costly measure to install when compared to an intersection control beacon.

This type of flashing beacon is a green sheet item: 24/7 flashing beacon assembly: red FOR SOLAR ONLY (note: if this beacon is using commercial power, it is NOT a green sheet item and will require a BMCF for the power and the control system).

Stop sign beacons require one type 1R signal head mounted directly above the sign on the support post. If solar power is used, the support post may be either a standard wood post or a Perforated Steel Square Tube (PSST). There are two standard details, DET4681 (PSST) and DET4670 (wood post) that should be used. See Figure 12-30. If commercial power is used, the support post is required to be a pedestal. See standard detail DET4452 (pedestal support). Standard detail DET4452 also contains additional design information and how to properly detail this type of flashing beacon on a plan sheet.

Figure 12-30 | Stop Sign Beacon

12.12 Intersection Control Beacon

Intersection control beacons are used at intersections to supplement the traffic control at the intersection. ODOT takes a conservative approach to installing intersection control beacons as other treatments may be more effective in warning traffic of an upcoming intersection. See the ODOT Traffic Manual for more information and alternative solutions.

Intersection control beacons are always mounted overhead. See Figure 12-32 and Figure 12-33 for examples. Standard practice is to use a mast arm pole and mount the flashing beacons on a single mast arm oriented diagonally across the intersection. See Figure 12-34. This will allow the beacons to be as close to the center of the intersection as possible.

Intersection control beacons typically have beacons that face each approach of the intersection. However, there may be cases where only the mainline approaches or only the side street approaches have beacons, as determined by the engineering study documented in the RTE operational approval. Each approach requiring beacons shall have 2 beacons:

- Type 1Y signal heads for free flow operation
- Type 1R signal heads for stop controlled operation

The red indication for stop-controlled operations is only supplemental to a STOP sign and therefore a STOP sign is required on each approach having a red flashing beacon. Flashing yellow indications shall not face conflicting vehicular approaches.

Clearances above the pavement are the same as for traffic signal heads, 18 feet minimum to 19 feet maximum. Lateral placement of the beacons should be as shown in Figure 12-31.

A base mounted flasher cabinet (BMCF) provides power and serves as the control system. See standard drawing TM485 for the wiring diagram. ODOT uses a model 204 flasher, which provides two alternating flash circuits. Beacons are wired with one 7-conductor No. 14 AWG control cable for each direction (flash circuit).

Figure 12-31 | Intersection Control Beacon Placement

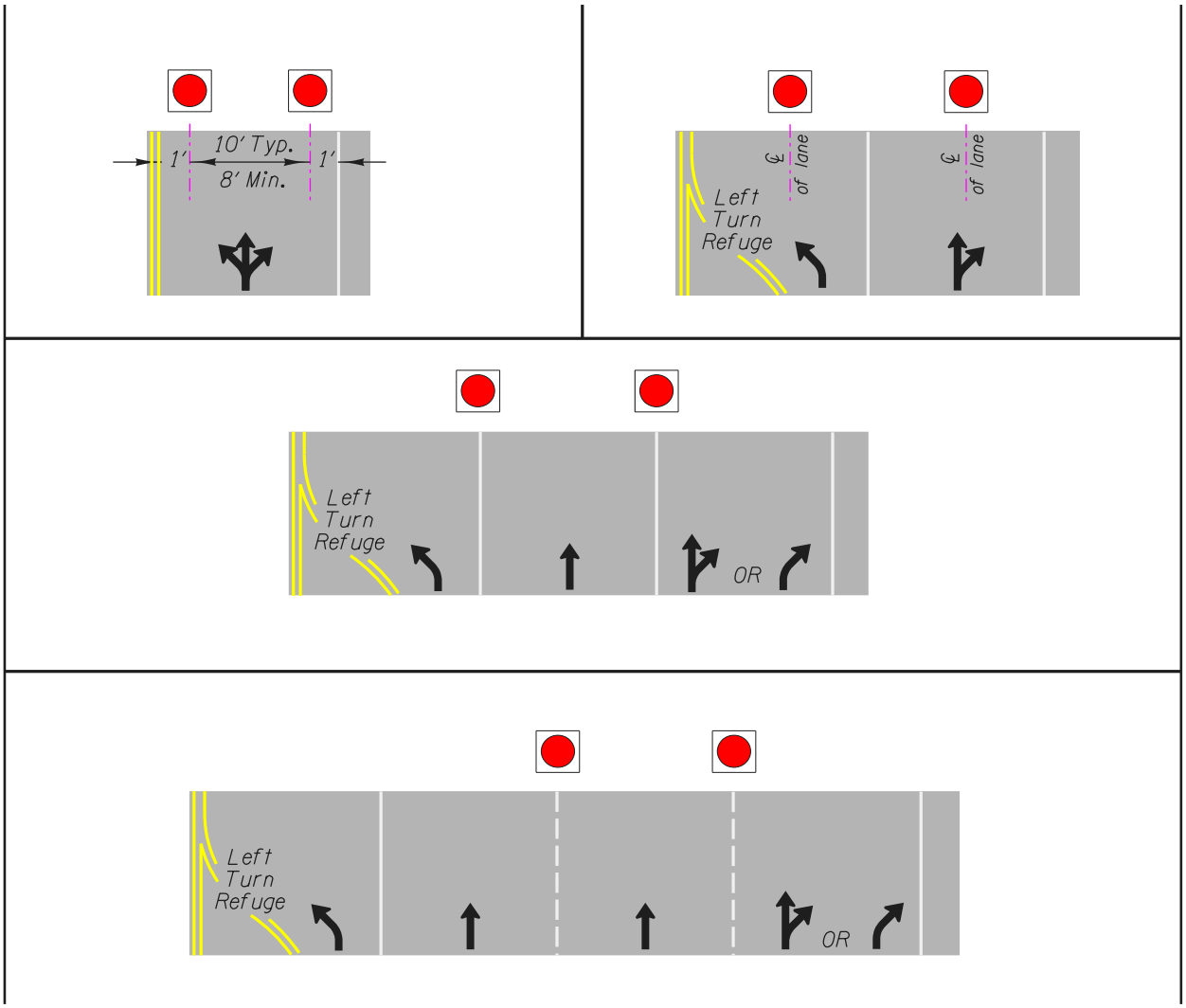
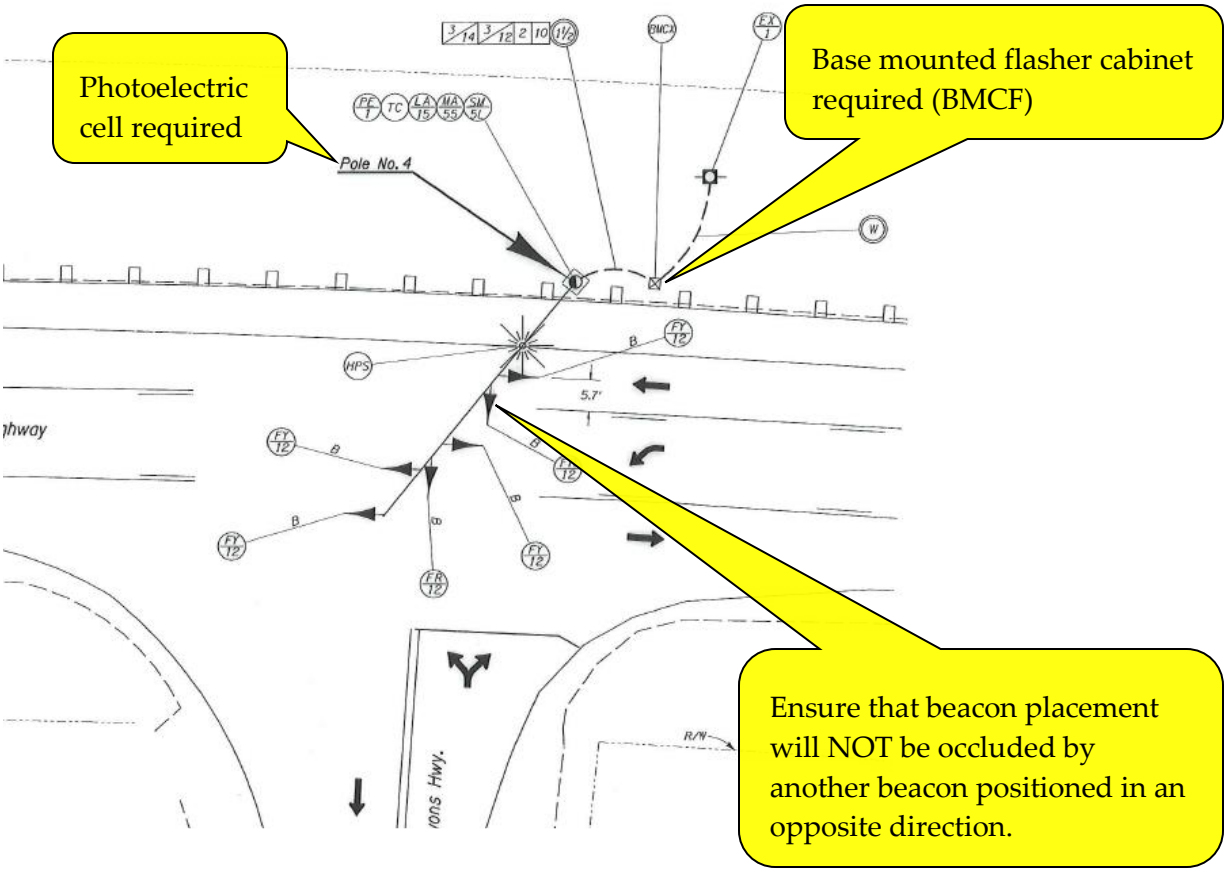


Figure 12-32 | Intersection Control Beacon, Mast Arm Example 1

Figure 12-33 | Intersection Control Beacon, Mast Arm, Example 2

Figure 12-34 | Intersection Control Beacon, Span Wire, Example 3



12.13 Pedestrian Hybrid Beacon

Pedestrian hybrid beacons (PHB) are generally not installed on the state highway for the following reasons:

- ODOT and local agencies have installed PHBs in the past with minimal success due to driver confusion, even after trying various different strategies beyond local education to improve driver understanding.
- Local agencies have reported that coordinating a PHB in a signal system leads to additional confusion for both the pedestrian and driver. Because PHB indications for the driver rest in "dark" mode until just prior to the pedestrian phase being served, a coordinated PHB will result in drivers approaching a dark PHB that will remain dark for a certain duration after the pedestrian activates the pushbutton and makes their intent to cross clear. Dark traffic signals are treated as an uncontrolled intersection (as per ORS 811.275) and drivers must then follow ORS 811.028 which requires them to stop and remain stopped for a pedestrian that moves into the crosswalk with the intent to proceed. However, a pedestrian at the PHB will still be facing a solid don't walk indication and therefore shouldn't start the crossing. The longer the delay between the pushbutton activation and the activation of PHB indications for the driver (to allow the pedestrian phase to be served), the more unpredictable driver and pedestrian behavior becomes. The only way to prevent this type of confusion is to always immediately activate the PHB indications for the driver upon pushbutton activation (e.g., coordination is not possible).

In lieu of a PHB, a pedestrian signal (see chapter 14) or an overhead RRFB (see section 12.9) are preferred alternatives to consider. See the ODOT Traffic Manual and contact the state traffic operations engineer for more information about completing the engineering study and requesting operational approval for pedestrian signals or RRFBs.