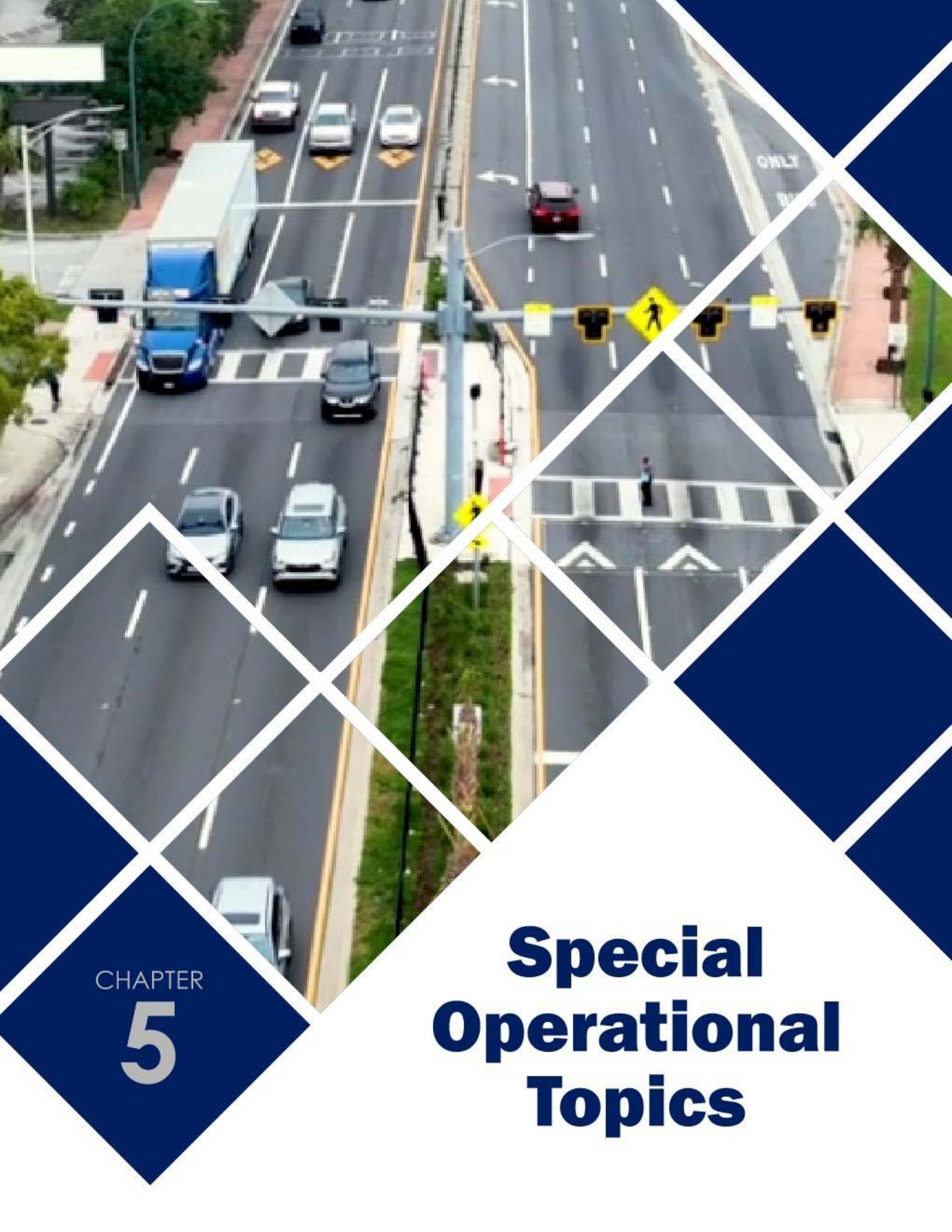


CHAPTER

5

Special Operational Topics

SECTION 5.1
GOLF CART CROSSING AND OPERATION ON THE STATE HIGHWAY SYSTEM

5.1.1 PURPOSE

This section establishes criteria and guidelines for safe golf cart operation on authorized portions of the State Highway System and for uniform crossings at designated locations.

This section also provides safety recommendations for counties and municipalities that wish to enact ordinances authorizing golf cart use on the State Highway System or adjacent sidewalks within their jurisdictions.

5.1.2 GENERAL

Golf carts can be used for short trips from residential neighborhoods to shopping, social, and recreational destinations. These small passenger vehicles offer several advantages, including comparatively low cost and energy-efficient mobility at lower speeds.

Florida authorizes golf cart use and operation on public roads only under certain circumstances, as described in ***Section 316.212, F.S.*** and the ***Guide to Safe and Legal Golf Cart Operation in Florida***.

5.1.3 DEFINITIONS

Golf Cart: A motor vehicle that cannot exceed 20 mph and is designed and manufactured to operate on a golf course for sporting or recreational purposes.

Grade-Separated Crossing: A crossing of two facilities (roadways, railroad, or pedestrian pathways) at different levels.

Local Government: The governing body of a unit of local general-purpose government, such as a county agency, municipality, tourist development council, county tourism promotion agency, or special district, as defined in ***Section 189.012, F.S.*** and ***Section 11.45 (g), F.S.***

State Roadway: Road within the State Highway System (owned and maintained by the State of Florida). This includes roads signed as interstate highways, U.S. routes, and state roads.

5.1.4 PROCEDURE

Local governments are required to obtain ***District Traffic Operations Engineer (DTOE)*** approval before installing a golf cart crossing on the State Highway System. FDOT prefers that golf cart crossings on state roads be grade-separated facilities.

Non-governmental entities seeking authorization for a golf cart crossing may do so through the local government with jurisdictional authority.

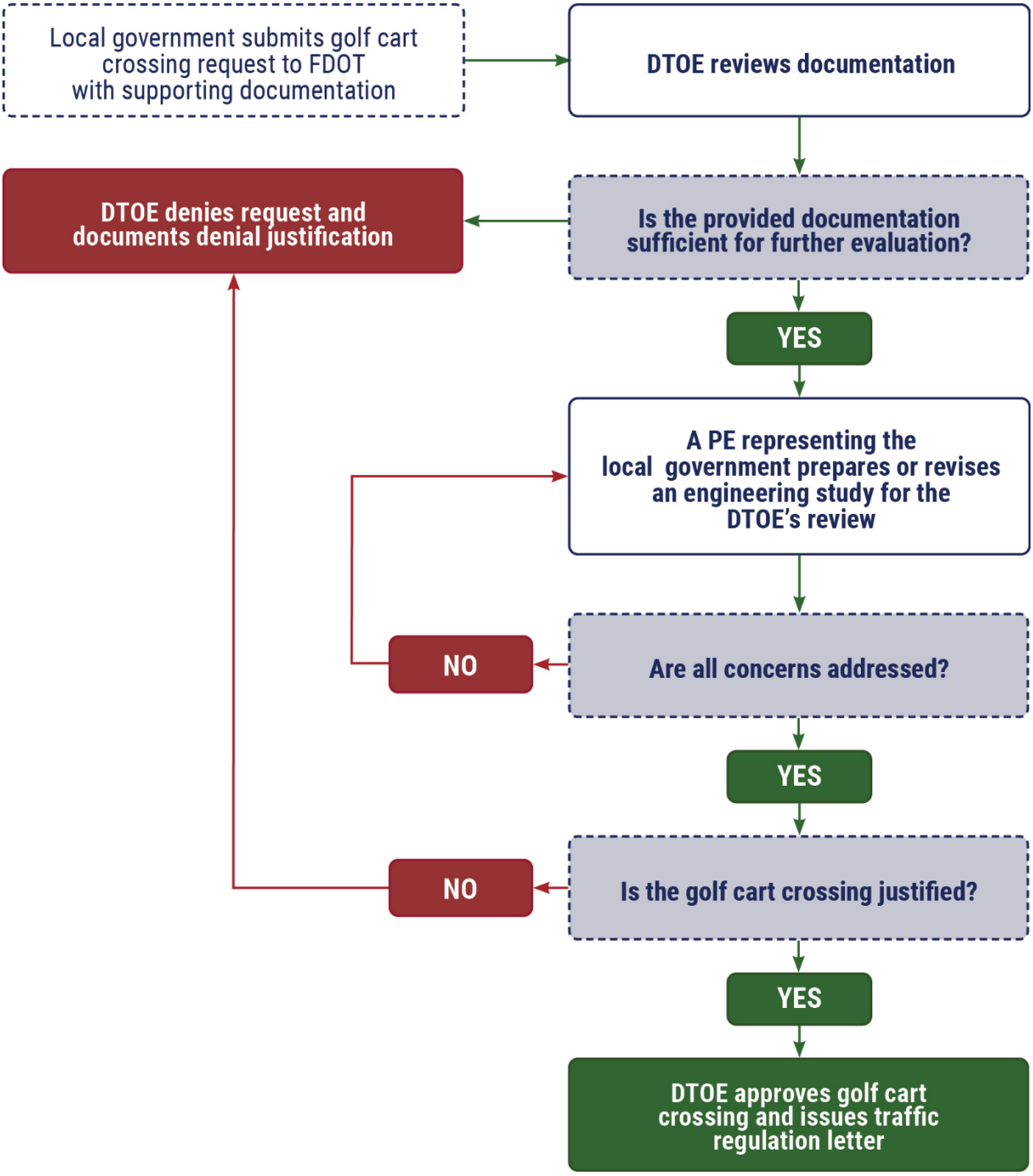
If the ***DTOE*** supports installing a golf cart crossing based on ***TEM 5.1.5*** criteria, the requester must have a Professional Engineer licensed in the State of Florida conduct an engineering study that documents:

- The need for a golf cart crossing based on conditions outlined in ***Section 316.212, F.S.*** and verifies that:
    - The intersecting county or municipal road has been designated for use by golf carts.
    - A golf course or single mobile home park is constructed on both sides of the state road.
- All safety considerations at the proposed location, including intersecting sight distances, proximity to intersection and driveway conflict areas, number and configuration of approach lanes to signalized intersections, and roadway speed and volume thresholds, as described in ***TEM 5.1.5***.
- The proposed golf cart crossing; roadway segment location (roadway ID and milepost); and corresponding signing, marking, and signal treatments, as applicable. Provide a schematic layout over aerial imagery or survey to show the proposed signs, markings, and other treatments and existing traffic control devices nearby.
- A minimum of five years of crash data within the influence area of the proposed crossing.

If the ***DTOE*** decides not to authorize the golf cart crossing, they will document the reasons and advise the local government of their findings. Meeting the minimum criteria outlined in this section does not guarantee approval for a golf cart crossing.

Before a golf cart crossing can be approved, the local government must coordinate with the appropriate ***District Traffic Operations Office*** and ***District Maintenance Office*** to determine permitting requirements and review existing maintenance agreements to determine if adjustments are needed.

Figure 5.1-1. Procedure Flowchart



5.1.5 CRITERIA FOR CROSSINGS

Florida-specific sign details are available in the ***Standard Plans, Index 700-102*** and ***FDOT's Sign Library***.

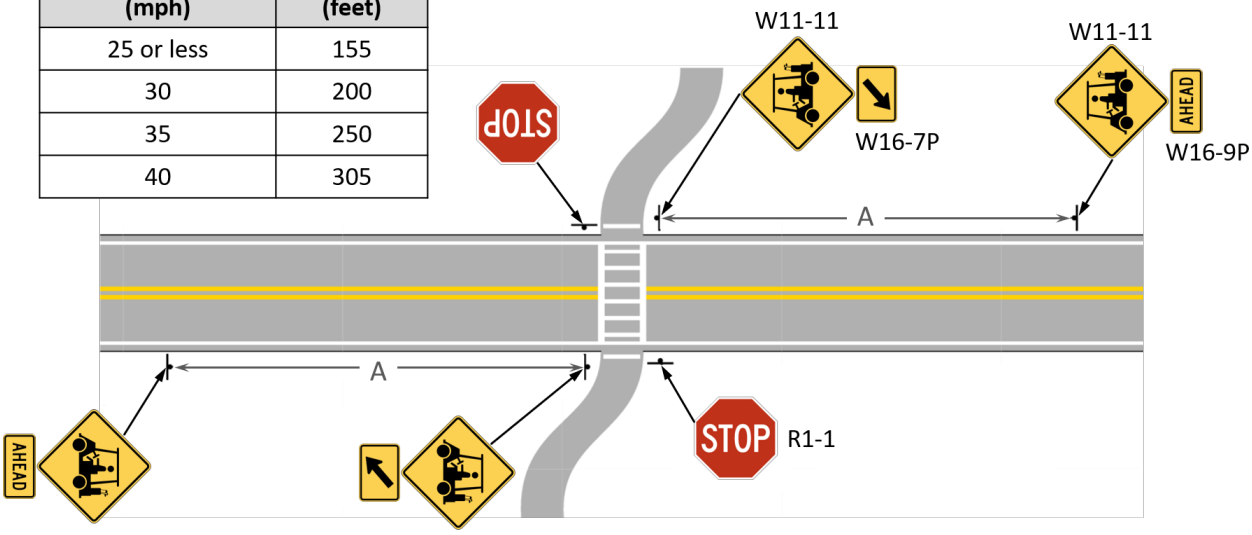
5.1.5.1 Midblock Crossing

Golf carts may cross a state road at a midblock location where there is a golf course or a single mobile home park on both sides of the road if the following criteria are met:

- Roadway segment vehicular volume of 15,000 Average Daily Traffic (ADT) or less.
- 40 mph posted speed limit or less.
- Crossing distance is three lanes or less, excluding bike lanes.
- 15 feet median width or less.
- The minimum distance to the nearest driveway, access point, or crosswalk is 350 feet.
- The crossing must be on a straight road segment, with the nearest point of curvature at least 350 feet away.
- Clear and unobstructed view of the roadside on the approach to the crossing.
- Place *GOLF CART* signs (***W11-11***), *AHEAD* plaques (***W16-9P***), and downward arrow plaques (***W16-7P***) on the street approach, as shown in ***Figure 5.1-2***.
- Golf carts are the only motor vehicles permitted to use the designated crossing or traverse the State's right-of-way.

Figure 5.1-2. Midblock Crosswalk

Posted Speed Limit (mph)	Distance A (feet)
25 or less	155
30	200
35	250
40	305



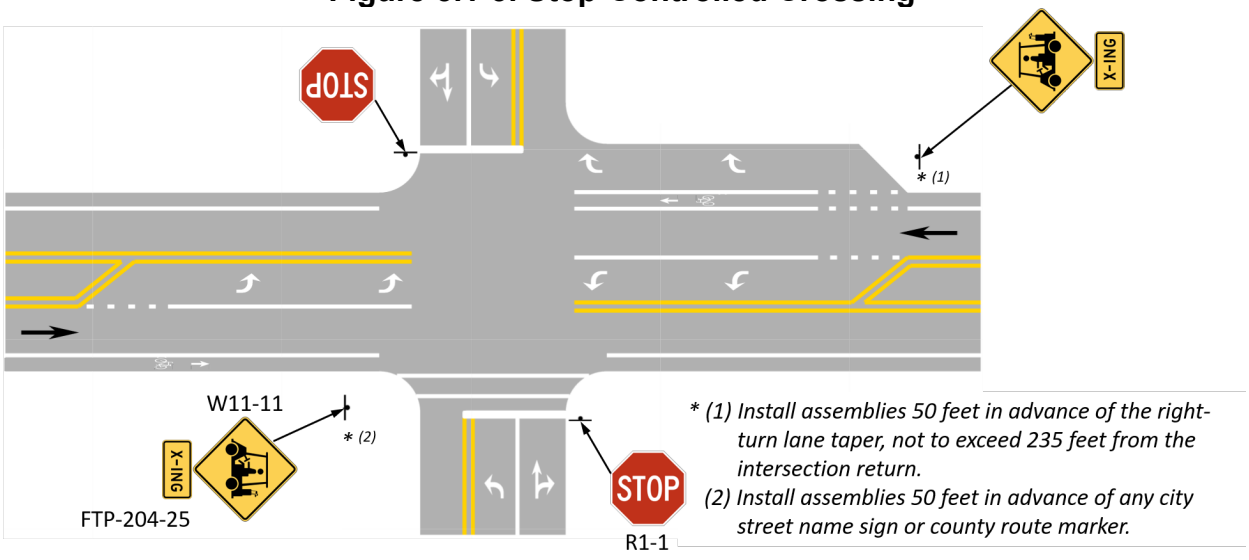
Note: *See FDOT Standard Plans, Index 711-001 for pavement marking application details.*

5.1.5.2 Side Street Stop-Controlled Intersections

Golf cart crossings at roadway intersections with side street stop control along any state road must meet the following criteria:

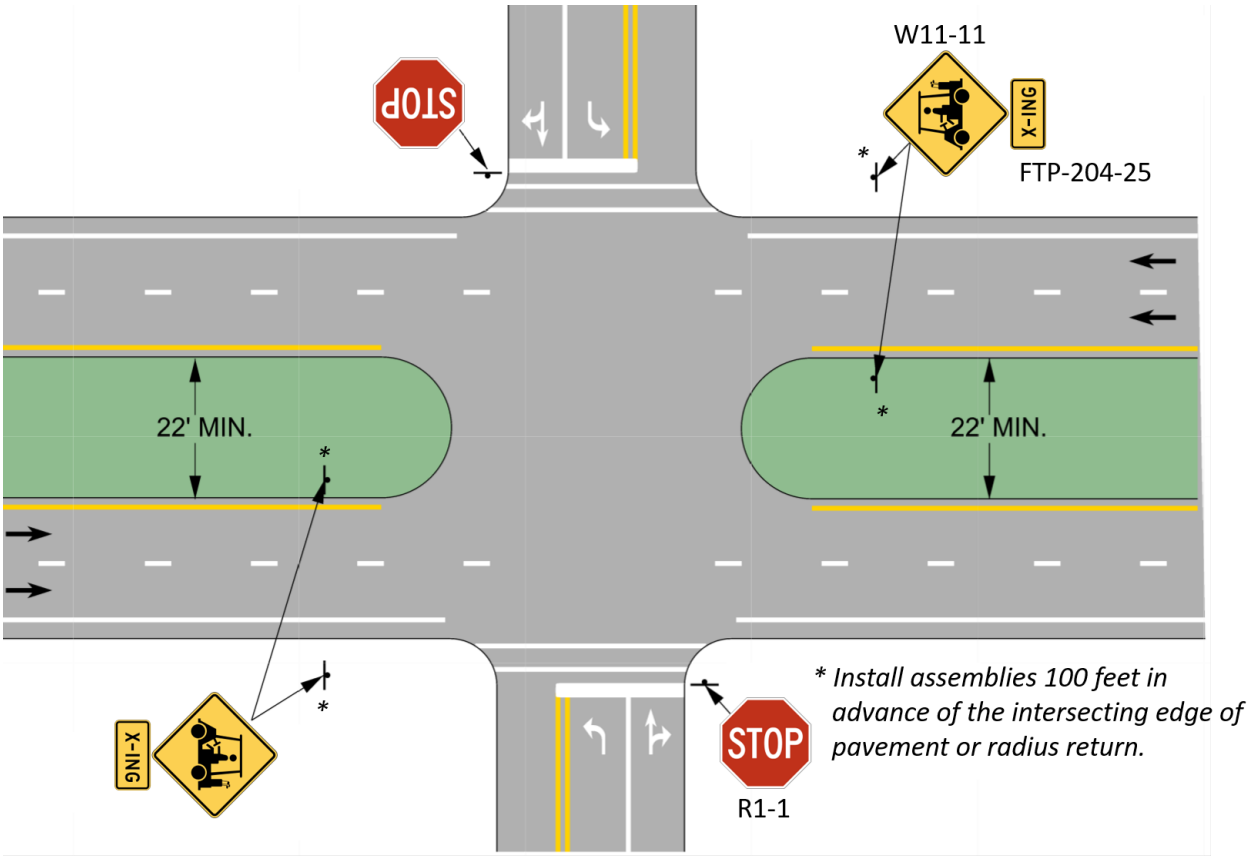
- Side street vehicular volume of 1,200 ADT or less.
- Side street vehicular volume of 110 vehicles per hour or less per approach during the AM and PM peak hours.
- Side street approaches have an exclusive left-turn lane.
    - Side street alignment angle to the mainline tangent is 90 degrees (±15 degrees).
    - Offset intersections are not considered for golf cart crossings.
- Crossing distance for undivided roadways is three lanes or less, excluding right-turn lanes, bike lanes, and crosswalks (***Figure 5.1-3***). For divided roadways of four lanes or fewer, a 22-foot minimum median width is required.
- Main street's posted speed limit is 35 mph or less.
- Place *GOLF CART* signs (***W11-11***) and *X-ING* plaque (***FTP-204-25***) on the mainline approach, as shown in ***Figure 5.1-3*** and ***Figure 5.1-4***.

Figure 5.1-3. Stop-Controlled Crossing



Note: *See FDOT Standard Plans, Index 711-001 for pavement marking application details.*

Figure 5.1-4. Four-Lane Stop-Controlled Crossing



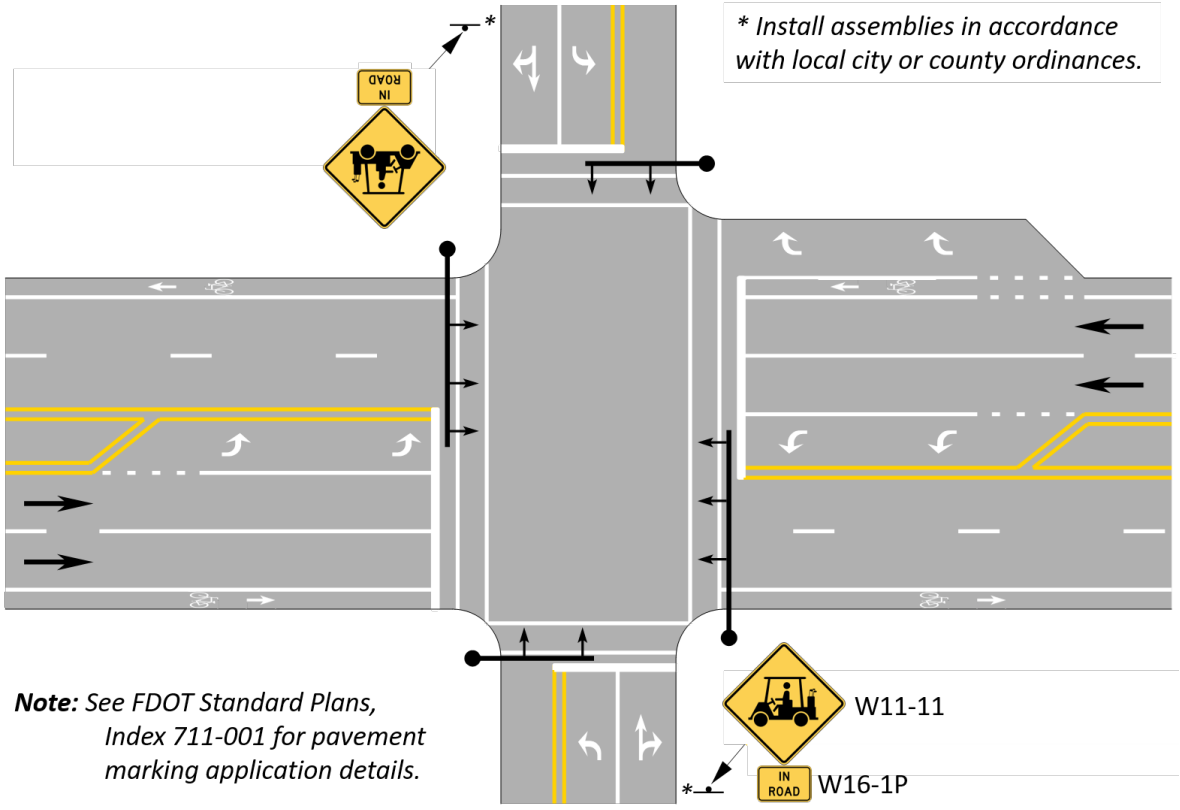
Note: *See FDOT Standard Plans, Index 711-001 for pavement marking application details.*

5.1.5.3 Signalized Intersections

Golf cart crossings at signalized intersections must meet the following criteria:

- Side street vehicular volume of 1,500 ADT or less.
- Side street vehicular volume of 200 vehicles per hour or less per approach during the AM and PM peak hours.
- Side street posted speed limit is 35 mph or less.
- Side street approaches have an exclusive left-turn lane.
- Side street alignment angle to the mainline tangent is 90 degrees (±15 degrees).
- Offset or T-intersections are not considered for golf cart crossings. A proposed fourth leg at signalized T-intersections for exclusive golf cart use will not be considered.
- Crossing distance is five lanes or less, excluding right-turn lanes, bike lanes, and crosswalks.
- Golf carts are not allowed to use crosswalks or sidewalk ramps to cross the mainline.
- Place *GOLF CART* signs (***W11-11***) and *IN ROAD* plaques (***W16-1P***) on the side street approach, as shown in ***Figure 5.1-5***.

Figure 5.1-5. Traffic Signal Controlled Crossing



5.1.6 OPERATION OF GOLF CARTS ON SIDEWALKS

Title 23 of the United States Code, Section 217 prohibits using motorized vehicles, such as golf carts, on existing and proposed non-motorized trails and pedestrian walkways that use federal transportation funds. However, the Federal Highway Administration can authorize exceptions through a framework it developed.

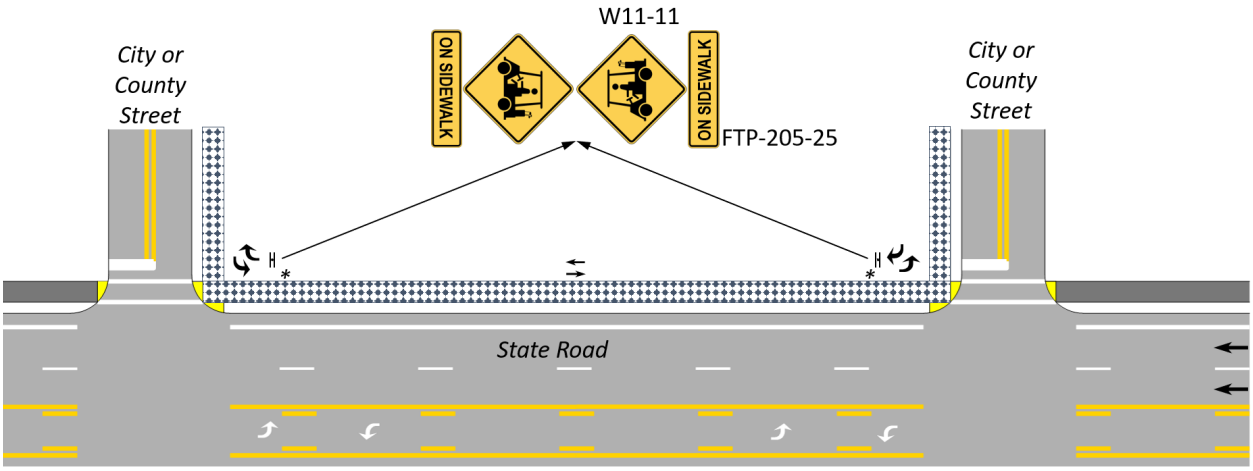
5.1.6.1 Safety and Operational Recommendations

Consider the following when requesting approval of golf cart operation on sidewalks adjacent to a state road by local government ordinance:

- Golf carts are only allowed to access State-maintained sidewalks from sidewalks along county- or city-maintained side streets intersecting the State Road. They are not allowed to access State-maintained sidewalks from county- or city-maintained streets using curb ramps.
    - FDOT will not approve golf cart crossings on a State Road from county- or city-maintained streets to State-maintained sidewalks.
- Provide a minimum unobstructed sidewalk width of 8 feet; separation from the back of curb or edge of shoulder by at least 5 feet is recommended. Provide a minimum 4-foot width of grassed or stabilized, relatively flat area beyond the outside edge of sidewalks for recovery or stalled golf carts. Do not include adjacent drainage features or fencing in the minimum requirement.
- Terminate golf cart operation on State-operated sidewalks at a connecting county- or city-maintained sidewalk.
- Install *GOLF CART* signs *(**W11-11**)* and *ON SIDEWALK* plaques (***FTP-205-25***) along state-operated sidewalks, as shown in ***Figure 5.1-6***.
- Per ***Section 316.212, F.S.***, golf carts' speeds are not to exceed 15 mph when operated on sidewalks.

Refer to ***FDM 222*** for Pedestrian Facilities or ***FDM 224*** for Shared Use Paths design, including horizontal and vertical clearances.

Figure 5.1-6. Golf Cart Operation on Sidewalks Example



** Install double-sided, post-mounted sign assemblies at 200-foot intervals. Use the same configuration at T-intersections and driveways.*

Section 5.2
CROSSWALK TREATMENTS AT MIDBLOCK LOCATIONS AND UNSIGNALIZED INTERSECTIONS

5.2.1 PURPOSE

This section establishes criteria and guidelines for installing and operating pedestrian treatments at midblock locations and unsignalized intersections on the State Highway System. Treatments can include marked crosswalks, signs, beacons, and signals, among other traffic control devices. Crosswalk details at roundabouts can be found in the ***FDOT Design Manual (FDM), Chapter 213.***

5.2.2 GENERAL

A crosswalk is a designated location for pedestrians to cross a roadway, concentrating crossing activity. Crosswalks and other pedestrian treatments at midblock locations and unsignalized intersections are designed to enhance pedestrian connectivity, reduce confusion, and decrease unpredictable crossings, reducing collisions between pedestrians and motorists.

Consider context classification and documented pedestrian demand when deciding whether to install a crosswalk at a midblock location or an unsignalized intersection. Pedestrians risk crossing at unmarked locations when the nearest controlled crossing feels far away. They may cross unexpectedly, creating unexpected crossings and increasing the potential for crashes. Adding marked crosswalks and other supplemental treatments at these locations may be appropriate.

Supplemental signage can improve safety and compliance at marked crosswalks regardless of the control type. Crosswalk design treatments, including refuge islands, curb extensions, street lighting, and raised crosswalks, also support pedestrian visibility and safety. ***Table 5.2-1*** summarizes some of these treatments and their application.

Despite their safety and connectivity benefits, crosswalks are not suitable for every location. Before requesting to install a crosswalk on a state road, evaluate the context classification and expected levels of pedestrian crossing demand, the safety characteristics of the crossing location, and design considerations for the crossing control type.

5.2.3 DEFINITIONS

Alternative Pedestrian Crossing Location: A controlled crossing with a *STOP* sign (***R1-1***), traffic signal, or grade-separated pedestrian bridge or tunnel.

Average Day: A day with traffic volumes normally and repeatedly found at an intersection or location. Weekdays, with volumes influenced by travel to and from work, and weekend days, with volumes influenced by entertainment or recreation, represent two types of average days. Weather is also a factor to consider.

Context Classification: Description of a roadway's general land use characteristics, development patterns, and roadway connectivity. Roadways are designed to match the characteristics and demands of their context classification. See ***FDM 200*** for additional information.

Controlled Approach: All directional traffic lanes moving toward an intersection or a midblock location (including adjacent parking lanes) controlled by a sign, traffic signal, marking, or other traffic control device.

In-Roadway Warning Lights (IRWLs): A traffic control device installed on the roadway surface to warn users they are approaching a condition on or adjacent to the roadway that might not be readily apparent and require the road user to slow down or stop.

Marked Crosswalk: A portion of a roadway segment designated as a pedestrian crossing by pavement markings. Marked crosswalks guide pedestrians, define and delineate crossing paths, and define intersections. Pavement markings may be supplemented by contrasting pavement structure, style, or color.

Midblock Crosswalk: A location with a marked crosswalk (signalized or unsignalized) between intersections.

Midblock Pedestrian Signal (MPS): A hybrid non-motorist-actuated traffic control device that alternately directs traffic to stop and flashes a *RED* indication during the pedestrian clearance interval. This traffic control device is currently under an FHWA Request to Experiment (RTE) and requires prior approval coordinated through the State Traffic Engineering and Operations Office before installation.

Midblock Traffic Control Signal: A non-motorist-actuated traffic signal used to warn and control traffic at midblock crosswalks.

Passive Detection: A system that detects the presence and direction of non-motorists and activates the traffic control device without manual actuation.

Pedestrian Attractor: A residential, commercial, office, recreational, or other location that is expected to be a destination for pedestrian trips.

Pedestrian Generator: A residential, commercial, office, transit, recreational, or other location that serves as the starting point for a pedestrian trip.

Pedestrian Hybrid Beacon (PHB): A non-motorist-actuated traffic control device used to warn and control traffic at an unsignalized location when pedestrians cross a marked crosswalk. It is also known as a High-Intensity Activated Crosswalk (HAWK). A PHB is typically installed on mast arms above the controlled roadway. The PHB faces consist of

three signal sections: two horizontally aligned circular red indications and a circular yellow indication centered below. A PHB installation requires a minimum of two faces for each major street approach.

Rectangular Rapid Flashing Beacon (RRFB): A non-motorist-actuated traffic control device with two rapidly and alternately flashing rectangular yellow indications that function as a warning beacon.

Shared-Use Path: A multi-user path outside the traveled way and physically separated from motorized vehicular traffic by an open space or barrier. A shared-use path can be located within the right-of-way or have an independent alignment. Shared-use paths are used by pedestrians (including skaters, users of manual and motorized wheelchairs, and joggers), bicyclists, and other authorized users.

Two-Stage Pedestrian Crossing: A marked crosswalk with a median refuge island and an RRFB, PHB, MPS, or midblock traffic control signal. A two-stage pedestrian crossing may have less impact on vehicle delay than a single-stage crossing since the traffic control device serves each direction independently, while the median lets pedestrians pause midway before completing their crossing.

Uncontrolled Approach: All directional traffic lanes moving toward an unsignalized intersection or a midblock location (including any adjacent parking lane) that are not controlled by signs, signals, markings, or other traffic control devices.

Unmarked Crosswalk: The legal crossing area at an intersection (as defined in ***Section 316.003(17)(a), F.S.***) connecting opposite sides of the roadway without pavement markings or signs.

Unsignalized Intersection: An at-grade junction of two or more public roads where a traffic signal does not control the right of way for motorists, bicyclists, or pedestrians.

5.2.4 PROCEDURE

These procedures apply to midblock and unsignalized intersection marked crosswalks:

- Contact the ***District Traffic Operations Office*** to request an evaluation of a marked crosswalk or other treatments.
- The ***DTOE*** reviews and approves proposed marked crosswalks or treatments at midblock locations or unsignalized intersections on the State Highway System.
    - Coordinate with the ***District Access Management Engineer or Administrator*** on potential access management impacts.
- For existing midblock or unsignalized intersection marked crosswalks, conduct an engineering study or warrant analysis to justify installing midblock traffic control signals or PHBs. Refer to ***TEM 5.2.5*** for guidance.

- Before approving a proposed marked crosswalk or treatment for an existing crosswalk, the ***District Traffic Operations Office*** will coordinate with the local agency responsible for the maintenance agreement.

5.2.5 SELECTION CRITERIA

5.2.5.1 Marked Crosswalk

Validate the need for marked crosswalks at midblock and uncontrolled approaches with an engineering study, as described in ***TEM 5.2.6***. When available, review the local strategic plan for non-motorist connectivity needs. Consider marked crosswalks under the following conditions:

- Proximity to significant pedestrian generators and attractors
    - Locations with either of the following characteristics:
        - A well-defined spatial pattern of pedestrian generators, attractors, and flow (across a roadway) between them
        - A well-defined pattern of existing pedestrian crossings
    - Identify and document pedestrian generators and attractors in an engineering study to illustrate potential pedestrian routes in relation to proposed marked crosswalk locations, as described in ***TEM 5.2.6***.
- Pedestrian Demand
    - The pedestrian volume threshold for a proposed marked crosswalk is 20 or more pedestrians during a single hour (any four consecutive 15-minute periods) of an average day. Collect average-day pedestrian volume data using the methods outlined in ***TEM 5.2.6***.
    - Pedestrian demand data is not required to be collected under school zones or under the following Context Classifications:
        - C2T - Rural Town
        - C3C - Suburban Commercial
        - C4 - Urban General
        - C5 - Urban Center
        - C6 - Urban Core
- Shared-use path connection at midblock locations or unsignalized intersections
    - Supports the use of a shared-use path
    - Proposed marked crosswalks connecting to a shared-use path may apply a 50 percent reduction to the pedestrian demand threshold.

- Nature-based trail crossings
    - Before the ***DTOE*** approves a new nature-based trail crossing, evaluate whether installing the crossing on the State Highway System is appropriate
    - See ***TEM 2.33*** and ***FDM 230*** for additional information on nature-based trail crossings
- Location Characteristics
    - Vehicular volume of 2,000 ADT or greater along the roadway segment
    - The distance from the proposed crosswalk to the nearest intersection (or crossing location) is at least 300 feet, per ***FDM 222***
        - FDOT may consider a proposed crossing location between 100 and 300 feet from an alternative crossing or intersection if it is more practical for non-motorist use; document this justification in the engineering study
- Adjacent signalized intersection
    - The proposed location is outside the functional influence area of adjacent signalized intersections. This includes auxiliary turn lanes and associated tapers. See ***FDM 212*** for additional information.

5.2.5.2 Beacons and Signals

Use yellow flashing beacons to make standard signs more conspicuous, in accordance with ***MUTCD Section 2A.11***.

Rectangular Rapid Flashing Beacon (RRFB)

Limit RRFB use to roadways with the following conditions:

- Posted speed limit of 35 mph or lower
- Marked crosswalks with special emphasis pavement markings
- Four through lanes (both directions) or less regardless of median presence, or five lanes with a median refuge island. For facilities with five lanes, including a two-way left-turn lane, a refuge island or raised median must be present for RRFB application.

For use of RRFBs at locations that do not meet the minimum requirements stated above, obtain approval for a variation from the ***State Traffic Engineering and Operations Office***. Include the following information in the request for variation:

- AADT
- Sight distance
- Speed data

- Five years of crash data
- Supplemental information, including location description, Context Classification, and observations

Pedestrian Hybrid Beacon (PHB)

When installing a PHB, place it at least 100 feet away from side streets or driveways controlled by *STOP* (***R1-1***) or *YIELD* (***R1-2***) signs. Install *STOP HERE ON RED* (***R10-6a***) and *CROSSWALK - STOP ON RED* (***R10-23***) signs to inform motorists of the crossing. Avoid installing PHBs at intersections.

If the location is less than 100 feet from side streets or driveways controlled by a stop sign, install additional treatments to reduce the risk of pedestrian-vehicle conflicts. Side street and driveway treatments may include blank-out signs, static signs, and pavement markings.

Consider installing a PHB when an engineering study, per ***MUTCD Section 4J.01***, identifies the following conditions:

- Where a midblock traffic control signal is not justified under ***MUTCD Chapter 4C*** signal warrants and gaps in traffic are not adequate to permit pedestrians to cross.
- Where the approaching vehicle speed on the major street is too high to permit pedestrians to cross.
- Where pedestrian delay is excessive.

See ***MUTCD Chapter 4J*** for PHB volume guidance. This guidance is summarized in ***Figure 5.2-1***. At a location under C2T, C4, C5, or C6 context classification that meets the PHB warrants stated above, the PHB may be substituted with a midblock traffic control signal using ***MUTCD Warrant 8, Roadway Network***.

Follow ***MUTCD Section 4J.02*** for a PHB sequence; ***MUTCD Figure 4J-3*** provides a visual. Follow ***MUTCD Section 4J.03*** for PHB operation. Apply the following timing requirements for PHB operations:

- Keep the signal dark outside the activation window.
    - Follow ***TEM 3.6.2.1*** for the duration of the flashing yellow.
- Determine the steady yellow change interval using engineering practices with a minimum duration of 3 and a maximum of 6 seconds (see ***MUTCD Section 4F.17***). Use longer intervals on approaches with higher speeds.
    - Make the minimum duration of steady red equal to the pedestrian walk interval.
- Make the duration of the alternating flashing red equal to or greater than that of the pedestrian clearance interval.

Midblock Traffic Control Signal

To provide a safe pedestrian crossing, traffic control signals at midblock crosswalks must be positioned at least 300 feet away from side streets or driveways with *STOP* (***R1-1***) or *YIELD* (***R1-2***) signs. For midblock crosswalks over 300 feet from the nearest signalized intersection, consider the distance to adjacent signals and available gaps for pedestrian crossing to determine whether a signal is required.

To meet the criteria for safe pedestrian crossing, traffic control signals at midblock crosswalks must comply with ***MUTCD Warrant 4, Pedestrian Volume***. ***Figure 5.2-1*** summarizes this warrant for **(a)** 35 mph or less and **(b)** greater than 35 mph roadways.

The minimum pedestrian volume threshold under ***MUTCD Warrant 4*** may be reduced:

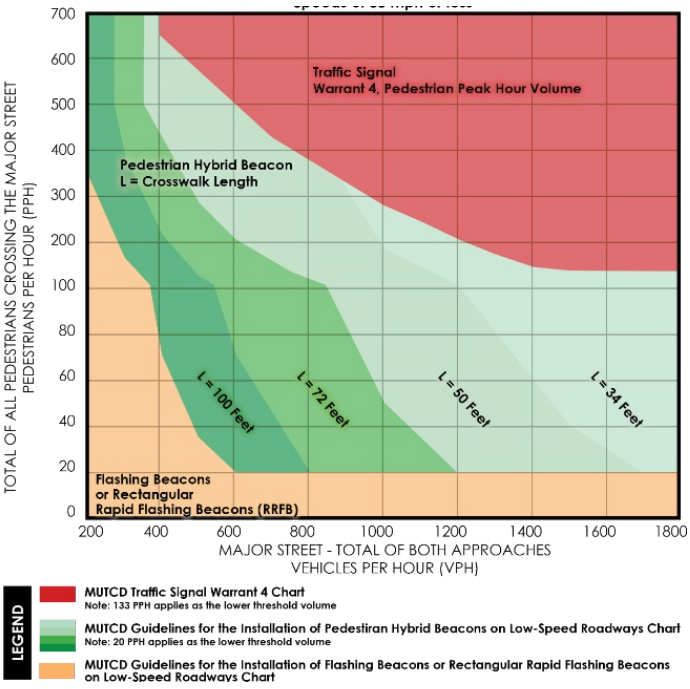
- Up to 50 percent when the 15th percentile crossing speed is below 3.5 feet per second.
- Up to 30 percent when the 85th percentile speed on the major street is greater than 35 mph or when the midblock crosswalk is in a built-up area of an isolated community with fewer than 10,000 inhabitants.

The 30 and 50 percent reductions can be combined when both corresponding criteria are met. Apply the applicable pedestrian volume thresholds shown in ***MUTCD Figures 4C-5 through 4C-8***.

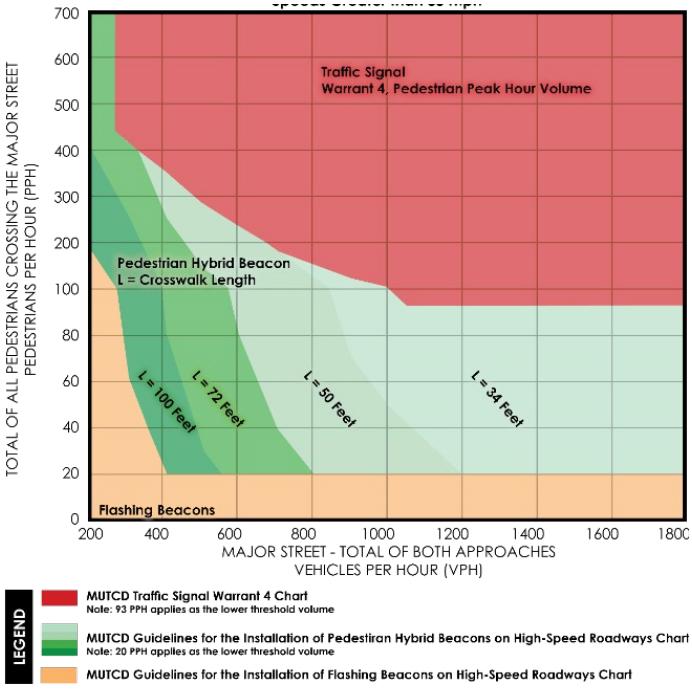
For details on requirements for traffic control signals at intersections, refer to ***TEM 3.3***.

Figure 5.2-1. Guidelines for the Installation of Pedestrian Treatments

(a) 35 mph or Less



***(b)* Greater than 35 mph**



5.2.6 ENGINEERING STUDY

Conduct an engineering study before installing a marked crosswalk or other pedestrian treatments at a midblock location or unsignalized intersection. Identify treatments based on pedestrian and vehicular volumes, roadway characteristics, and environmental factors documented in the study. Consider alternative control strategies to resolve the need for an intersection or midblock crosswalk. Include the following information in the engineering study:

- Field data demonstrating the need for a marked crosswalk based on pedestrian volumes.
    - Collect pedestrian crossing volumes outside of marked crosswalks at or in the vicinity of the proposed location when required in ***TEM 5.2.5.1***. Other non-motorists, including bicyclists, can be included in the pedestrian demand when crossing the roadway at the proposed crossing location. Do not include non-motorists traveling parallel to the roadway unless they cross at the proposed location.
        - The ***FDOT TDA Non-Motorized Traffic Monitoring*** Dashboard may be used as a resource for volume data.
    - Consider obtaining pedestrian group size and vehicle gap size to assess opportunities for safe crossings. See FDOT's ***Manual on Uniform Traffic Studies (MUTS)*** for data collection methodologies.
    - Consider collecting individual pedestrian walking speeds, pedestrian speed cumulative curve, and the 15th percentile pedestrian crossing speed when evaluating a PHB or midblock traffic control signal. See ***MUTS Chapter 9*** for data collection methodologies.
- Potential links between pedestrian generators and attractors to confirm existing pedestrian crossing patterns. Identify generators and attractors on an aerial to illustrate potential pedestrian routes in relation to the proposed marked crosswalk location.
- When recommending an RRFB, PHB, MPS (RTE approval required), or midblock traffic control signal, document the necessary location characteristics following ***TEM 5.2.5.2***
- Proximity to intersection conflict areas and safety considerations, including:
    - Stopping sight distance
    - Sidewalk connectivity
    - Adequate lighting and illumination levels at the crosswalk
    - Refuge island or raised median for roads with five or more lanes to facilitate two-stage crossing
    - Suitable bus stop location to minimize conflicts with transit vehicles

- Proposed crossing location and corresponding traffic control devices:
    - Provide a schematic layout over aerial imagery or survey to show the proposed signs, pavement markings, approach traffic control devices, other treatments (e.g., bulb-outs), and existing traffic control devices within the influence area of the proposed crosswalks.
    - Treatments are dependent on site context, vehicle operating speeds, roadway cross-section, pedestrian volumes, and other variables. Treatments may include midblock traffic control signals or other warning devices to enhance motorist-yielding behavior. Other treatments, such as median refuge islands, curb extensions, raised crosswalks, and supplemental signing and pavement markings, may also be applicable at some locations to reduce crossing distance and enhance pedestrian visibility. See ***TEM 5.2.7*** for treatment options and selection guidance.
- Document the latest five years of non-motorist-vehicle crashes in the vicinity of the proposed crosswalk, including frequency, crash type, lighting, and pavement conditions. Refer to the ***FDOT State Safety Office*** ***Crash Data Guidance*** for additional crash attribute considerations. Supplement the crash summary with any information regarding the nature of conflicts based on field observations.
- Transit route data and the location of transit stops in the vicinity of the proposed crosswalk.

5.2.7 TREATMENT OPTIONS

5.2.7.1 Pavement Markings

See ***Standard Plans, Index 711-001*** for pavement marking details. See ***FDM 230*** for typical pavement marking applications for midblock crosswalks.

Marked Crosswalks

Install special emphasis crosswalks at midblock crossings and uncontrolled approaches. Follow ***TEM 5.2.4*** procedure to install marked crosswalks on the State Highway System.

Install standard crosswalks at stop-controlled approaches, consistent with ***FDM 230***. An engineering study is not required to install standard crosswalks at stop-controlled approaches.

In-Pavement Warning Marking

In-pavement warning markings can supplement existing signage where high vehicular volumes and high operational speeds are reported approaching a marked crosswalk. These markings can use the *BICYCLE* (***W11-1***), *PEDESTRIAN* (***W11-2***), and *COMBINED BICYCLE / PEDESTRIAN* (***W11-15***) crossing symbols, as shown in ***Figure 5.2-2***.

Complete an engineering study and obtain ***DTOE*** approval to install the in-pavement warning markings. Once approved, coordinate installation with the District Maintenance Office.

Consider installing in-pavement warning markings when the following conditions are present at a marked crosswalk.

- Multi-lane roadway with a posted speed of 45 mph or greater
- Rural two-lane roadway with a posted speed of 50 mph or greater
- Crosswalks with restricted sight distance due to obstructions (e.g., trees).
- Reports of motorists not yielding at the crosswalk.

When approved, install in-pavement warning markings as follows. For an example, see ***Figure 5.2-3***.

- Center the markings in the travel lane(s) on the approach to the crosswalk and in alignment with adjacent lanes when used on multi-lane approaches.
- Place no more than one set of markings on each approach and do not mix symbol and word in-pavement markings (see ***TEM 4.2***).
- Follow ***MUTCD Table 2C-3*** to determine how far in advance to place markings based on the posted or 85th percentile speed coming to a full stop.

Figure 5.2-2. In-Pavement Warning Marking Details

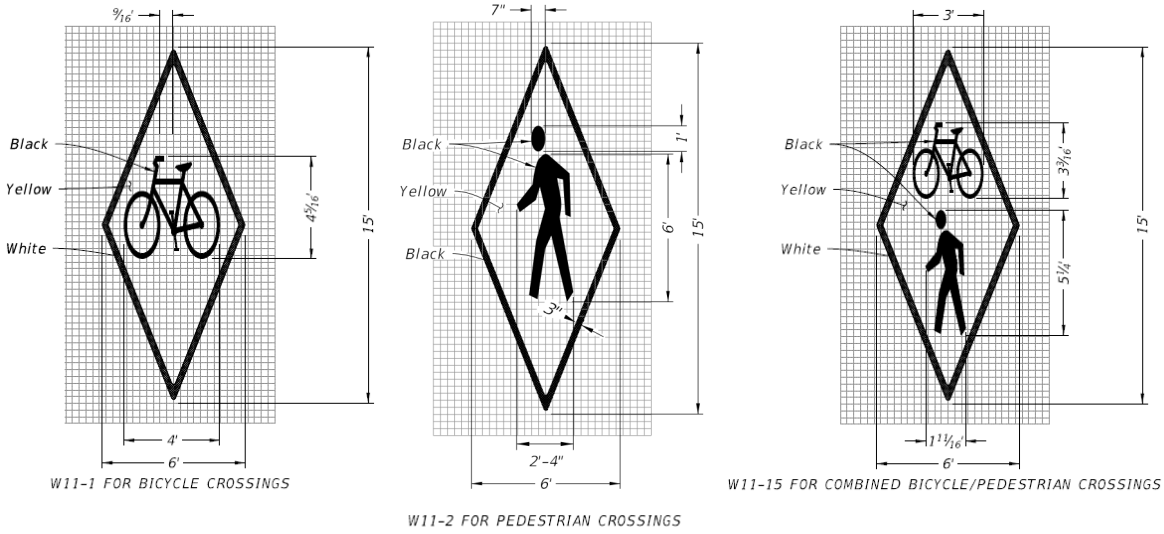


Figure 5.2-3. Pedestrian In-Pavement Warning (*W11-2*) Markings



5.2.7.2 Signs

Install the signs in this subsection at midblock crosswalks and unsignalized intersections to improve motorist yielding and stopping behavior at marked crosswalks. See ***FDM 230*** for sign placement details. Sign details are available in the ***Standard Plans, Index 700-102*** and ***FDOT's Sign Library***.

For greater visibility, install highlighted signs and flashing beacons, as described in ***MUTCD Sections 2A.11 and 2A.12***.

STOP HERE FOR PEDESTRIANS Sign (*R1-5b)*

On multilane approaches, add a stop line with the *STOP HERE FOR PEDESTRIANS* sign (***R1-5b***), as directed in ***MUTCD Section 2B.19***. Place the stop line 40 feet before the marked crosswalk. Parking is prohibited between the stop line and the marked crosswalk. Use a solid lane line between the stop line and the crosswalk.

Regardless of the number of lanes, use the *STOP HERE FOR PEDESTRIANS* sign (***R1-5b***) with the *PEDESTRIAN CROSSING* sign (***W11-2***) and diagonal downward arrow plaque (***W16-7P***), as shown in ***Figure 5.2-4***. Do not use the *STOP HERE FOR PEDESTRIANS* sign (***R1-5b***) with a traffic signal or PHB.

The *STOP HERE FOR PEDESTRIANS* sign (***R1-5b***) may be added at existing midblock crosswalks where motorists routinely fail to stop for pedestrians. Install as follows:

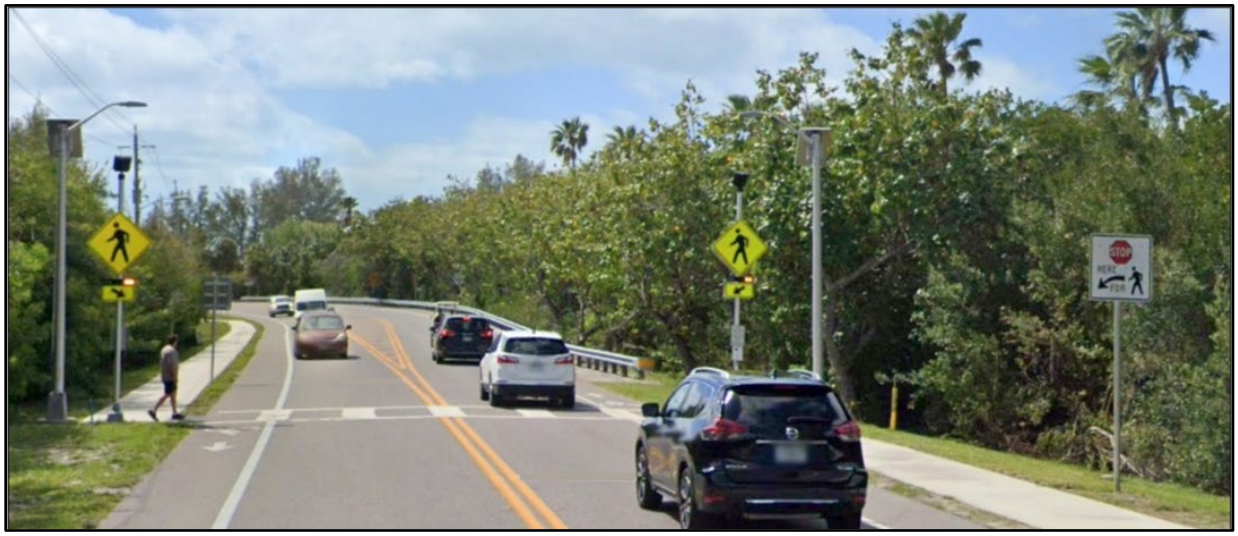
- One sign in each direction
- Install signs within 100 feet before the crosswalk

- Do not install these signs where they interfere with required signs

STOP HERE FOR SCHOOL CROSSING Sign (*R1-5c*)

For school crossings, use the *STOP HERE FOR SCHOOL CROSSING* sign (***R1-5c***) with the *SCHOOL* sign (***S1-1***) instead of the *STOP HERE FOR PEDESTRIANS* (***R1-5b***) and *PEDESTRIAN CROSSING* (***W11-2***) signs.

Figure 5.2-4. RRFB with *STOP HERE FOR PEDESTRIANS* (*R1-5b*) and *PEDESTRIAN CROSSING* (*W11-2*) Signs



IN-STREET PEDESTRIAN CROSSING Sign (*R1-6a*)

IN-STREET PEDESTRIAN CROSSING signs (***R1-6a***) are useful on low-speed roadways to remind motorists of right-of-way laws at midblock or unsignalized crosswalks. See ***Figure 5.2-5***. Engineers may use the *IN-STREET PEDESTRIAN CROSSING* sign ***FTP-029-25*** in lieu of ***R1-6a*** at locations with constrained geometric conditions. Use these signs on roadways with four or fewer through lanes and a posted speed of 35 mph or less.

Coordinate with the District Maintenance Office prior to requesting ***DTOE*** approval to use this sign type.

Do not post mount *IN-STREET PEDESTRIAN CROSSING* signs (***R1-6a*** or ***FTP-029-25***). Place them in one of the following locations:

- On a two-way road, place the sign in the roadway at the marked crosswalk location on the centerline
- On a one-way road, place the sign on a lane line
- Place the sign on a median island as allowed by ***MUTCD Section 2B.20***

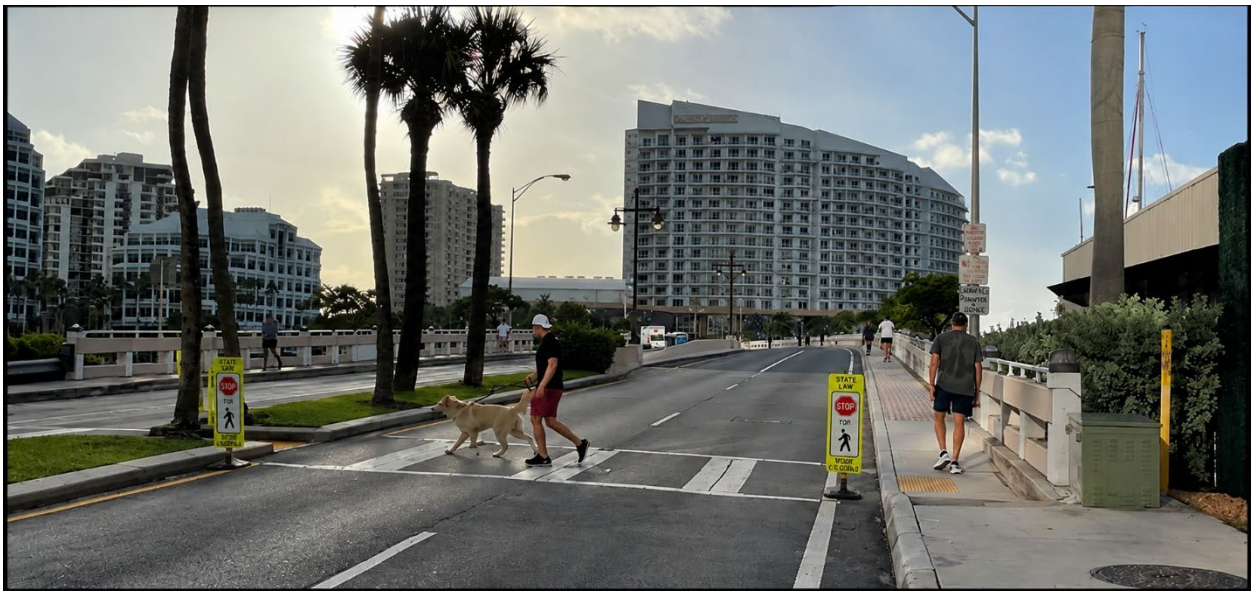
Tubular markers may be used to supplement *IN-STREET PEDESTRIAN CROSSING* signs (***R1-6a*** or ***FTP-029-25***) either on the centerline, lane line, or median island. When using tubular markers, do not install them on the same pavement marking line as the sign. Match tubular marker color to the pavement marking they supplement, in accordance with ***MUTCD Section 3I.01***.

IN-STREET PEDESTRIAN CROSSING signs (***R1-6a*** or ***FTP-029-25***) on lane lines may be substituted for tubular markers to reduce maintenance and replacement costs from motor vehicle impacts. For further guidance on tubular marker substitution, see ***TEM 5.2.7.2***.

IN-STREET SCHOOL CROSSING Sign (*R1-6c*)

For school crossings, use the in-street *SCHOOL CROSSING* sign (***R1-6c***) instead of the *IN-STREET PEDESTRIAN CROSSING* sign (***R1-6a***).

Figure 5.2-5. *IN-STREET PEDESTRIAN CROSSING* (*R1-6a*)

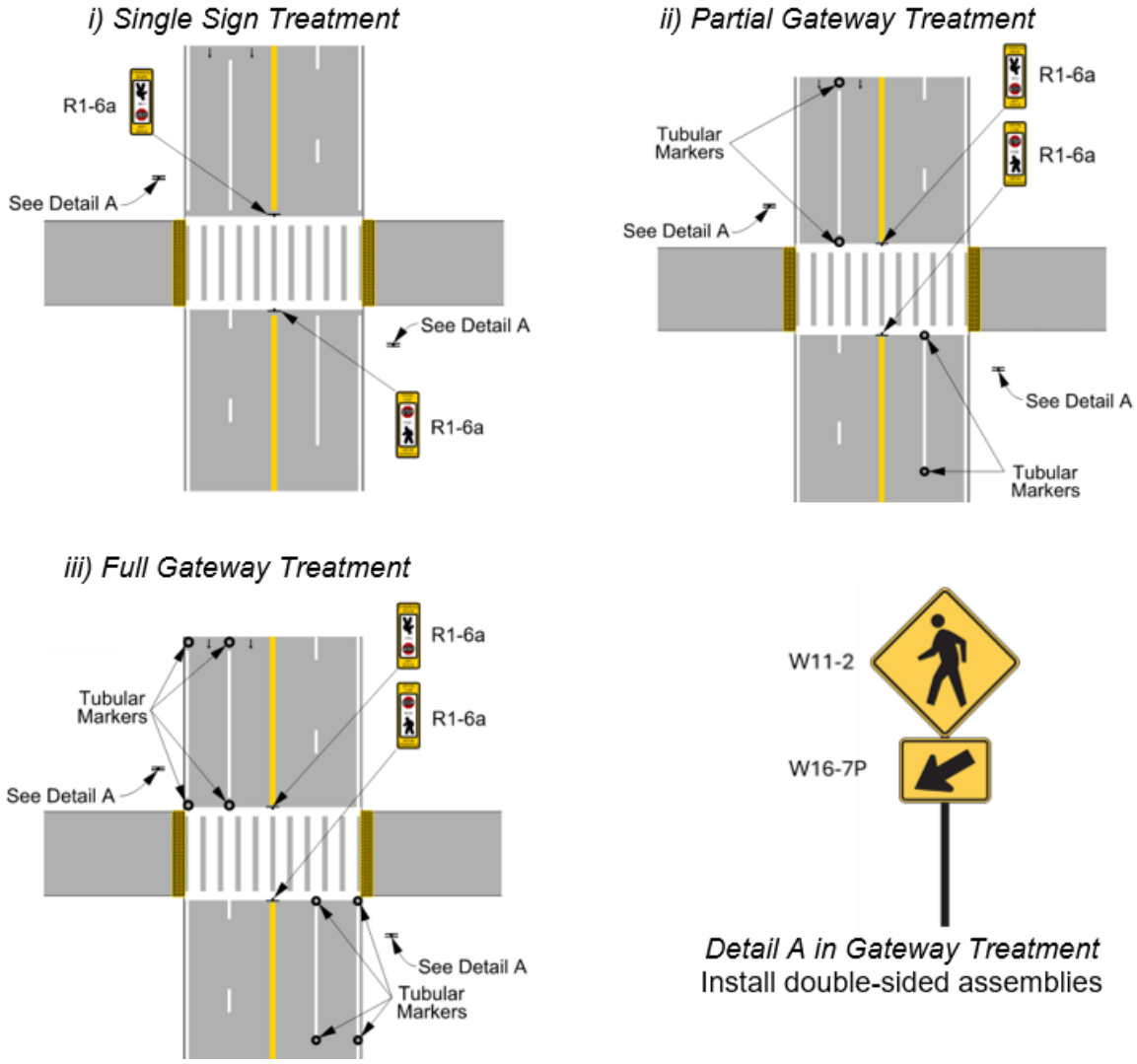


Tubular Marker Gateway Treatment

To further emphasize the midblock pedestrian crossing and to channelize and potentially calming traffic, supplement *IN-STREET PEDESTRIAN* and *SCHOOL CROSSING* signs (***R1-6a*** and ***R1-6c***) with tubular markers on the lane lines or edge lines. See ***Figure 5.2-6*** for illustrations of tubular markers used to supplement *IN-STREET PEDESTRIAN CROSSING* signs (***R1-6a***).

Tubular markers can supplement the ***R1-6*** gateway treatment per FHWA ***Official Ruling 3(09)-61 (I) – Channelizing Devices at Midblock Pedestrian Crossings in Conjunction with IN-STREET PEDESTRIAN CROSSING (R1-6 Series) Signs***.

Figure 5.2-6. R1-6 Gateway Treatments with Tubular Markers



STATE LAW STOP FOR PEDESTRIANS IN CROSSWALKS* Sign *(FTP-027-25)

Install the *STATE LAW STOP FOR PEDESTRIANS IN CROSSWALKS* sign ***(FTP-027-25)*** at marked, unsignalized crosswalks.

5.2.7.3 Beacons (Signal Warrant Analysis Not Required)

At locations without traffic signals or PHBs, engineers can use other pedestrian-activated devices to warn motorists and draw attention to people using marked crosswalks. Other treatments not listed here may be appropriate depending on the site's features.

Rectangular Rapid Flashing Beacons (RRFB)

RRFBs are activated by crosswalk users and installed in pairs below the *PEDESTRIAN CROSSING* sign (***W11-2***) and above the diagonal downward arrow plaque (***W16-7P***) for post-mounted RRFBs. They flash when activated by a non-motorist. An example of the RRFB treatment is shown in ***Figure 5.2-7***.

Figure 5.2-7. Rectangular Rapid Flashing Beacons (RRFB)



At school or trail crossings, a *SCHOOL CROSSING* sign (***S1-1***) or *TRAIL CROSSING* sign (***W11-15***) may be installed with RRFBs instead of a *PEDESTRIAN CROSSING* sign (***W11-2***).

Mount a pedestrian instruction sign (***FTP-033-25***) adjacent to the RRFB or integrate it with the corresponding pedestrian push button. Sign details are available in the ***Standard Plans, Index 700-102***. The instruction sign has a three-line legend, as shown in ***Figure 5.2-8***.

Figure 5.2-8. RRFB Push-Button Sign (*FTP-033-25)*



RRFB push buttons with an audible warning message are to state, "*WAIT FOR TRAFFIC TO STOP THEN CROSS WITH CAUTION"* when activated.

On multilane undivided roadways, consider installing overhead RRFBs unless design constraints or engineering documentation preclude overhead installation. Overhead RRFBs enhance visibility for approaching motorists and align with installing overhead school zone warning signs on multilane roadways. When overhead RRFBs are used, combine these with ground-mounted devices when feasible.

Consider advance warning signs with RRFBs on multilane approaches, especially those with higher traffic volumes and speeds.

Detailed conditions of use, including sign/beacon assembly, dimensions, placement, and flashing rates, are provided in ***MUTCD Chapter 4L***. Refer to the following resources for more guidance on the RRFB design:

- ***Standard Plans, Index 654-001***
- ***FDM 941***
- ***Standard Specifications, Section 654***

Flashing Yellow Beacons

At locations where traffic signals are not warranted, engineers may consider installing a flashing yellow beacon to supplement the appropriate warning or regulatory signs at a marked crosswalk. See ***MUTCD Chapter 4S*** for a complete list of requirements. Refer to ***Standard Plans, Index 700-120*** for design and installation details.

A flashing yellow beacon may be overhead or post-mounted. Post-mounting the beacon is preferred as it may prevent confusing it with a flashing traffic signal.

- Install post-mounted flashing yellow beacons with two vertically aligned beacons operating in an alternating flash pattern.
- Pair overhead-mounted, flashing yellow beacons with an overhead *STOP FOR PEDESTRIANS* sign (***R1-9a***), continuously lit at night.

In-Roadway Warning Lights (IRWLs)

IRWLs are installed in the pavement to warn road users they are approaching a condition that requires them to slow down or stop. Based on an engineering study, engineers may recommend installing IRWLs at marked crosswalks with applicable warning signs.

Operate IRWLs in a flashing pattern (50 to 60 flash periods per minute). When installing IRWLs with overhead or post-mounted LED-highlighted signs or flashing yellow beacons, match the flashing rates. See ***MUTCD Chapter 4U*** for detailed guidance on this treatment.

Consider installing IRWLs in locations where overhead lighting is not provided. Use the following criteria:

- Coordinate with the District Maintenance Office prior to seeking ***DTOE*** approval.
- Install only at marked crosswalks with applicable warning signs.
- Install along both sides of the crosswalk and span its entire length.
- Do not use IRWLs at crosswalks controlled by *STOP* signs (***R1-1***), *YIELD* signs (***R1-2***), PHBs, or traffic control signals.
    - A Request to Experiment (RTE) approval from FHWA is required to install IRWLs with traffic signals or PHBs.

Include an ***FTP-033-25*** sign or a *PUSH BUTTON TO TURN ON WARNING LIGHTS* sign (***R10-25***) on non-motorist-actuated installations.

5.2.7.4 Beacons and Signals (Warrant Analysis Required)

Pedestrian Hybrid Beacon (PHB)

A PHB is a special type of hybrid beacon that warns and controls traffic at an unsignalized location to assist pedestrians in crossing a roadway at a marked crosswalk. Install PHBs only at marked crosswalks. See ***Figure 5.2-9*** for a PHB example. See ***MUTCD Chapter 4J*** for PHB guidance and criteria.

For six-lane roadways or crossing distances exceeding 80 feet, consider a two-stage pedestrian crossing with a 6-foot minimum median refuge island where a warranted PHB controls the marked crossing.

Include the *CROSSWALK, STOP ON RED, PROCEED ON FLASHING RED WHEN CLEAR* sign (***FTP-028-25***) or the *CROSSWALK, STOP ON RED* sign (***R10-23***) in PHB treatments.

Figure 5.2-9. Pedestrian Hybrid Beacons (PHB)



Midblock Traffic Control Signal

Where pedestrian volumes meet ***MUTCD Signal Warrant 4***, engineers may install a midblock traffic control signal, as directed by ***MUTCD Section 4C.05, Warrant 4, Pedestrian Volume***. See FDOT's ***Manual on Uniform Traffic Studies (MUTS)*** for guidance on conducting Pedestrian Group Size and Vehicle Gap Size studies supporting the documentation for Warrant 4.

Install a signal that is compatible with the existing signal system along the corridor.

For six-lane divided roadways or crossing distances exceeding 80 feet, consider a two-stage pedestrian crossing with a 6-foot minimum median refuge island, where a warranted traffic control signal controls the proposed marked crossing.

Include pedestrian signal heads with midblock traffic control signals. See ***Standard Plans, Index 653-001*** for details on installing pedestrian control signals

To improve pedestrian compliance at the crosswalk, install a feedback device with the traffic control signal push button to confirm their call. See ***TEM 3.7*** for information on the use of accessible pedestrian signals.

A traffic control signal may not be needed at a midblock location if adjacent coordinated traffic control signals consistently provide adequate gaps for pedestrians to cross the roadway.

A midblock traffic control signal treatment example is shown in ***Figure 5.2-10.***

Figure 5.2-10. Midblock Traffic Control Signal



5.2.7.5 Other Treatments

In addition to raised medians, curb extensions, and raised crosswalks (see ***Figure 5.2-11***), the following treatments enhance visibility, support pedestrian travel, and increase motorist awareness of pedestrians at crossings. See ***FDM 222*** for pedestrian treatment design criteria. See ***FDM 202*** for other speed management treatments.

Figure 5.2-11. Raised Crosswalk



Pedestrian Refuge Islands

Pedestrian refuge islands allow pedestrians and bicyclists to stop midway before finishing a crossing. Provide pedestrian refuge islands as directed in ***FDM 210*** and ***FDM 222***. Refuge islands can also be used to manage speed, as discussed in ***FDM 202***.

Pedestrian refuge islands can facilitate two-stage pedestrian crossings. When pedestrian signal control is provided for a two-stage crossing, each stage should be operated independently, with pedestrian actuation or detection provided for each stage.

Minimize the delay between pedestrian actuation or detection at the median and activation of the second-stage pedestrian crossing. Consider pedestrian progression and expected pedestrian behavior (e.g., pedestrians tend to cross when they see a gap in traffic and may not wait for the WALKING PERSON signal indication) when establishing signal timing and detection for each stage.

Before installing a pedestrian refuge island, evaluate potential effects on vehicular operations, access management, and turning movements. Consider driveway access, median opening spacing, U-turn opportunities, and accommodating design vehicles,

transit vehicles, and emergency vehicles. Coordinate the design of proposed refugee islands with applicable access management requirements.

Crosswalk Illumination

Provide crosswalk illumination in accordance with ***FDM 222*** and ***FDM 231***.

For crosswalks serving environmentally sensitive areas or facilities that are open only during daylight hours, the engineer may omit lighting if ***DTOE*** approves. Consider IRWLs at crosswalk locations without illumination.

Passive Pedestrian Detection

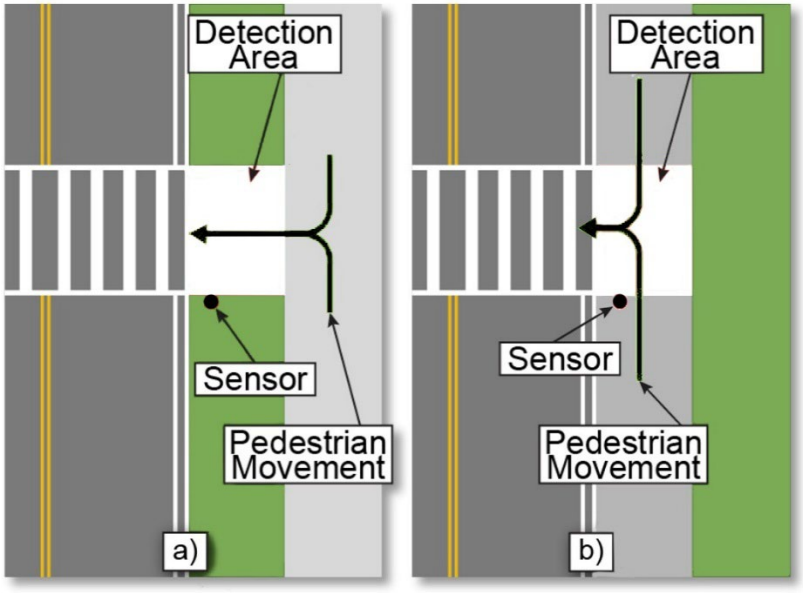
Passive pedestrian detection detects the presence and direction of pedestrians and activates the traffic control device. This system does not require manual actuation. Consider passive pedestrian detection where low actuation (push-button activation) has been documented. Passive pedestrian detection implementation may be particularly beneficial for crosswalks used by children, teenagers, or older adults, and those at school crossings.

In addition to pedestrian actuation, engineers may install passive pedestrian detection at RRFBs, PHBs, MPSs (RTE approval required), and midblock traffic control signals. When installing passive pedestrian detection:

- Provide adequate passing width around the waiting detection area on the sidewalk.
- Install overhead lighting to increase pedestrian visibility and detector accuracy.
- Provide adequate installation height, detection distance, and detector position/angle to recognize pedestrian features.
    - If there are no existing poles or infrastructure at the site, consider a supplemental pole or an extended arm from an existing pole.
- Calibrate the detector after installation to cover the pedestrian waiting area.
- Place the detector facing the sidewalk, as shown in ***Figure 5.2-12***.
    - If possible, maintain a buffer between the sidewalk and the road. The space leading towards the crosswalk can be used as the detection area.
    - If the sidewalk is adjacent to the curb without any buffer, pedestrians walking past the crosswalk may trigger false detections. Consider this limitation when implementing passive pedestrian detection.
- For shared-use paths where bicyclists are to be detected:
    - Place the passive detection devices adjacent to the expected path of bicyclists.
    - Supplement the detection with signing and pavement markings to inform bicyclists where to wait.

- At signalized shared-use path crossings, consider installing advance detection on the shared-use path approach to extend or actuate the signal phase and allow continuous through movements.
- Certain loop configurations are better at detecting bicyclists than others. Consider the amount of metal in typical bicycles when designing loop detectors. Adjust the loop detectors' settings to accurately detect bicycles.

Figure 5.2-12. Sidewalk Location Options for Passive Pedestrian Detection



Raised Rumble Strips

Raised rumble strips, also known as transverse rumble strips, can improve motorist awareness when placed ahead of rural stop-controlled intersections. Consider applying this treatment upstream of midblock crosswalks and unsignalized intersections where the other treatments described in this section have not improved motorist-yielding behavior. Install raised rumble strips according to ***Standard Plans, Index 546-001*** and ***Standard Specifications, Section 546***.

Consider the following factors when installing transverse rumble strips near midblock or unsignalized crosswalks:

- Evaluate the noise impact that transverse rumble strips would have on nearby residential areas before installation.
- Coordinate with the District Maintenance Office prior to ***DTOE*** approval for using transverse rumble strips.
- There are two basic layouts for transverse rumble strips: extending across the entire traffic lane or placed only in the wheel tracks. The wheel track layout is

preferred because it allows motorists who do not need any additional warning to avoid the rumbles without driving into adjacent lanes.

- Use the transverse rumble strips with *PEDESTRIAN CROSSING* signs (***W11-2***).

5.2.8 TREATMENT OPTIONS SELECTION MATRIX

Select pedestrian treatments at midblock crosswalks and unsignalized intersections based on pedestrian volume, roadway context classification, number of lanes, posted speed limit, and other related factors as identified in ***TEM Section 5.2.4***, ***TEM Section 5.2.5***, and ***TEM 5.2.7***.

Table 5.2-1 has been designed to help engineers select treatment options. This matrix summarizes the procedures, selection criteria, and treatment requirements identified in ***TEM Section 5.2***.

5.2.9 OUTREACH COORDINATION

To promote smooth implementation in coordination with local agencies and law enforcement, follow these public notification procedures before installing a new RRFB, PHB, midblock traffic control signal, MPS (RTE approval required), flashing yellow beacon, or other midblock or uncontrolled crosswalk.

- Notify the District Public Information Office of the programmed treatment at least two weeks before activating the new traffic control device.

- Inform the District Community Traffic Safety Team (CTST) Coordinator about the new traffic control device. Request that they coordinate with local law enforcement, local government agencies, and the District Law Enforcement Liaison at least two weeks before activating the new traffic control device.

Portable Changeable Message Sign (PCMS)

Apply the following criteria when using a Portable Changeable Message Sign (PCMS):

- New RRFBs, PHBs, midblock traffic control signals, MPSs (RTE approval required), flashing yellow beacons, and any other type of midblock crosswalks require a PCMS to inform the traveling public of a new traffic control pattern.
- Display the following safety message on the PCMS, using standard abbreviations as needed to accommodate the available PCMS display:
    - *NEW SIGNAL mm/dd* or *NEW CROSSWALK mm/dd*
    - *PREPARE TO STOP*
- Deploy the PCMS two weeks prior to activating the new traffic control device and retain it in place for a minimum of one week after installing the marked crosswalk treatment.

Table 5.2-1. Guidance Matrix for Pedestrian Treatments at Midblock Crosswalks and Unsignalized Intersections

TEM 5.2 Midblock Crosswalks and Unsignalized Intersection Selection Guidance Matrix			Midblock and Unsignalized Intersections					Midblock		TEM SECTION
			Special Emphasis Crosswalk			RRFB		PHB	Traffic Signal	
			20 PPH for 1 hr. *or* Shared Use Path 50% PPH reduction *or* school zones			2, 3, or 4 lanes with no refuge island or median	3 or 5 lanes with refuge island or raised median	Florida warrants must be met		
			or C2T, C3C, C4, C5, and C6	40-45 mph	> 45 mph					
			≤ 35 mph			≤ 35 mph		All Speeds		
Pavement Markings	Special Emphasis Crosswalk	Midblock	M	M	M	M	M	M	M	5.2.7.1
		Intersection	M	M	M	M	M	N	N	
Signs	Stop Here for Peds sign (R1-5b) / Stop Here for Pedestrians Sign (R1-5c)	Enhance option: highlighted or beacon	O	O	O	M	M	N	N	5.2.7.2
	Pedestrian sign (W11-2) / Ahead plaque (W16-9P)		M	M	M	M	M	M	M	
	Push Button for Warning Lights, Wait for Traffic to Stop, Cross With Caution Sign (FTP-033-25)		O	O	O	M	M	O	O	
	Overhead Ped Crossing Sign (R1-9a)		O	O	O	O	O	O	O	
	Crosswalk, Stop on Red sign (R10-23a or FTP-028-25)		N/A	N/A	N/A	N	N	M	N	
	In-street Ped Crossing sign (R1-6a)		R	N	N	R	N	N	N	
Emphasis/ Enhancements	Audible message		N/A	N/A	N/A	R	R	O	O	5.2.7.3
	In-Road Warning Light (IRWL)		N/A	N/A	N/A	O	O	N	N	
	Passive pedestrian and bike detection	Shared Use Path	N/A	N/A	N/A	R	R	R	R	5.2.7.5
		All other locations	N/A	N/A	N/A	O	O	O	O	
TEM SECTION			5.2.5.1			5.2.5.2				

Legend

M Mandatory

R Recommended

O Optional

N Not to be Applied

N/A Not Available [1]

[1] Identifies where the treatment cannot be applied because the infrastructure is not there. Ex: Audible Message on a Marked Crosswalk.

Section 5.3
PEDESTRIAN AND BICYCLIST TREATMENTS ON MOVABLE BRIDGES

5.3.1 PURPOSE

This section establishes criteria and guidelines for the consistent installation and operation of pedestrian treatments on movable bridges. These treatments include swing-style pedestrian gates, signs, and advance detection systems such as LiDAR and thermal imaging cameras. See ***FDOT Structures Manual, Volume 1 - Structures Design Guidelines, Chapter 8.1.9*** for more design information.

5.3.2 GENERAL

Signs and swing-style pedestrian gates can significantly improve non-motorists' safety on movable bridges. Advance detection systems help bridge tenders detect non-motorists and prevent the bridge from opening when non-motorists are in the vulnerable zones of the movable span. See ***Figure 5.3-1*** for typical detection zones.

5.3.3 DEFINITIONS

Advance Detection System: A passive detection system that can identify, target, track, and alert if a moving or still person is spatially referenced within a predetermined area during any weather condition.

Bascule Bridge: A movable bridge (also referred to as a drawbridge or a lifting bridge) with a counterweight that continuously balances a span or leaf throughout its upward swing to provide clearance for maritime traffic. It may be single- or double-leafed.

Bridge Tender (Drawtender): Operator of the movable bridge according to U.S. Coast Guard regulations (***Code of Federal Regulations, Title 33, Part 117***) and ***Florida Statutes***.

Lift Bridge: A vertical-lift bridge, or just a lift bridge, is a type of movable bridge in which a span rises vertically while remaining parallel with the deck.

Movable Bridge: A bridge that moves to accommodate the passage of maritime vessels. These include lift, bascule, and swing bridges.

Swing Bridge: A swing bridge (or swing span bridge) is a movable bridge that has, as its primary structural support, a vertical locating pin and support ring, usually at or near its center of gravity, and a swing span (turning span) that pivots horizontally around it.

Swing-Style Pedestrian Gate: A gate that opens and closes automatically by electronic, hydraulic, or mechanical means. Swing-style pedestrian gates open on the vertical axis, allowing them to swing toward or away from pedestrians.

Vulnerable Zones: Areas of high risk for pedestrians, bicyclists, and motorists during bridge openings.

5.3.4 TREATMENT OPTIONS

5.3.4.1 Swing-Style Pedestrian Gate

Install a swing-style pedestrian gate on a movable bridge in accordance with ***FDOT Structures Manual, Volume 1 - Structures Design Guidelines, Chapter 8.1.9***.

5.3.4.2 Signage

Install a *NO PEDESTRIANS OR BICYCLES BEYOND GATE* sign (***FTP-036-25***) on a movable bridge swing-style pedestrian gate as shown in ***TEM 2.6.7***. Sign details are available in the ***FDOT's Sign Library***.

5.3.4.3 Advance Detection Systems

These passive thermal or laser-based systems identify, target, track, and alert the bridge tender station if they detect pedestrians or bicyclists in the movable bridge's vulnerable zones.

- The thermal camera system is an advance detection system that uses infrared radiation to detect and locate objects with a heat signature.
- The LiDAR camera system is an advance detection system that uses **Li**ght **D**etection **a**nd **R**anging technology. It emits pulsed laser beams in a predetermined geographic space and measures the time each pulse takes to reflect off the environment and objects of interest, creating a 3D image of the target.

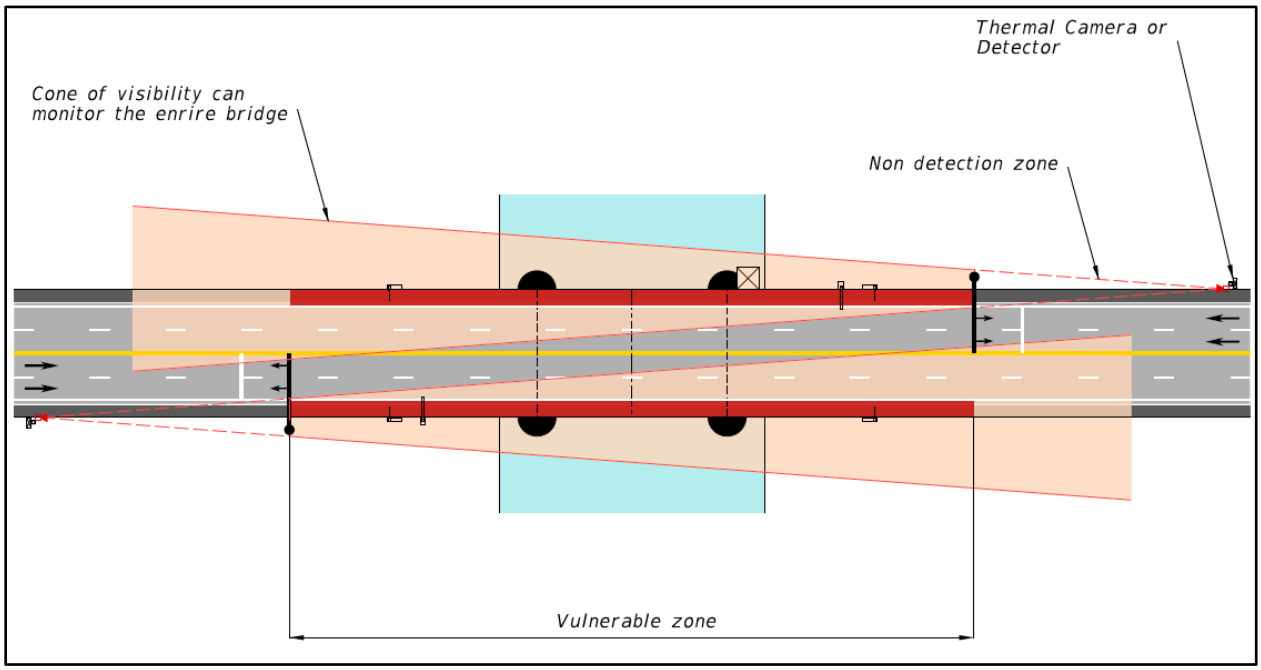
A computer in the bridge tender house with an uninterruptible power supply processes the sensor data from the advance detection system, and the feed is displayed. These systems, including all integrated components, are on the FDOT's ***Approved Products List (APL)***.

The ***DTOE*** approves the selection of the advance detection system technology. ***State Traffic Operations Engineer (STOE)*** approval is required to select technology not covered in this section.

Systems may include:

- Thermal camera, or LiDAR camera
- Controller or server cabinet
- Communication system (wired, wireless, or cellular service)
- Network switch
- Conduit and pull box
- Power supply (hook up to existing power or solar power systems)
- Wire, cable, and related fittings

Figure 5.3-1. Typical Detection Zones



SECTION 5.4

TREATMENTS FOR DETERRING WRONG-WAY DRIVING

5.4.1 PURPOSE

This section establishes guidelines for applying treatments to deter wrong-way driving (WWD). This section complements the design criteria found in the ***FDM***. Refer to ***FDM 230*** for guidance on selecting and applying wrong-way driving traffic control devices.

5.4.2 GENERAL

FDOT installs the minimum required *DO NOT ENTER* (***R5-1***) and *WRONG WAY* (***R5-1a***) signs and pavement markings (e.g., Wrong-Way Arrow, etc.) as directed in ***MUTCD Sections 2B.46 through 2B.50***. As part of evolving efforts to deter wrong-way crashes, FDOT has released four bulletins:

- "Signing and Pavement Marking Standards at Ramp Intersections" (***Traffic Engineering and Operations Bulletin 03-15***).
- 'Wrong-Way Driving Advanced Countermeasures at Interchange Exit Ramps" (***Traffic Engineering and Operations Bulletin 19-03***).
- "Wrong-Way Driving Countermeasures for Arterials and Collectors" (***Traffic Engineering and Operations Bulletin 21-03***).
- "Wrong-Way Arrows with RPMs and Wrong-Way Signage in Median" (***Office of Design Bulletin 26-01***).

Appropriate WWD treatments vary depending on location. For new facilities, include geometric design elements that reduce WWD. To reduce WWD on existing facilities, prioritize signage and pavement marking enhancements and consider adding traffic control signals. In all cases, maintain adequate sight distance. Combine solutions to develop the most effective strategy before considering advanced countermeasures.

Use advanced countermeasures for locations with high-risk operational characteristics or an established history of WWD events at the ***DTOE***'s discretion. Consider applying advanced countermeasures at locations with land use (e.g., poorly aligned commercial driveways, proximity to tourist areas, etc.) or lighting issues, a history of impaired driving or crashes, or a high proportion of licensed motorists 25 and younger or 65 and older. Also consider social factors, such as proximity to establishments that serve alcohol, as noted in ***FDOT Research Report BDV29-977-36: A Data-Driven Approach to Implementing Wrong-way Driving Countermeasures***.

Consider interchange geometry when prioritizing treatments. Certain interchange geometry types, such as partial cloverleaf, are more susceptible to WWD incidents.

Frontage road type is another factor to consider, as one-way frontage roads that intersect with freeway off-ramps are more susceptible to causing freeway WWD incidents than standard frontage roads, according to ***NCHRP Research Report 1050: Wrong-Way Driving Solutions Handbook***.

FDM 230 describes strategies for deterring wrong-way driving on divided and one-way arterial and collector roadways.

5.4.3 TREATMENT OPTIONS

Consider the following treatment options to deter WWD on freeway ramps and arterials:

- Geometry
- Signs
- Pavement markings
- Traffic signal control
- Advanced countermeasures

5.4.3.1 Geometry

Consider the following geometric recommendations when designing a new interchange or addressing WWD at an existing interchange:

- Install red retroreflective linear barrier delineators, as shown in ***Figure 5.4-1***.

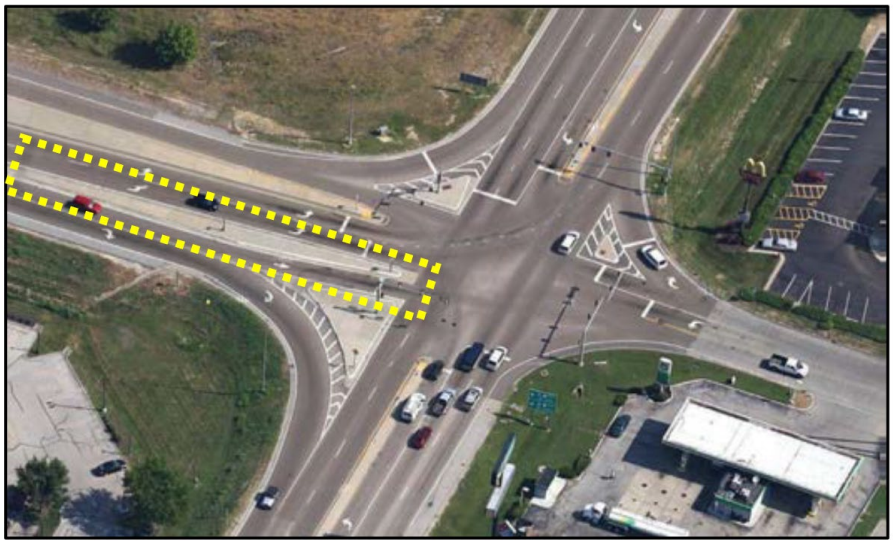
Figure 5.4-1. Linear Barrier Delineators



- Install non-traversable medians to discourage left-turn wrong-way entry onto exit ramps.
- Install tubular markers to prohibit left-turn wrong-way entry when no raised medians are present.

- Install raised medians or median barriers between ramps of trumpet interchanges.
    - Do not use raised medians to separate vehicles traveling in the same direction on exit ramps. This gives the impression of two-way traffic, as shown by the partial cloverleaf (parclo) entrance ramp in ***Figure 5.4-2***.

Figure 5.4-2. Raised Median Separating Same-Direction Vehicles



Channelize islands to reduce the approach width at the end of the exit ramp.

- Add a short-radius curve or angular break at the intersection of the left edge of exit ramps and the right edge of the street to discourage wrong-way right turns from the intersecting street.
- Provide open sight distance throughout the entire length of entrance and exit ramps, especially at the ramp terminal of the intersecting street.
- At the intersection of two-way ramps and intersecting streets (parclo interchanges), move stop lines for left turns from the intersecting street forward so motorists have a better view of the entrance ramp and a better turning radius.
- Do not extend median barriers to block the left-turning motorist's view of the entrance ramp where the entrance ramp and exit ramp are adjacent. See ***FDM 210*** for more design information on medians, islands, and hardened centerlines.
- Deter left-turn wrong-way movements with narrowed or directional median openings on arterial highways.

5.4.3.2 Signs

Consider the following WWD signage treatments on freeway ramps and arterials:

- Angled *DO NOT ENTER* (***R5-1)*** or *WRONG WAY* (***R5-1a****)* signs near intersections toward motorists traveling in the direction most likely to make the

wrong-way movement. Engineers may use alternative screening solutions to limit the signs' visibility to motorists traveling in the correct direction.

  - To enhance conspicuity, supplement WRONG WAY (R5-1a) signs with the DO NOT ENTER SIGNS on the same sign post. Additionally, consider using oversized signs. See ***MUTCD Section 2A.11*** for additional information.

- Utilize minimum mounting heights for *DO NOT ENTER* (***R5-1)*** and *WRONG WAY* (***R5-1a***) signs where no pedestrian access is permitted. See ***Standard Plans, Index 700-101-1***.
- Place turn prohibition signs to avoid wrong-way movements. This can be accomplished with *NO RIGHT TURN (**R3-1**) and NO LEFT TURN (**R3-2**)* signs.
- Consider using supplemental *WRONG WAY* (***R5-1a***) signs in the following scenarios:
  - Within 100 feet of the *DO NOT ENTER* (***R5-1***) sign(s).
  - Exit ramps with an extensive history of WWD may receive a third set of signs beyond the required set.
  - Along one-way frontage roads that lead from freeway exit ramps.

5.4.3.3 Pavement Markings

Consider the following recommendations regarding use of pavement markings as a treatment for WWD on freeway ramps or on arterials:

- Avoid placing lane-use arrows where they can be misunderstood and possibly cause wrong-way maneuvers. For example, do not put left-turn-only arrows in a through lane at an exit ramp intersection. Refer to ***TEM 4.2.3.2*** for additional information. See ***FDM 230*** for more design information.
- Move the stop lines forward for left turns from the intersecting road, especially at large intersections with adjacent entrance/exit ramps, as shown in ***Figure 5.4-3***.
- Provide lane line extensions at ramp terminals with large turning radii or adjacent entrance/exit ramps.

Figure 5.4-3. Cross Road Stop Bar That Has Been Moved Forward



5.4.3.4 Traffic Signals

The following recommended treatments can be applied to traffic signals at freeway ramps and intersections with one-way roads:

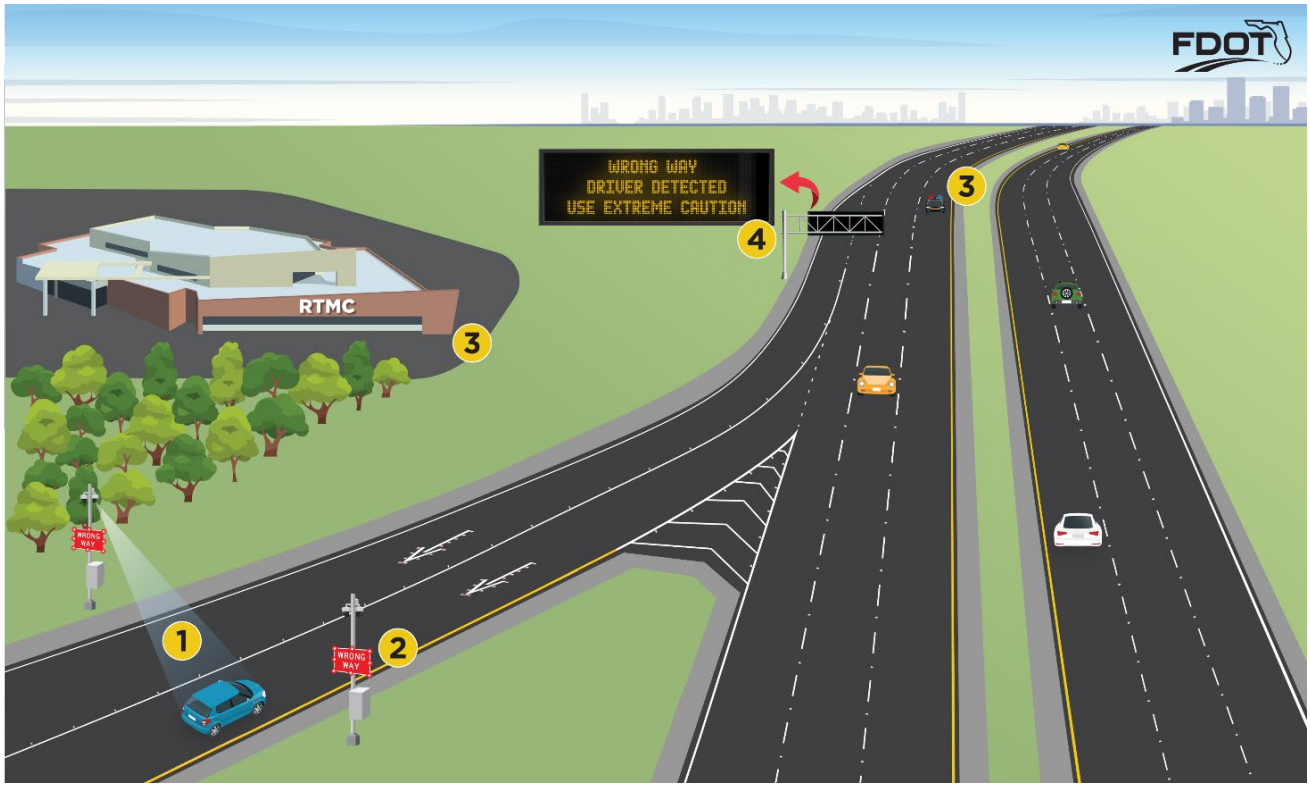
- To discourage wrong-way turns and supplement other wrong-way signing and pavement marking treatments, replace the circular green signal bulb with a green upward arrow on the signal face for the exclusive through-travel lane closest to the intersecting off-ramp or one-way road. See ***MUTCD Section 4F.01(05)*** for reference.
- Place a supplemental signal face with a green upward arrow on a pedestal in the median for left-turn storage that carries through the interchange ramp terminal to deter motorists from turning into the incorrect facility. This treatment is appropriate where additional storage for queueing to the entrance ramp is needed, as in a diamond interchange. This signal is not considered a primary signal face.

5.4.3.5 Advanced Countermeasures

Advanced WWD countermeasures use wrong-way vehicle detection systems (WWVDS), motorist awareness systems, and a centralized logic platform. A detection system may include thermal, radar, or video detection. A motorist awareness system consists of a *WRONG WAY* (***R5-1a***) sign highlighted by light-emitting diodes (LEDs), actuated by the WWVDS. The WWVDS may connect to a centralized logic platform that alerts the Regional Transportation Management Centers (RTMC) via SunGuide software when it detects a wrong-way motorist, as illustrated in ***Figure 5.4-4***.

Consider applying advanced countermeasures at on-ramps with extensive WWD history or that are geometrically prone to WWD. Apply advanced countermeasures at the ***DTOE***'s discretion. See ***FDM 230***, ***Standard Plans, Index 700-120***, ***Standard Specifications, Sections 660 and 995***, and ***Supplemental Wrong Way Vehicle Detection System SunGuide HTTP Protocol Requirements*** for more design information.

Figure 5.4-4. Visual Schematics of Advanced Countermeasures



How a Wrong-Way Vehicle Detection System Works

(1) Detects Vehicle: Signs located on the exit ramps use the system to detect vehicles traveling the wrong way.

(2) Triggers Lights: Flashing lights are turned on along the sign border to alert the motorist that he/she is traveling in the wrong direction.

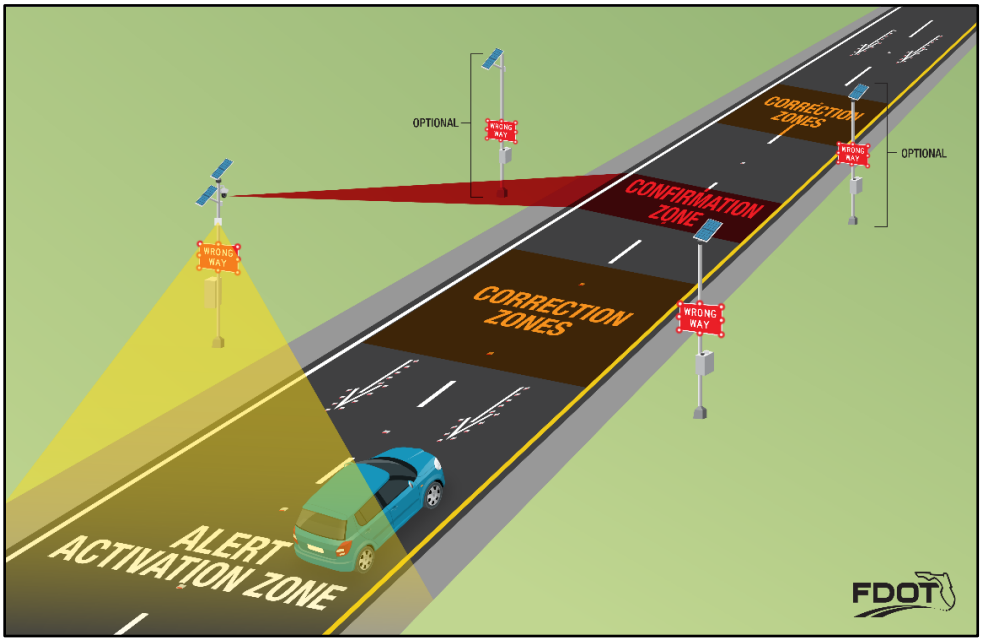
(3) Notifies Officials: The detection system sends an alert immediately to operators at an FDOT Regional Transportation Management Center (RTMC) and law enforcement officials.

(4) Alerts Other Motorists: The RTMC system broadcasts a wrong-way motorist alert on message boards along the freeway.

The following recommendations and considerations apply to adding advanced WWD countermeasures on freeway ramps:

- The vehicle detection system includes sensors capable of creating unique “detection” and “verification” zones, as shown in ***Figure 5.4-5***. Use utility power and fiber connections where possible rather than solar power because they perform better.
- The proposed sensor locations adequately cover vehicle detection across all lanes, shoulders, and slip ramps of the exit ramp.
- Each sensor can capture both detection and verification zones across all lanes and shoulders.

Figure 5.4-5. Typical Detection Zones



- For straight exit ramps, start the detection zone at least 25 feet before the stop line.
- On ramps with right-turn lanes or islands, begin the detection zone at the island gore point or the start of the tangent.
- Position detection zones to prevent false alerts from opposing or right-way traffic on nearby roads and entrance ramps.
- Keep sight lines clear, without obstructions like signs, lighting poles, vegetation, walls, or other physical features.
- The vehicle detection system can operate effectively in all weather and lighting conditions.
- Any additional hardware or equipment, such as illuminators, is provided as necessary components of the system.
- The setup of the vehicle detection subsystem depends on the roadway geometry and physical constraints at the specific location (e.g., primary and remote; primary, secondary, and remote).
- Place reflective stripes in yellow or white on the traffic-facing side of posts to reduce the chances of motorists knocking them down.
- Closed-circuit television (CCTV) cameras in freeway or arterial areas near the vehicle detection system help operators confirm and track wrong-way detections.

5.4.4 EDUCATION

FDOT has developed educational and outreach resources to support wrong-way driving (WWD) prevention efforts and increase public awareness of appropriate motorist responses to WWD events.

FDOT created print and digital materials to educate motorists on WWD countermeasures implemented on the Interstate Highway System. These materials inform motorists about what to do if they enter a ramp the wrong way or encounter a wrong-way motorist on the roadway.

Download or order free copies of tip cards from the ***Safe Mobility for Life Resource Center*** ***(Figure 5.4-6)***. Digital graphics can be downloaded from the ***Safe Mobility for Life Digital Resource Center*** ***(Figure 5.4-6).*** These resources provide consistent research-based WWD safety information to support public education and outreach efforts***.***

Figure 5.4-6. Wrong-Way Driving Educational Graphic

