Outline

- State of pedestrian safety in Florida
- Pavement markings and signs for midblock crosswalks
- Enhanced treatments for midblock crosswalks
  - Crosswalk visibility enhancements
  - Raised crosswalks
  - Pedestrian refuge islands
  - Rectangular rapid-flashing beacons
  - Pedestrian hybrid beacons
  - Road diets
- New technologies for midblock crosswalks
  - Passive pedestrian detection
  - Connected vehicle
The State of Pedestrian Safety in Florida

- Florida ranked as one of the highest in pedestrian fatalities and serious injuries amongst the other states.

- Pedestrian and bicycle-related crashes are an emphasis area within the Florida Strategic Highway Safety Plan.

**Florida’s Pedestrian and Bicycle Safety Coalition**

is a diverse group of national, state, and local partners and safety advocates that priorities and implements the strategies identified in the statewide Pedestrian and Bicycle Strategic Safety Plan (PBSSP) to reduce pedestrian and bicycle-related fatalities and serious injuries as a result of traffic crash involvement on Florida’s roadways.

The PBSSP was finalized in 2013 in response to a pedestrian fatality rate that was nearly double the national average and a bicycle rate that was nearly triple. The Coalition meets regularly to discuss and update the progress of the PBSSP implementation.
VISION ZERO
DRIVING DOWN FATALITIES

TRAFFIC FATALITIES (FLORIDA 2007 - 2017)

PEDESTRIAN FATALITIES (FLORIDA 2007 - 2017)

BICYCLE FATALITIES (FLORIDA 2007 - 2017)
Pavement Markings for Crosswalks

- Use special emphasis crosswalk markings at signalized intersections on all approaches, midblock crossings, and school crossings. *Standard Plans 711-001, Sheet 10 of 13*

- Use standard crosswalk markings for stop or yield-controlled intersections where pedestrian facilities are present. *FDOT Design Manual Exhibit 230-1*
Signing for Crosswalks

- Florida Statutes 316.130 (7)(b)
  - Vehicle’s driver to stop at any pedestrian crosswalk where signage so indicates

- Typically used for uncontrolled approaches

- FDOT Standard Specification 700-1.2.4 use Type IV fluorescent yellow-green sheeting
Installation Criteria for Marked Crosswalks

- FDOT Traffic Engineering Manual (TEM) Section 3.8
  - Traffic Engineering and Operations
  - Placement of marked crosswalk should be based on an identified need
  - Factors for evaluating marked crosswalk need
    - Proximity to significant generators and attractors
    - Pedestrian demand
    - Pedestrian-vehicle crash history
    - Distance between crossing locations
Minimum Pedestrian Demand for Marked Crosswalk

- FDOT TEM Section 3.8
  - Minimum pedestrian volume
    - 20 or more pedestrians during a single hour of an average day, or
    - 18 or more pedestrians during each of any two hours of an average day, or
    - 15 or more pedestrians during each of any three hours of an average day
  - Exceptions to the minimum pedestrian volume
    - Within a school zone
    - The following context classification and speed limit combinations
      - ✓ C2T with speed limit of 35 MPH or less
      - ✓ C4 with speed limit of 35 MPH or less
      - ✓ C5 with speed limit of 35 MPH or less
      - ✓ C6
  - Engineering Study is still required
Midblock Crosswalk

TEM Section 3.8

Figure 3.8-3. Guidelines for the Installation of Pedestrian Treatments on Low-Speed Roadways

Figure 3.8-4. Guidelines for the Installation of Pedestrian Treatments on High-Speed Roadways

Speeds greater than 35 mph

Legend:
- MUTCD Traffic Signal Warrant 4 Chart
  Note: 133 PPH applies as the lower threshold volume
- MUTCD Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways Chart
  Note: 20 PPH applies as the lower threshold volume
- MUTCD Traffic Signal Warrant 4 Pedestrian Peak Hour Volume
- Traffic Signal Warrant 4, Pedestrian Peak Hour Volume
- Pedestrian Hybrid Beacon
  L = Crosswalk Length
- Rapid Flashing Beacons or Rectangular Rapid Flashing Beacons (RRFB)
- MAJOR STREET - TOTAL OF BOTH APPROACHES - VEHICLES PER HOUR (VPH)
Pedestrian Traffic Signal
Warrant 4
Pedestrian Peak Hour
133 PPH
Pedestrian Traffic Signal

Warrant 4

Pedestrian Peak Hour (70% factor)

93 PPH

- Posted speed limit on major street 35 MPH or higher (or)
- Intersection within rural area (10,000 or less)
Pedestrian Traffic Signal
Section 4C.05 Option 07
47 PPH

- The criterion for the pedestrian volume crossing the major street may be reduced as much as 50 percent if the 15th-percentile crossing speed of pedestrians is less than 3.5 feet per second
Enhanced Treatments for Midblock Crossing

- Crosswalk visibility enhancements
- Raised crosswalks
- Pedestrian refuge islands
- Rectangular rapid-flashing beacons (RRFB)
- Pedestrian hybrid beacons (PHB)
- Road diets

EDC 5 STEP
Crosswalk Visibility Enhancements
In-street Pedestrian Crossing Sign (R1-6a)

GOAL

- Mitigate vulnerable road user hazards at uncontrolled crosswalks
- Increase driver yield/stop rates and lower pedestrian crash frequencies through the use of In-street Pedestrian Crossing Signs (R1-6a)
- Expand upon the results of the Western Michigan University/Michigan DOT studies
- FDOT TEM Section 3.8
  - R1-6a may be used on low speed roadways to remind road users of laws regarding right-of-way at an unsignalized pedestrian crosswalk.
In-street Pedestrian Crossing Sign (R1-6a)

- FHWA RTE Gateway Effect
- 31 sites Statewide (see eTraffic website)
- R1-6a signs are placed on edge lines, lane lines and centerline (or median) to create a “gateway” effect
- Preliminary studies show 70% increase in yielding behavior
- Traffic calming effect - decreases vehicle speeds with or without pedestrians present
## R1-6a Study Locations

<table>
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<tr>
<th>FDOT District</th>
<th>Number of R1-6a Locations</th>
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<tr>
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- The Request to Experiment (RTE) is to test a wider variety of crosswalk sites and conditions throughout Florida.
- Each FDOT District selected a minimum of three locations.
- Each FDOT District considered a combination of factors to select locations with known safety concerns.
R1-6a Available Sign Products under Review

- Slender Bender™
- Shur-Tite

FDOT developmental specifications

- To ensure product quality and durability
- Meet MUTCD bending criteria
- May be crash tested in accordance with MASH 08/16
R1-6a Configurations

Partial Gateway Configuration
MUTCD Compliant

Full Gateway Configuration
FHWA RTE
Percentage of Drivers Yielding to Pedestrians

- Collected data for 24 locations in Florida
- Use of R1-6 signs increases yielding behavior to pedestrians at crosswalks
- Yielding rate for full gateway higher than that for MUTCD-compliant configuration
Vehicles stop in advance of the crosswalk when the gateway is installed

Number of drivers yielding more than 10 feet, 30 feet and 50 feet in advance of the crosswalk recorded
Gateway Effect Next Steps

- Final data review and summary of results
- Develop guidance and placement configurations for two-lane and multilane roads
- Update TEM Section 3.8
Curb Extensions for Midblock Crossing

Benefits for curb extension

- Reduces the pedestrian crossing distance
- Narrows the roadway visually and physically
- Improves the ability of pedestrians and motorists to see each other
- Reduces pedestrians’ time in the street
- Allows space for installing curb ramps
222.2.6 Curb Extensions

- May be used at intersections or midblock locations
- The needs of transit vehicles, drainage, and bicyclists must be taken into consideration
In-Roadway Warning Lights

- Recent improvements for in-roadway LED solar products
- More effective with less maintenance issues
- Improve driver yielding to pedestrians
- Better yielding at night
- May be used in conjunction with highlighted signs
Limitations for In-Roadway Warning Lights

- Lights generally are visible only to the first car in a platoon
- Headlights from oncoming traffic can obscure a driver’s view of the entire crossing
- Independent of the pedestrian’s crossing direction
Raised Crosswalks
Raised Crosswalks

- Crosswalks raised above the level of street, often at grade
- Most often on two-lane business streets in urban environments
- Applicable at both intersections and midblock locations
- Generally installed on lower speed roads
  - Designed for speed less than 35 miles per hour (mph)
Benefits for Raised Crosswalks

- Reduces vehicle speed
- Enhances pedestrian visibility
- Typically used for mid-block crossings
- Eliminates the need for curb ramps
Pedestrian Refuge Islands
Pedestrian Refuge Islands

- Raised areas to protect pedestrians that are crossing the road at intersections and mid-block locations
- Allows pedestrians to focus on one direction of traffic at a time
- Gives pedestrians a place to wait for an adequate gap between vehicles
- Can be combined with curb extension to further enhance pedestrian safety
Pedestrian Refuge Islands (cont’d)

- Enhances the visibility of pedestrian crossings at unsignalized crossing points
- Reduces the speed of vehicles approaching pedestrian crossings
- Can be used for access management
  - Allow only right-in/right-out turning movements
- Provides space for supplemental signage on multi-lane roadways
Safety Effects for Pedestrian Refuge Islands

- Three documented studies* on safety impacts for pedestrian refuge islands
  - **Study 1:** Replace 6-foot painted median with a wide raised median
    - 23% reduction in pedestrian crashes
  - **Study 2:** Before/after study for raised pedestrian refuge island
    - 73% reduction in mid-block pedestrian crashes
    - Recommend better island design and lane alignment to reduce vehicle-island crashes
  - **Study 3:** Cross-sectional study
    - Pedestrian crash rates for roads with 10-foot medians are 33% lower than that for roads with 4-foot painted medians

*Source: NCHRP Research Report 841 Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments
Rectangular Rapid-Flashin g Beacons
Rectangular Rapid-Flashing Beacons

- MUTCD interim approval IA-21 issued on March 2018
- Local agencies must submit/resubmit request to use IA-21
- FDOT received blanket approval for use on State Highway System
- Can be used with active and passive pedestrian detection (see TEM Section 3.8 and Standard Specification 654-2.23)
Pedestrian Hybrid Beacons
Pedestrian Hybrid Beacons (PHB)

- To increase motorists’ awareness of pedestrian crossings at uncontrolled marked crosswalk locations
- Only activated by pedestrians when needed
- FDOT TEM Section 3.8
  - Alternative to traffic signal when pedestrian volumes do not meet Warrant 4 requirements
Pedestrian Hybrid Beacons

- Install high-emphasis crosswalk and stop bars
- Install advance warning and regulatory signs for better compliance
  - Must have an R10-23 sign
  - May place a pedestrian warning sign (W11-2) with an AHEAD (W16-9P) supplemental plaque
Road Diets
Road Diets

- Provides enhanced safety, mobility, and access for all road users
  - A potential crash reduction of 19% to 47%
  - Reduced vehicle speed differential
  - Provides more opportunities for safe pedestrian crossings
Crash Modification Factors for Midblock Crossing Treatments

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<th>Treatment</th>
<th>Crash Type</th>
<th>Recommended CMF</th>
<th>Study Basis</th>
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Passive Pedestrian Detection
Passive Pedestrian Detection

What Is Passive Pedestrian Detection?

- To detect the presence of pedestrians in a stationary or moving state at the curbside of and/or in a pedestrian crossing by means other than those requiring physical actuation by the pedestrian. (Source: FHWA)

- Various means of detection:
  - Infrared
  - Ultrasonic
  - Microwave radar
  - Video imaging
  - Piezometric sensors
  - Smartphone application

- Devices currently available on FDOT APL
Passive Pedestrian Detection (cont’d)

How Does Passive Pedestrian Detection Work?

- Road users aren’t required to push the button
- Detector tracks pedestrian movement and assigns pedestrian phases and monitors the following:
  - Counts
  - Speed
  - Direction
- Detectors can adjust signal timing
- Potentially use smartphone application running in the background via cellular communications
Passive Pedestrian Detection (cont’d)

- FDOT testing new technologies in conjunction with the University of Florida and the City of Gainesville

- Current research being conducted by the University of South Florida (USF) Center for Urban Transportation Research (CUTR)
  - Identify currently available passive detection devices
  - Test the devices for accuracy and limitations
  - Report findings to supplement Standard Specification
Connected Vehicle Applications
Connected Vehicle (CV) Applications

USDOT Research - Ongoing

- A smartphone application is under development for pedestrian detection
- Geared for disabled or elderly pedestrians
- Alerts pedestrian to the presence of an intersection and status of the light for pedestrian crossing
- The application communicates two-way with the signal controllers via web-based cellular communications and requests a green extension, if needed
- The application communicates with the vehicles to alert pedestrian presence via on-board units
Connected Vehicle Applications (cont’d)

Tampa-Hillsborough Expressway Authority (THEA)

- Tampa is one of the first cities in the nation to test and deploy CV technology on real streets in live traffic
- THEA was selected by the USDOT for the CV pilot project focusing on urban issues
  - 1,500 private vehicles
  - 10 buses and 10 streetcars
- Pedestrian safety featured as a prominent use case
- Equipment deployed for testing
  - Vehicle On-board Units (OBUs)
  - Human/Machine Interfaces (HMIs)
  - Roadside Units (RSUs)
  - LiDAR

Source: Tampa-Hillsborough Expressway Authority (THEA)
Connected Vehicle Applications (cont’d)

I-STREET University of Florida (UF) Smart Test Bed

- FDOT, City of Gainesville, and UF connected vehicle pilot project
  - 13 traffic signals
  - Seven (7) mid-block crossings

What to test?

- Passive pedestrian/bicyclist detection
- Real-time notification to transit, motorists, pedestrians, and bicyclists
- Signal Phasing and Timing (SPaT) data broadcasting with active pedestrian and bicyclist detection via roadside units
Questions?

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