

DPS 201

# RECTANGULAR RAPID FLASHING BEACON (RRFB)



# WHY? PEDESTRIANS NEED TO CROSS



# CASE STUDY: RRFB (ST. PETERSBURG, FL)

## Problem/Background

- Multi-lane, high-speed roadways
  - Conflicts at uncontrolled crosswalks
- Motorist yielding rates less than 2% at the city's 100 uncontrolled crosswalks
- Pedestrian injury rate higher than the county/state averages



# CASE STUDY: RRFB (ST. PETERSBURG, FL)

## Solution

- In 2003 city listed enhancements to uncontrolled crosswalks as top priority
- Vendor offered to install RRFB's at two locations
  - City agreed, conducted studies
- Cost was \$10,000-15,000 dollars for purchase and installation, which was less expensive than other options



# CASE STUDY: RRFB (ST. PETERSBURG, FL)

## Details

- Compared RRFB's with dual overhead round yellow flashing beacons and side-mounted round flashing beacons
  - RRFBs provided higher yielding compliance
- Also compared two-beacon and four-beacon RRFB systems
- In all cases, yield markings placed 30 feet before crosswalks



**Before**

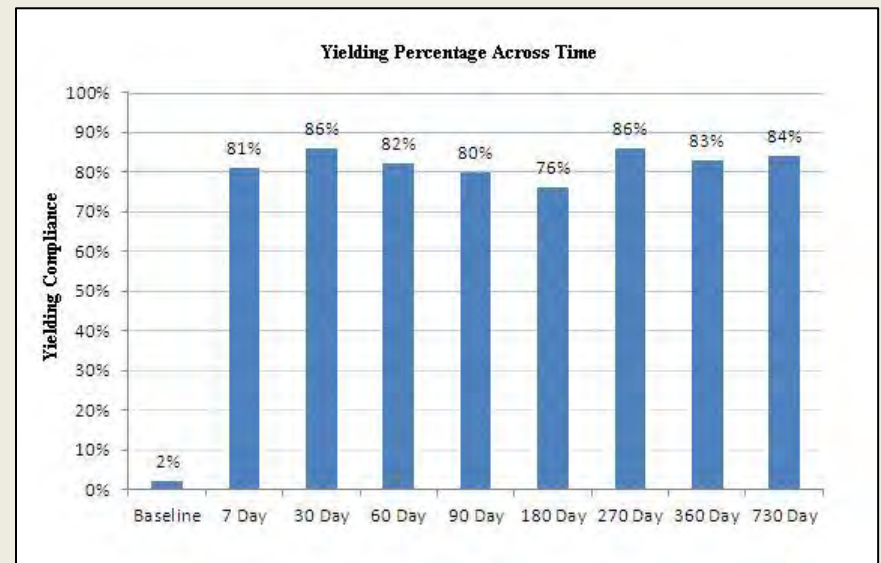


**After**

# CASE STUDY: RRFB (ST. PETERSBURG, FL)

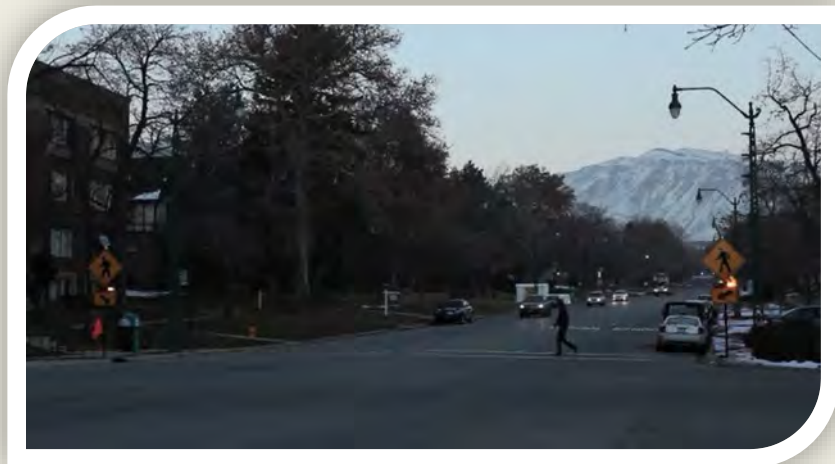
## Results

- Initial success led city to install 17 more RRFB's
- Two-year review of the crosswalks
  - RRFB's led to sustained yielding over time
- Performed equally well at night
  
- Four-beacon system had highest yield rates
- RRFB's also improved yield distance
- In May 2012 City had 42 RRFBs and plans for 20-30 more



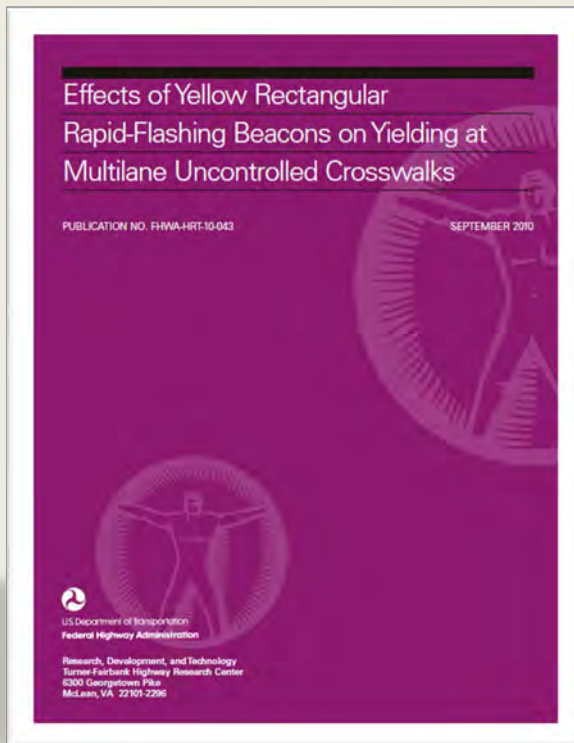
# WHERE THEY'VE BEEN USED

- Mid-block crossings
- Uncontrolled intersection approaches
  - Does not have similar language in the MUTCD regarding use at an intersection like the PHB
  - RRFBs may control both uncontrolled legs at an intersection
- RRFBs may be used at roundabout crosswalks
- Trail crossings



# SAFETY CMF & RESEARCH

- “Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks” (Publication No. FHWA-HRT-10-043) 2010







# RESEARCH

## Objective

- Examine effects of side-mounted RRFB at uncontrolled marked crosswalks for driver yielding behavior
- 22 Sites in 3 Cities
  - St. Petersburg, FL
  - Washington, DC
  - Mundelein, IL
- 18 Sites studied for 2 years for long-term effects
- Compare RRFB with traditional overhead yellow flashing beacon and a side-mounted traditional yellow flashing beacon
- Identify ways to further increase effectiveness of RRFB



# RESEARCH, CONTINUED

## “Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments” (NCHRP RESEARCH REPORT 841) 2017

### ■ Recommended CMF

- Estimate: 0.526
- Standard Error: 0.377
- Study Basis: Cross-sectional study

### ■ “Rectangular Rapid Flashing Beacons and Pedestrian Hybrid Beacons (TRR, 2015)”

- Increased yielding rates of 36%-79% points at four Texas crossing after RRFB installation



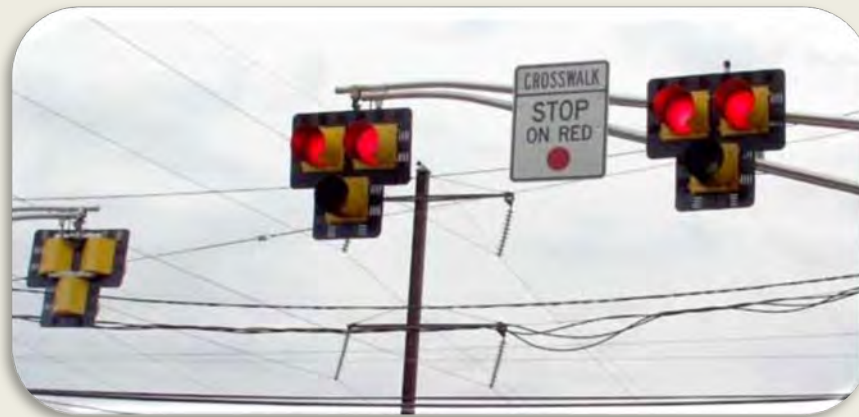
# FHWA IA-11 MEMO/RESEARCH

- Very high rates of motorist "yield to pedestrians"
  - RRFB - Mostly high 80% & close to 100%
  - 15 to 20% yield rate for standard yellow beacons
- Very high yield rates sustained after 2 years operation
- No identifiable negative effects have been found

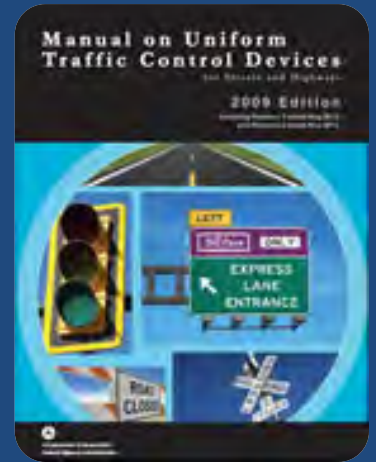


# FHWA IA-11 MEMO/RESEARCH


- RRFB's very high compliance rates are previously unheard of for any device other than a full traffic signal and a pedestrian hybrid beacon (HAWK)
- St. Petersburg data shows drivers exhibit yielding behavior much further in advance of the crosswalk with RRFB than with standard yellow flashing beacons



MUTCD  
INTERIM APPROVAL - 21  
MARCH 20, 2018



# RECTANGULAR RAPID FLASHING BEACON NEW IA-21

 U.S. DEPARTMENT OF TRANSPORTATION  
Federal Highway Administration

## Memorandum

Correction issued 3/21/2018

Subject: **INFORMATION:** MUTCD – Interim Approval for Optional Use of Pedestrian-Actuated Rectangular Rapid-Flashing Beacons at Uncontrolled Marked Crosswalks (IA-21) Date: MAR 20 2018

From: Martin C. Knopp *Martin C. Knopp*  
Associate Administrator for Operations In Reply Refer To: HOTO-1

To: Federal Lands Highway Division Directors  
Division Administrators

[https://mutcd.fhwa.dot.gov/res-interim\\_approvals.htm#valid09](https://mutcd.fhwa.dot.gov/res-interim_approvals.htm#valid09)



**Figure 1.** Example of an RRFB dark (left) and illuminated during the flash period (center and right) mounted with W11-2 sign and W16-7P plaque at an uncontrolled marked crosswalk.

- Must request and receive permission to use this new Interim Approval (1A-21) even if prior approval had been given for Interim Approval 1A-11
- A State may request Interim Approval for all jurisdictions in that State.

# INTERIM APPROVAL – ALLOWABLE USES

- a. Function as pedestrian-actuated conspicuity enhancement
- b. Shall only be used to supplement post-mounted Pedestrian, School, Trail Crossing warning sign with diagonal downward arrow, plaque, or overhead-mounted warning sign located at or immediately adjacent to an uncontrolled marked crosswalk
- d. If deemed necessary by the engineer, in event of sight distance, additional RRFB may be installed in advance of crosswalk. Shall supplement not replace.



IA-21 3.a For any approach two RRFB required, One on right-hand and one on left-hand of roadway. If divided highway left-hand should be installed on median if practical rather than far left-hand.



# IA-21 BEACON FLASHING REQUIREMENTS

- b. Left-hand 50ms - Both Dark 50ms - Right-hand 50ms - Both Dark - Repeat Left Right Sequence - Both 50ms - Both Dark 50ms - Both 50ms - Both Dark 250ms - Repeat from start
- f. Existing RRFB units using IA-11 should be reprogrammed as part of a systematic upgrading process, such as when the units are serviced or when replaced

# RRFB VIDEO IA-21FLASH PATTERN



# IA-21 BEACON OPERATION

- 6. e.
  - Flash period shall be immediately initiated each and every time a pedestrian is detected through passive detection or pushbutton activated, including when pedestrians are detected while RRFB's are already flashing and when pedestrians are detected immediately after the RRFB's have ceased flashing.
- 6. f.
  - Small pilot light may be installed



Figure 2. View of pilot light to pedestrian at shared-use path crossing with median refuge. Enlargement of pilot light at right.

# IA-21 ACCESSIBLE PEDESTRIAN FEATURES

7. a. - If speech pushbutton information message is used locator tone shall be provided

7. b. - If speech pushbutton information message is used, the audible information device shall not use vibrotactile indications or percussive indications

7. c. - Speech pushbutton message “Yellow lights are flashing”. Message should be spoken twice.



# CONDITIONS OF INTERIM APPROVAL BEACON OPERATION

- Shall be normally dark
- Shall initiate operation only upon pedestrian actuation
- Shall cease operation at a predetermined time after the pedestrian actuation or, with passive detection, after the pedestrian clears the crosswalk
- All RRFBs associated with a given crosswalk (including those with an advance crossing sign, if used) shall, when activated, simultaneously commence operation of their alternating rapid flashing indications and shall cease operation simultaneously

# ACTUATION OPTIONS

- Pushbutton activated or passive detection
- If pushbutton activated should be ADA compliant
  - Locator tone
  - Message should only let blind pedestrian know beacon is flashing, not when they can cross.
- Passive detection options bollards, video, microwave



# ADDITIONAL DESIGN CONSIDERATIONS

# NOT A SUBSTITUTE FOR GOOD DESIGN

- RRFBs are NOT a substitute for good crosswalk placement and design.
- The Crosswalk is still the primary traffic control element that assigns ROW to the pedestrian.
  - Note that in the event a user does not activate the RRFB (assuming manual actuation) the crosswalk still assigns ROW to the pedestrian.
- RRFBs supplement the crosswalk - call attention to the crosswalk warning signs
- Pre-requisites for RRFB: Use best practices for
  - Crosswalk placement
  - Pavement markings
  - Lighting



# RRFB'S ON HIGHER VOLUME & SPEED STREETS IN ST. PETERSBURG

Roadway				Location	Number of Lanes	Median Y or N	Peak 8-hr Volume	24 Hour Volume	Posted Speed	Average 85th %ile Speed
Park	Street		@	Elbow Lane	5	N	10,719	31,133	40	47.6
38th	Avenue	N	w/of	18th Street	5	Y	15,590	30,750	40	46.9
4th	Street		@	Sunken Gdns	5	Y	16,164	29,333	35	48.0
22nd	Avenue	N	@	56th Street	4	N	14,675	25,370	40	43.0
37th	Street	N	@	Pinellas Trail	4	N	13,156	24,282	35	47.4
22nd	Avenue	S	e/of	40th Street	4	N	13,156	24,282	35	47.4

Since the initial “Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks” (Publication No. FHWA-HRT-10-043) was published in 2010, St. Petersburg has installed RRFBs in some higher-volume, higher-speed locations that test the “envelope” of where they may be applied.

**Preliminary results:** These have all performed well (75%+ Yield rates, no crash problem).

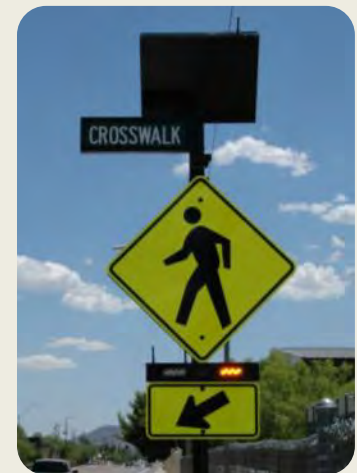
# ALL OTHER RULES APPLY

- All other rules for crosswalk placement and pavement marking apply (sight distance, advance stop/yield bar, lighting, clear pedestrian desire lines, etc.)



# TIMING DURATION

- Flash duration of RRFBs should be based on the MUTCD procedures for clearance times at pedestrian signals
- MUTCD: Section 4E.06 Pedestrian Intervals and Signal Phases
- May allow pedestrians to actuate RRFB immediately after a flash interval has ended



# INDICATOR LIGHT FOR PEDESTRIAN

A small light directed at and visible to pedestrians in the crosswalk may be integral to the RRFB or push button confirm that the RRFB is in operation.



# OVERHEAD PLACEMENT

- Overhead placement is an option
  - Originally permission was for the event that the shoulder mounting would be sight-obstructed, but then granted to supplement shoulder and median mounted beacons
- Undetermined whether or not supplemental overhead placement improves yield rate or reduces crashes



# DESIGN CRITERIA GUIDANCE

When there is a median (which is preferred for crossing multi-lane roads) a RRFB should be placed in the median



# ENFORCEMENT FOR NEW INSTALLATIONS

- New installations should be accompanied by education and enforcement
- Yielding compliance should be monitored by police
  - Exception - a new installation along a corridor with multiple beacons or in a community where RRFBs are common throughout
  - No specific threshold or standard but a logical approach is to continue enforcement until yield rates achieve 75%
  - Do added enforcement if yield rates drop precipitously



# COST (2013)

From PEDSAFE

## Estimated Cost

Infrastructure	Description	Median	Average	Min. Low	Max. High	Cost Unit	# of Sources (Observations)
Flashing Beacon	RRFB	\$14,160	\$22,250	\$4,520	\$52,310	Each	3(4)

Easy to install since they communicate wirelessly and may be solar powered

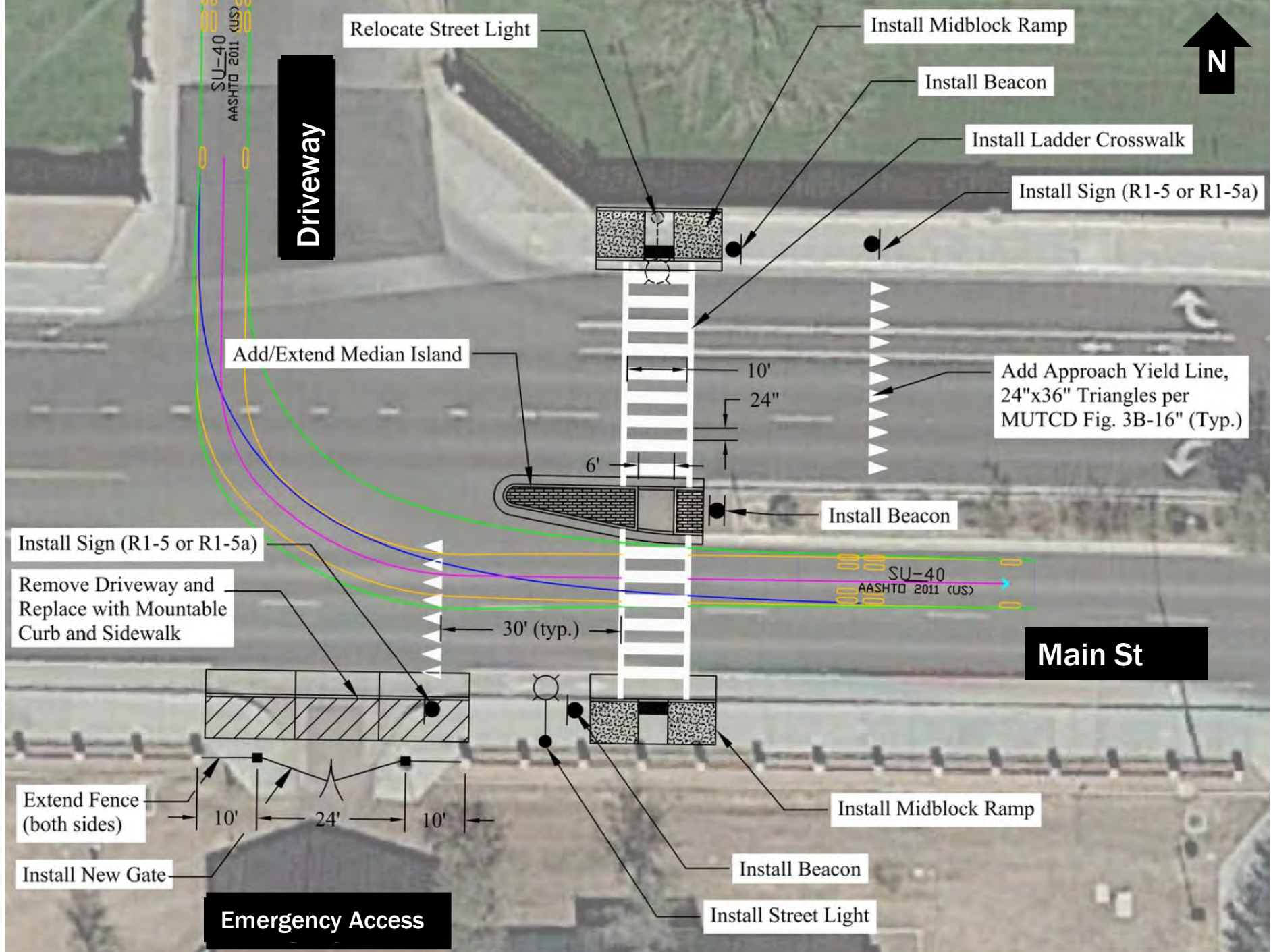


# CASE STUDY

# CONSIDER RRFB FOR CROSSING

## Problem/Background

- Midblock crossing desired
- Street width - 64 to 74 feet
- ADT 18,600 vehicles per day
- Arterial street with 2 lanes in each direction
- Median (7 ft wide) – Consider 2-stage crossing
- Potential for nighttime crossing
- Double-sided lighting
- Speed limit - 40 mph
- Police report high proportion of speeding



# FHWA CROSSING GUIDANCE (2018)

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
<b>2 lanes</b> (1 lane in each direction)	① 2 4 5 6	① 5 6 7 9	① 5 6 ⑦ ⑨	① 4 5 6	① 5 6 7 9	① 5 6 ⑦ ⑨	① 4 5 6 7 9	① 5 6 7 9	① 5 6 ⑨
<b>3 lanes with raised median</b> (1 lane in each direction)	① 2 3 4 5	① ③ 5 7 9	① ③ 5 ⑦ ⑨	① 3 4 5 7 9	① ③ 5 ⑦ ⑨	① ③ 5 ⑦ ⑨	① ③ 4 5 7 9	① ③ 5 ⑦ ⑨	① ③ 5 ⑨
<b>3 lanes w/o raised median</b> (1 lane in each direction with a two-way left-turn lane)	① 2 3 4 5 6 7 9	① ③ 5 6 7 9	① ③ 5 6 ⑨	① 3 4 5 6 7 9	① ③ 5 6 ⑦ ⑨	① ③ 5 6 ⑨	① ③ 4 5 6 7 9	① ③ 5 6 ⑨	① ③ 5 6 ⑨
<b>4+ lanes with raised median</b> (2 or more lanes in each direction)	① ③ 5 7 8 9	① ③ 5 7 8 9	① ③ 5 8 ⑨	① ③ 5 7 8 9	① ③ 5 ⑦ 8 ⑨	① ③ 5 8 ⑨	① ③ 5 ⑦ 8 ⑨	① ③ 5 8 ⑨	① ③ 5 8 ⑨
<b>4+ lanes w/o raised median</b> (2 or more lanes in each direction)	① ③ 5 6 7 8 9	① ③ 5 ⑥ 7 8 9	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ 7 8 9	① ③ 5 ⑥ ⑦ 8 ⑨	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ ⑦ 8 ⑨	① ③ 5 ⑥ 8 ⑨	① ③ 5 ⑥ 8 ⑨

**6 = Island, 7 = RRFB, 8 = Road Diet, 9 = PHB**

# CASE STUDY - CONSIDER RRFB

- RRFB Issues
  - No RRFB warrants or applications in MUTCD or IA
  - Lower cost than PHB
  - Median too narrow for two-stage crossing (out of travel path)
  - Median Island can be extended
  - Warning beacon (NOT a **red** light)
- Crossing Countermeasure Conclusion
  - RRFB NOT in compliance with FHWA Guidance – USE PHB (Speeds, ADT and # of Lanes)

# QUESTIONS / RESOURCES

- Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks” (Publication No. FHWA-HRT-10-043) 2010
  - <https://www.fhwa.dot.gov/publications/research/safety/pedbike/10043/10043.pdf>
- MUTCD Interim Approvals
  - [http://mutcd.fhwa.dot.gov/res-interim\\_approvals.htm](http://mutcd.fhwa.dot.gov/res-interim_approvals.htm)
  - RRFB Specific
    - [http://mutcd.fhwa.dot.gov/resources/interim\\_approval/ia11/fhwamemo.htm](http://mutcd.fhwa.dot.gov/resources/interim_approval/ia11/fhwamemo.htm)
- Before-and-after study of the effectiveness of rectangular rapid-flashing beacons used with school sign in Garland, Texas
  - [https://www.texite.org/wp-content/uploads/papers/Tech\\_Paper\\_Brewer\\_Fitzpatrick.pdf](https://www.texite.org/wp-content/uploads/papers/Tech_Paper_Brewer_Fitzpatrick.pdf)
- Driver-Yielding Results for Three Rectangular Rapid-Flash Patterns
  - <http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/TTI-2014-5.pdf>