PEDESTRIAN & BICYCLE CRASH FACTS

Pedestrian and bicycle crashes are a top emphasis area of Florida's Strategic Highway Safety Plan. The Root Cause Analysis is a methodology to identify top contributing factors present in pedestrian and bicycle crashes to help inform strategic investments and decisions to improve our effectiveness toward Florida's target of ZERO roadway fatalities and serious injuries.

2017-2021 SIGNAL FOUR (S4) ANALYTICS

STATEWIDE (ALL PUBLIC ROADS)

OVERVIEW

46,198 Crashes
3,673 Fatalities
7,350 Serious Injuries
1 in 4 pedestrians hit by motorists were killed or severely injured

32,285 Crashes
804 Fatalities
3,952 Serious Injuries
1 in 7 bicyclists hit by motorists were killed or severely injured

2 fatalities per day
6 serious injuries per day

Pedestrian and bicycle crashes are...

4% of all CRASHES but **27%** of all FATALITIES

WHEN DID CRASHES OCCUR?

Serious Injuries
Fatalities

Fatalities and Serious Injuries by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Serious Injuries	949	997	1,076	912	884	753	770	826	922	1,070	1,043	1,100
Fatalities	414	406	405	323	379	318	290	300	376	422	394	450

Fatalities and Serious Injuries by Year

	2017	2018	2019	2020	2021
Serious Injuries	2,414	2,385	2,305	2,023	2,175
Fatalities	788	879	892	889	1,029

Crashes commonly occur on **MON, WED & SAT**

Crashes commonly occur from **3 PM-12 AM**

72% of fatalities occur from **6 PM-6 AM**

Roadway Location

Midblocks	Intersections
74% Pedestrians	26% Pedestrians
54% Cyclists	46% Cyclists

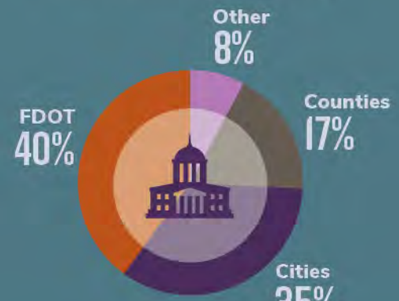
Environment

90% on dry roads
81% in clear weather
56% in non-daylight

Lighting Conditions During Fatal Crashes

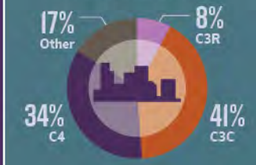
22% daylight
5% dusk/dawn
31% dark
41% dark but lighted

Road Maintaining Agency

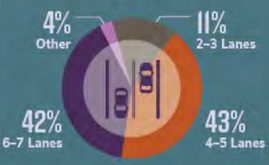


Metrics for State Highway System Only

Context Classification



Number of Lanes



Posted Speed*

57% 40-45 MPH
22% 50+ MPH

*Driver speed, even if not 'speeding,' is a significant factor in the severity of injuries to vulnerable road users.

WHERE DID CRASHES OCCUR?

	Crashes by District	Centerline Miles
DISTRICT 1	15%	15%
DISTRICT 2	8%	21%
DISTRICT 3	6%	20%
DISTRICT 4	18%	11%
DISTRICT 5	21%	18%
DISTRICT 6	13%	6%
DISTRICT 7	19%	9%

DRAFT MAY 2023

Source: Signal Four (S4) Analytics, 2017-2021 data, downloaded March 2022 & February 2023.

Roadway data for non SHS roadways is not as comprehensive as data for SHS roadways.

WHO WERE INVOLVED?

PEDESTRIAN PROFILE

FATALITIES

Male age range:
50–64 YEARS
Percent male:
72%
Percent male that reside in Florida:
94%

Female age range:
45–64 YEARS
Percent female:
28%
Percent female that reside in Florida:
91%

SERIOUS INJURIES

Male age range:
20–39 YEARS
50–59 YEARS
Percent male:
62%
Percent male that reside in Florida:
94%

Female age range:
15–44 YEARS
55–69 YEARS
Percent female:
38%
Percent female that reside in Florida:
94%

Pedestrian Action Contributes to 70% of Crashes*

Dart/Dash
In Roadway Improperly
Failure to Yield ROW
Other Actions

BICYCLIST PROFILE

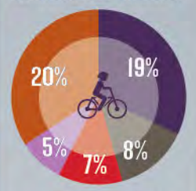
Male age range:
45–74 YEARS
Percent male:
88%
Percent male that reside in Florida:
96%

Female age range:
35–54 YEARS
Percent female:
12%
Percent female that reside in Florida:
94%

Male age range:
20–24 YEARS
50–64 YEARS
Percent male:
81%
Percent male that reside in Florida:
96%

Female age range:
30–34 YEARS
45–59 YEARS
Percent female:
19%
Percent female that reside in Florida:
93%

Bicyclist Action Contributes to 61% of Crashes*



Failure to Yield ROW
Dart/Dash
Violate Traffic Control Device
Wrong Way Riding
Other Actions

AGE/GENDER

VEHICLE PROFILE

DRIVER PROFILE

Male age range:
20–39 YEARS
Percent male:
66%
Percent male that reside in Florida:
96%

Female age range:
20–39 YEARS
Percent female:
34%
Percent female that reside in Florida:
97%

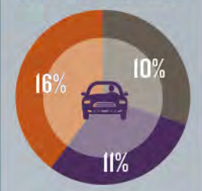
VEHICLE TYPE

Passenger Car in
50% of crashes
SUV/Pickup Truck in
35% of crashes

VEHICLE YEAR

2012-2016 in
29% of fatalities
2017-2021 in
18% of fatalities

Driver Action Contributes to 37% of Crashes*



Failure to Yield ROW
Careless Driving
Other Actions

*As reported by law enforcement in crash reports.

ROADWAY CHARACTERISTICS OF OVERREPRESENTED AND HIGHEST CRASHES (SHS)

CONTEXT CLASS

SUBURBAN COMMERCIAL (C3C) CONTEXT CLASS

41% of severe and fatal crashes occur on C3C roadways

which are **19%** of the network

URBAN GENERAL (C4) CONTEXT CLASS

34% of severe and fatal crashes occur on C4 roadways

which are **9%** of the network

POSTED SPEED

POSTED SPEEDS OF 45 – 50 MPH

47% of severe and fatal crashes occur on roadways with a posted speed of

SPEED LIMIT 45 TO SPEED LIMIT 50

which are **24%** of the network

POSTED SPEEDS OF 35 – 40 MPH

32% of severe and fatal crashes occur on roadways with a posted speed of

SPEED LIMIT 35 TO SPEED LIMIT 40

which are **12%** of the network

NUMBER OF LANES

ROADWAYS WITH 5 – 6 TRAVEL LANES

43% of severe and fatal crashes occur on 5 – 6 lane roadways

which are **19%** of the network

ROADWAYS WITH 3 – 4 TRAVEL LANES

43% of severe and fatal crashes occur on 3 – 4 lane roadways

which are **37%** of the network

TRANSIT FREQUENCY

TRANSIT IS AVAILABLE

72% of severe and fatal crashes occur on roadways with transit routes.

which are **51%** of the network

DEMOGRAPHIC CONSIDERATIONS

SOCIOECONOMIC FACTORS

- **%** of population **above age 65**
- **%** of households **below poverty level**
- **%** of population **with disabilities**
- **%** of **minority** population
- **%** of population with **limited English proficiency**
- **%** of households **with no vehicles**

Census Tracts with **4 OR MORE FACTORS***

8 Fatalities and Serious Injuries /10,000 population

Census Tracts with **LESS THAN 4 FACTORS***

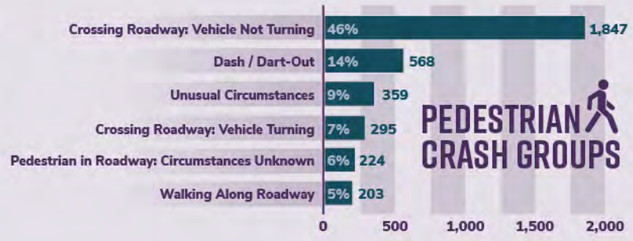
4 Fatalities and Serious Injuries /10,000 population

*Represents Census Tracts within a County where a factor falls below that County's Average.

Source: Signal Four (S4) Analytics, 2017-2021 data, downloaded March 2022 & February 2023.

PEDESTRIAN & BICYCLE TOP PEDESTRIAN CRASH TYPES ON STATE ROADS

The top pedestrian crash groups and types on state roadways for the 2016–2019 time period were evaluated using the Pedestrian and Bicycle Crash Analysis Tool (PBCAT), a method for classifying crashes based on the operational dynamics of the parties leading to the crash. Together the top five crash groups account for over 82 percent of the pedestrian fatalities and serious injuries. **The crash groups were reorganized based on crash location, pedestrian location, and motorist action to identify pedestrian problem areas.** The top three pedestrian problems listed below account for 71 percent of all crashes. Countermeasures to address these problems are identified in the following sections.



CRASH PROBLEM #1
Pedestrians getting struck by through motorist at midblock locations
(41%)

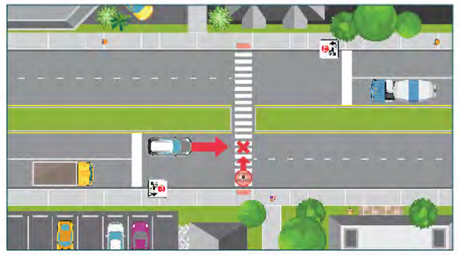
CRASH PROBLEM #2
Pedestrians getting struck by through motorist at intersections
(20%)

CRASH PROBLEM #3
Pedestrian getting struck by motorist conducting turning movements
(8%)

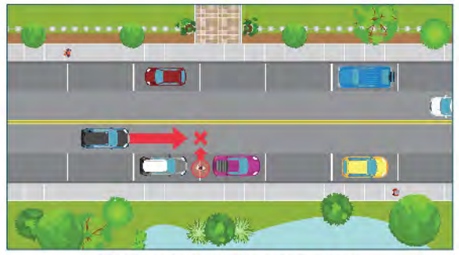
CRASH PROBLEM #1: PEDESTRIANS GETTING STRUCK BY A THROUGH MOTORIST AT MIDBLOCK LOCATIONS WHILE CROSSING A ROADWAY (41% OF CRASHES)

Pedestrians getting struck by a through motorist crossing a roadway at midblock locations constitute 41 percent of pedestrian fatalities and serious injuries on state roads. The crash types involved in midblock crashes are illustrated in the crash type images. The crash types "Pedestrian Failed to Yield", "Motorist Failed to Yield", "Dash" and "Dart-Out" **have similar contributing causes at midblocks and will respond to similar countermeasures**. The countermeasures should include provision of adequate crossing opportunities and roadway design elements that improve comfort and safety for all users.


PEDESTRIAN FAILED TO YIELD AT MIDBLOCK LOCATION


MOTORIST FAILED TO YIELD AT MIDBLOCK LOCATION


DASH AT MIDBLOCK LOCATION


DART-OUT AT MIDBLOCK LOCATION

47% IN C3C

36% IN C4

62% ON 40 AND 45 MPH ROADS

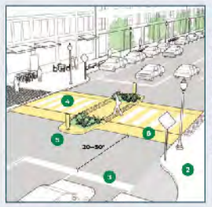
87% ON 4 AND 6-LANE ROADS

80% IN DARK CONDITIONS

Engineering Countermeasure 1: Install midblock crossing opportunities for pedestrians at high volume multi-lane roads near activity centers in C3C, C4, C5 with crosswalk enhancement elements outlined below.


High-visibility crosswalks can help make pedestrians on the crosswalk more visible and reduce pedestrian injury crashes up to 40%. Data and Image Source: FHWA


Pedestrian refuge islands can reduce pedestrian crashes by 32%. Data and Image Source: FHWA


Raised crossings make the pedestrian more prominent in the driver's field of vision. Approach ramps may reduce vehicle speeds and improve motorist yielding and reduce pedestrian crashes by 45%. Data Source: FHWA; Image Source: NACTO


Advance stop or yield markings improve visibility of pedestrians; prevent multiple-threat crashes and reduce pedestrian crashes up to 25%. Data Source: FHWA; Image Source: SR A1A in Brevard County


Pedestrian Hybrid Beacons are ideal for multilane roadways and can reduce pedestrian crashes by 55%. Image Source: PHB on US 441 in Orange County


In-pavement flashing lights reinforced by well maintained retro reflective markings can enhance crosswalk visibility at night. Image Source: SR A1A in Brevard County


Pedestrian scale lighting increases visibility of pedestrians in the crosswalk and provides a feeling of safety and security to pedestrians crossing the road. Image Source: US 441 rendering in Orange County


Rapid Rectangular Flashing Beacons can reduce crashes up to 47% and increase motorist yielding rates up to 98%. Data Source: FHWA Image Source: RRFB on SR A1A in Brevard County


Curb extensions improve the ability of pedestrians and motorists to see each other and reduces crossing distance.
Photo Source: NACTO Urban Street Design Guide

Engineering Countermeasure 2: Evaluate and redesign strategic high volume multi-lane roads near activity centers in C3C, C4, C5 based on appropriate speed limits for all road users and roadway reconfiguration with elements to reduce speeding, increase visibility of pedestrians and minimize conflicts.


Road Diet from four-lane undivided roadway to a three-lane roadway can reduce total crashes from 19–47%. Image Source: FDOT Lane Repurposing Guidebook, 2020

Speed control is the most important method for reducing fatalities and serious injuries. Establishing appropriate target speeds increases safety and comfort for pedestrians and other road users.


Wide sidewalks or shared use paths separated by landscaping can create a buffer from traffic and establish priority areas for pedestrians. Image of Lake Nona Blvd., Orlando, FL


Narrower travel lanes can help with reduced speeds and allows room for landscaping and pedestrian amenities. Source: NACTO Urban Street Design Guide


Vertical speed control elements are applied where the target speed of the roadway cannot be achieved through the use of conventional traffic calming elements. Source: NACTO Urban Street Design Guide


Raised Median with refuge islands reduce the exposure time experienced by a pedestrian while crossing a road. Image Source: The Greenway Collaborative

Education Countermeasure 1:
Targeted education for drivers to reinforce that pedestrians have right of way in a crosswalk, whether marked or unmarked; not passing vehicles stopped at a crosswalk; dangers of not stopping at signal or stop bar and dangers of speeding and aggression.

Education Countermeasure 2:
Provide safety education to pedestrians about nighttime visibility limitations; watching for motorists even if pedestrian has right-of-way, yielding to motorists at non-crosswalk locations; and using designated crossings.

Enforcement Countermeasure 1:
Implement progressive ticketing at midblock crossing locations regarding motorist yielding compliance including education, warnings and then citation.

CRASH PROBLEM #2: PEDESTRIANS GETTING STRUCK BY A THROUGH MOTORIST AT STOP CONTROLLED OR SIGNALIZED INTERSECTIONS (20% OF CRASHES)

The same four crash types have similar contributing causes at intersections and account for 20 percent of all crashes on state roads. The countermeasures for addressing this crash problem should include implementing pedestrian friendly accommodations at traffic signals to reduce excessive delay to pedestrians, which will improve yielding behavior and reduce opportunities for violations.

44% IN C4

39% IN C3C

60% ON 40 AND 45 MPH ROADS

85% ON 4 AND 6-LANE ROADS

76% IN DARK CONDITIONS

DASH AT INTERSECTION

PEDESTRIAN FAILED TO YIELD

MOTORIST FAILED TO YIELD

Engineering Countermeasure 1: Design or retrofit intersections to improve visibility of pedestrians, lower speeds on intersection approaches and reduce pedestrian crossing distances.

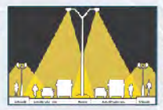
Compact intersections maximize activity within the sight triangle, giving all users a better view of potential conflicts. Source: NACTO

Roundabouts substantially reduce pedestrian crashes by reducing speeds and conflicts. Converting a 2-way two way stop controlled intersection and signalized intersection to a roundabout reduces crashes by 82% and 78% respectively. Source: FHWA

Raised intersections create a safe, slow-speed crossing and public space at minor intersections. May be applicable in C5 and C6 roads. Source: NACTO

Curb extensions improve ability of motorists and pedestrians to see each other and reduce the pedestrian crossing distances. Source: PEDSAFE

Raised pedestrian crossings make the pedestrian more prominent in the driver's field of vision. Image of Tavistock Lakes Blvd., Orlando, FL



Lighting is crucial to the visibility of pedestrians and approaching vehicles. Lighting can reduce crashes up to 42% for nighttime injury pedestrian crashes at intersections. Source: FHWA

Pedestrian refuge islands can reduce pedestrian crashes by 56%. Medians with marked crosswalks reduce pedestrian crashes by 46%. Source: FHWA

High-visibility crosswalks can help make pedestrians on the crosswalk more visible and reduce pedestrian injury crashes up to 40%. Source: FHWA

Far side bus stops allow pedestrians to cross behind the bus and also increase the visibility of crossing pedestrians for drivers waiting at the signal. Image Source: NACTO

Engineering Countermeasure 2: Modify signal timing and phasing on C3C, C4 and C5 roads with elements that are more responsive to pedestrian movement including:

Leading Pedestrian Intervals increase visibility of pedestrians, minimizes conflicts between pedestrians and vehicles and increases motorist yield rates. FHWA reports 13% reduction in pedestrian-vehicle crashes at intersections. Image Source: NACTO

Automated pedestrian detection or passive detection identifies pedestrians and prompts a walk signal without needing to press a button. Can be applied at both signalized intersections and midblock crossings equipped with RRFB, PHB and MPS. Source: FDOTResearch.com

Shorter signal cycles are more appropriate along C4, C5 and C6 roadways to help streets function as a complete network rather than a series of major corridors and improves pedestrian compliance. Source: NACTO

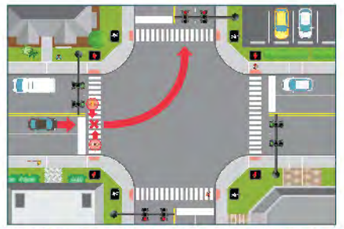
Education Countermeasure 1: Provide safety education for motorists to reinforce the dangers of not stopping at a red signal or stop bar before proceeding. Image Source: alerttodayflorida.com

Enforcement Countermeasure 1: Implement progressive ticketing at midblock crossing locations regarding motorist yielding compliance including education, warnings and then citation through high visibility enforcement programs. Image Source: Bike/Walk Central Florida

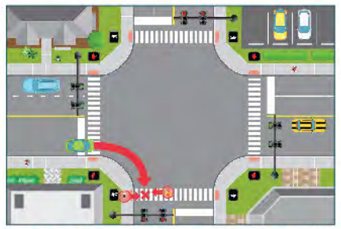
CRASH PROBLEM #3: PEDESTRIAN GETTING STRUCK BY A MOTORIST CONDUCTING TURNING MOVEMENT AT INTERSECTIONS OR DRIVEWAYS (8% OF CRASHES)

These crashes include where a pedestrian is struck while crossing a road by a turning motorist. The most common crash type is where the motorist is turning left while initially traveling on a parallel path with the pedestrian before making a left turn and striking the person. Countermeasures to address the problem should include strategies to reduce conflicts between pedestrians and left turning motorists and right turning motorists.

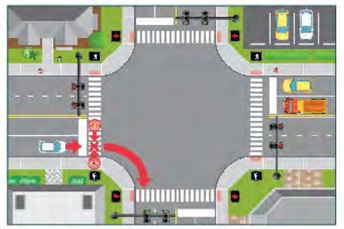
MOTORIST LEFT TURN – PARALLEL PATHS



MOTORIST LEFT TURN – PERPENDICULAR PATHS



MOTORIST RIGHT TURN – PARALLEL PATHS



MOTORIST RIGHT TURN – PERPENDICULAR PATHS

42% IN C4

32% IN C3C

54% ON 40 AND 45 MPH ROADS

81% ON 4 AND 6-LANE ROADS

34% IN DARK CONDITIONS

Engineering Countermeasure 1: Redesign high pedestrian crash intersections in C3C and C4 with countermeasures that reduce pedestrian crossing distances and reduce turning speeds for left turning vehicles.

Curb extensions at an intersection shortens the crossing distance for pedestrians and improves ability of motorists and pedestrians to see each other. Source: PEDSAFE

High-visibility crosswalks can help make pedestrians on the crosswalk more visible and reduce pedestrian injury crashes up to 40%. Source: FHWA

Tighter corner radii will reduce vehicle turning speeds and pedestrian crossing distances. The smallest practical curb radii should be chosen based on effective curb radius for design vehicle. Source: PEDSAFE

Advance stop or yield markings improve visibility of pedestrians; prevent multiple-threat crashes and reduce pedestrian crashes up to 25%. Source: FHWA

Engineering Countermeasure 2: Tighten and calm left turns by implementing a permanent plastic curb delineator on receiving centerline and/or by marking guiding radius and turn path. Source: NACTO

Engineering Countermeasure 3: Provide fully protected left turn phase separate from the pedestrian walk phase signal at high priority intersections. Source: FHWA STEP Countermeasure

Engineering Countermeasure 4: Install Leading Pedestrian Interval (LPI) in conjunction with "Right Turn on Red" restrictions at high pedestrian crash intersections. Source: NACTO

Engineering Countermeasure 5: Redesign high pedestrian crash intersections with reduced radii or right turn slip lanes, high visibility marked crosswalks, advanced stop lines and reduced curb radii. Source: NACTO

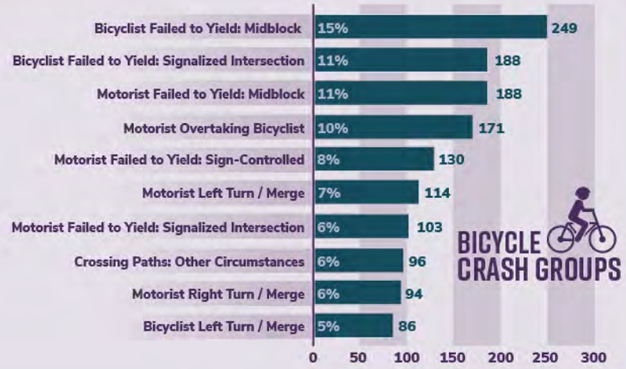
Education Countermeasure 1: Provide safety education to pedestrian on using LPI and other signal modifications as well as emphasize the importance of looking back for a motorist turning left or right before crossing.

Education Countermeasure 2: Provide safety education to motorists to stop prior to entering crosswalk and look for pedestrians before making a left or right turn. Image Source: alerttodayflorida.com

PEDESTRIAN & BICYCLE TOP BICYCLE CRASH TYPES ON STATE ROADS

The top bicycle crash types for state roadways from 2016-2019 was also evaluated using the Pedestrian and Bicycle Crash Analysis Tool (PBCAT). Together the top ten crash types contribute to 83% of the crashes. These crash types have been grouped into crash problems and presented below with recommended countermeasures. The eighth crash type, Crossing Paths: Other Circumstances, has not been detailed below as some of the other countermeasures will address this crash type as well.

1. Bicyclist Failed to Yield: Midblock **(15%)**
2. Bicyclist Failed to Yield: Signalized Intersection **(11%)**
3. Motorist Failed to Yield: Midblock **(11%)**
4. Motorist Overtaking Bicyclist **(10%)**
5. Motorist Failed to Yield: Sign-Controlled Intersection **(8%)**
   Motorist Failed to Yield: Signalized Intersection **(6%)**
6. Motorist Left Turn/Merge **(7%)**
   Motorist Right Turn/Merge **(6%)**
7. Bicyclist Left Turn/Merge **(5%)**



CRASH PROBLEM #1: BICYCLIST RIDES OUT FROM A MIDBLOCK LOCATION INTO THE ROAD AND IS STRUCK BY A MOTORIST (15%)

This is the highest crash group on state roads and constitutes 15% of fatalities and serious injuries. The bicyclist rides out from a midblock location without stopping/yielding or after stopping/slowing. 40% of this crash type involves children under 15 who may fail to stop and scan for motorists before crossing. Motorist speeding could increase the severity of these crashes. The following countermeasures can be effective at addressing this crash type.

BICYCLIST RIDE OUT AT MIDBLOCK

44% IN C3C
40% IN C4
39% ON 45 MPH ROADS
25% ON 40 MPH ROADS
41% ON 4-LANE ROADS
44% ON 6-LANE ROADS
53% IN DARK CONDITIONS
55% OF BICYCLISTS RODE FACING TRAFFIC

Adequate roadway lighting helps motorists see bicyclists and allows bicyclists to judge motorist speeds. Source: BikeSAFE

Median refuge islands provides protected spaces for bicyclists to cross one direction of traffic at a time. Source: NACTO

Improve **sight distance** through landscaping maintenance, parking limitation and proper sign placement. Source: FHWA BIKESAFE

Enhanced crossings use flashing beacons, signing, striping and pavement markings to alert motorists to crossing bicyclists. Source: FHWA

Active warning beacons can be placed to alert motorists that bicyclists may be crossing the road. Source: NACTO

Optimize **signal timings** to create gaps midblock and provide crossing opportunities for bicyclists along the corridor. Source: NACTO

Provide **safety education** to bicyclists to slow down and yield to motorists at midblock locations and nighttime visibility.

Educate motorists to anticipate bicyclists or pedestrians and midblock locations and the dangers of speeding.

Implement **positive enforcement campaign** directed at bicyclists about yielding before entering roadway and not making improper turns. Distribute bicycle lights as part of enforcement.

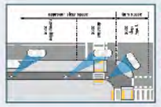
CRASH PROBLEM #2: BICYCLIST RIDES INTO A SIGNALIZED INTERSECTION AND IS STRUCK BY A MOTORIST (11%)

The bicyclist violated the signal and rode into the intersection and collided with the motorist or first stopped and then rode in. This crash type has the third highest fatalities of all crash types.

47% IN C3C
38% IN C4
40% ON 45 MPH ROADS
20% ON 40 MPH ROADS
48% ON 6-LANE ROADS
37% ON 4-LANE ROADS
44% IN DARK CONDITIONS
46% OF BICYCLISTS RODE FACING TRAFFIC

BICYCLIST RIDE THROUGH AT SIGNAL

BICYCLIST RIDE OUT AT SIGNAL



Improve sight lines and sight distances at intersections. Source: Separated Bike Lane Design Guide, MDOT

Cycle tracks provide exclusive space for bicyclists and may be one- or two-way. Source: Urban Bikeway Design Guide, NACTO. (Photo from Chicago, IL)

Optimize **signal timings** and add bicycle activation to the traffic signal with Bicycle Detector Pavement Marking. Source: NACTO Bikeway Design Guide

Bicycle signals make crossing intersections safer for bicyclists by clarifying when to enter and by restricting conflicting vehicle movements. Source: NACTO

Buffered bike lanes provide buffer space separating bicyclists from motorists. Source: Urban Bikeway Design Guide, NACTO. (Photo from Chicago, IL)

Bike boxes provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase. Source: NACTO Bikeway Design Guide

Roundabouts substantially reduce bicycle crashes by reducing speeds and conflicts. Source: FHWA

Median refuge islands provide protected spaces for bicyclists. Source: Urban Bikeway Design Guide, NACTO. (Photo from San Luis Obispo, CA)

Educational materials reminding bicyclists that they have the same rights and responsibilities as a motorist on the roadway.

CRASH PROBLEM #3: MOTORIST RIDES OUT FROM A MIDBLOCK LOCATION AND STRIKES THE BICYCLIST (11%)

This crash type group occurs when a motorist pulls out of a midblock location and fails to yield to a bicyclist riding along a roadway or a sidewalk. Motorist visibility may be obstructed due to street elements or motorist might fail to look right before pulling out or fail to detect bicyclists riding the wrong way on the roadway or sidewalk.

MOTORIST DRIVE-OUT

57% IN C3C
31% IN C4
56% ON 45 MPH ROADS
16% ON 40 MPH ROADS
57% ON 6-LANE ROADS
30% ON 4-LANE ROADS
88% IN DAYLIGHT CONDITIONS
82% OF BICYCLISTS RODE FACING TRAFFIC

Access management through consolidating driveways and adding medians can help reduce conflict between motorists and bicyclists.

Driveway improvements with narrow driveways, tighter radii and improved driveway definition can increase sight distance and manage speeds.

Educational materials reminding bicyclists about nighttime visibility limitations and dangers of wrong way riding.

Roadway lighting can improve crosswalk visibility and help motorists see bicyclists and bicyclists better judge motorist speeds at night.

Improve **sight distance** through landscape maintenance, parking limitation and proper sign placement.

Educational materials reminding motorists to look both ways and stop and yield before pulling out of the driveway.

Signage reminding motorists to look for cross traffic can be implemented at commercial driveways.

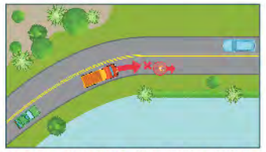
Improve **crosswalk visibility** through pavement markings, green paint at conflict points, enhanced bike lane markings and surface materials.

Sidewalk stencils reminding bicyclists to be aware of motorists who may not expect to see them on their right before pulling out at a midblock location.

CRASH PROBLEM #4: MOTORIST OVERTAKES A BICYCLIST (10%)

This crash type group involves motorists overtaking but misjudging the space to safely pass the bicyclist, bicyclist suddenly swerving onto the path of the motorist or motorist failing to detect bicyclists and striking from behind. This crash type has the second highest fatalities of all crash types.

MOTORIST OVERTAKING – MISJUDGED SPACE



MOTORIST OVERTAKING – UNDETECTED BICYCLIST

39% IN C3C
22% IN C2
37% ON 45 MPH ROADS
18% ON 55 MPH ROADS
53% ON 4-LANE ROADS
25% ON 2-LANE ROADS
42% BICYCLIST IN SHARED TRAVEL LANE
57% BICYCLISTS IN PAVED SHOULDER

Roadway surface hazard improvements to prevent poor drainage, slippery surface, pavement gaps and debris accumulation. Include bike safe grates, curb inlets, narrow rumble strips. Source: BikeSafe

Implement **pavement markings** to provide separation for bicyclists via colored bike lanes and markings for merging and weaving. Source: NACTO

Bicyclist safety education to reinforce bicyclists have same rights and responsibilities; wearing high visibility clothing; wearing a properly fitted helmet; and taking over the travel lane if the bicycle lane or shoulder is too narrow.

Exclusive bike facilities like buffered bike lanes, cycle tracks or wide curb lanes increased bicyclist comfort and safety. Source: Urban Bikeway Design Guide, NACTO.

Lighting is crucial to the visibility of bicyclists and approaching vehicles; especially in over and underpasses. Photo: Seattle, WA. Source: BikeSafe

Driver safety education about Florida's 3-ft safe passing law, bicyclists having same rights and dangers of distracted driving.

Provide **safe, accessible spaces on bridges and overpasses** for bicyclists to navigate ascents and descents with smooth riding surfaces. Source: Bike Safe

Sign improvements such as "Bicycles may use full lane", "3-ft minimum passing", and "share the road" signs can make motorists more aware of bicyclists on roads.

Enforcement of safe passing law via automatic sensor-based or video-based enforcement.

CRASH PROBLEM #5: MOTORIST FAILED TO YIELD AT INTERSECTIONS - SIGN-CONTROLLED (8%) AND SIGNALIZED (6%)

This crash type group involves crashes where the motorist drove into the crosswalk area or intersection and collided with the bicyclist. The motorist either violated the signal or the sign or did not properly yield right-of-way to the bicyclist.

54% IN C3C
30% IN C4
53% ON 45 MPH ROADS
29% ON 35-40 MPH ROADS
49% ON 6-LANE ROADS
37% ON 4-LANE ROADS
56% BICYCLISTS FACING TRAFFIC
84% DAYLIGHT CONDITIONS

MOTORIST DRIVE-OUT SIGNALIZED INTERSECTION

MOTORIST DRIVE-THRU STOP-CONTROLLED INTERSECTION

High-visibility crosswalks can help make bicyclists on the crosswalk more visible and reduce injury crashes up to 40%. Source: FHWA

Protected Intersections can reduce crossing distances and exposure, keeps bicyclists physically separate, making bicycling at intersections more comfortable. Source: NACTO

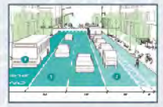
Speed control is the most important method for reducing fatalities and serious injuries. Establishing appropriate target speeds increases safety and comfort for pedestrians.

Roundabouts substantially reduce bicycle crashes by reducing speeds and conflicts. Source: FHWA Image Source: NACTO

High visibility pavement markings to improve awareness and visibility of bicyclists via bike boxes, colored bike lanes, bike lane striping thru the intersection and left of right turn lanes. Source: NACTO

Bicyclist safety education about the importance of conspicuity through use of bike lights and reflective clothing and the dangers of wrong way riding.

Tighter corner radii will reduce vehicle turning speeds and bicyclist crossing distances. The smallest practical curb radii should be chosen based on effective curb radius for design vehicle. Source: BikeSafe



Narrower travel lanes can help with reduced speeds and allows room for landscaping and pedestrian amenities. Source: NACTO

Enforcement of yielding violations and positive reinforcement through distribution of bike lights and discussion about wrong way riding.

CRASH PROBLEM #6: LEFT TURN MERGE (7%)/RIGHT TURN MERGE (6%)

This problem consists of two crash groups associated with motorist left turning and right turning crashes. In the left turn crashes, the motorist could be looking for gap in traffic and fail to look for bicyclist on multilane roads. In right turning crashes, the motorist may be making a right turn (on red) and fail to look to the right for approaching bicyclist. Bicyclist could be riding against traffic on the road or sidewalk.

MOTORIST LEFT TURN – OPPOSITE DIRECTION

MOTORIST LEFT TURN – SAME DIRECTION

39% IN C4
38% IN C3C
44% ON 45 MPH ROADS
35% ON 35-40 MPH ROADS
40% ON 4-LANE ROAD
33% ON 6-LANE ROADS
53% BICYCLISTS RIDING WITH TRAFFIC
75% DAYLIGHT CONDITIONS

MOTORIST LEFT TURN

MOTORIST RIGHT TURN – OPPOSITE DIRECTION

MOTORIST RIGHT TURN – SAME DIRECTION

46% IN C3C
32% IN C4
47% ON 45 MPH ROADS
33% ON 35-40 MPH ROADS
43% ON 4-LANE ROAD
42% ON 6-LANE ROADS
71% BICYCLISTS RIDING WITH TRAFFIC
78% DAYLIGHT CONDITIONS

MOTORIST RIGHT TURN

Provide **protected-only left-turn phasing** at high priority intersections in urban areas and near activity centers. Image Source: BIKESAFE

Through Bike Lanes can allow bicyclists to position themselves to the left of right turn lanes and signage for right turn motorists to yield to bicyclists increase yielding behavior by motorists. Image Source: NACTO

Implement **intersection pavement markings and design** such as colored bike lanes combined with advanced stop bar at intersections to allow bicyclists to proceed to the front of the queue at signalized locations.

Restrict left turns at midblock locations or side streets to reduce left turn conflicts at high bicycle usage corridors or near activity centers. Image Source: NACTO

Combined bike/turn lane with a bike lane delineation in the inside portion of a dedicated right turn lane can minimize conflicts with right turning vehicles. Image Source: NACTO

Educate bicyclists to take over the travel lane if designated bicycle lane does not continue through to the far end of the intersection.

MUTCD-approved regulatory or warnings signs (such as Yield when Turning or Watch for Bikes types of signs) can reduce motorist violations at intersections. Source: NACTO

Implement right-turn-on-red (RTOR) restrictions at intersections with high bicycle volumes and high right turning vehicles and crashes

Enforce motorist requirement to fully stop behind stop bar before turning.

CRASH PROBLEM #7: BICYCLIST LEFT TURN MERGE (5%)

This crash type group involves crashes where a bicyclist turns or merges left in front of a motorist going in the same direction or opposite direction. In the former, the rider could fail to yield to a motorist coming from behind or motorist may not suspect the bicyclist will turn (speed could be a factor). In the latter, the bicyclist may turn left into the motorist's path at an intersection or midblock.

43% IN C3C
23% IN C4
35% ON 45 MPH ROADS
29% ON 35-40 MPH ROADS
44% ON 4-LANE ROADS
30% ON 6-LANE ROADS
89% BICYCLISTS RIDING WITH TRAFFIC
54% DAYLIGHT CONDITIONS

BICYCLIST LEFT TURN – OPPOSITE DIRECTION

BICYCLIST LEFT TURN – SAME DIRECTION

Bike boxes extending across the intersection can facilitate bicyclist left turn positioning at intersections and provide a safe way to get ahead of queuing. Image Source: NACTO Urban Bikeway Design Guide

Leading Bicycle Intervals can provide priority and lead time to bicyclists at intersections, especially school intersections along priority corridors. Image Source: NACTO Bikeway Guide

Medians and crossing islands can help manage left turn movements, provide a refuge for bicyclists and break the crossing in two stages. Image Source: NACTO Urban Street Design Guide

Two-stage turn queue boxes allows bicyclists to safely make left turns on multi lane roadways with higher traffic speeds. Image Source: NACTO Urban Bikeway Design Guide

Bicycle detection and activation improves efficiency and reduces delay for bicycle travel. Image Source: NACTO Bikeway Guide

Bicycle lanes buffered by pavement markings can provide exclusive space for bicyclists and create a buffer between the bike and motor vehicle lanes. Image Source: NACTO Bikeway Guide