



Infrastructure Reference Guide

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Advanced Stop Bar



Description

An advanced stop bar is a solid white line painted ahead of crosswalks on multi-lane approaches to alert drivers where to stop to let pedestrians cross. It is recommended that advanced stop bars be placed twenty to fifty feet before a crosswalk. This encourages drivers to stop back far enough for a pedestrian to see if a second motor vehicle is approaching, reducing the risk of a hidden-threat collision. Advanced stop bars can also be used with smaller turning radii to create a larger effective turning radius to accommodate infrequent (but large) vehicles.

Resources

- [Reducing Conflicts Between Motor Vehicles and Pedestrians: The Separate and Combined Effects of Pavement Markings and a Sign Prompt](#)
- [FHWA Signalized Intersections: Informational Guide](#) – Pages: 192- 193
- MN MUTCD: [Part 3. Markings](#) – Page: 3B-32
- [NACTO Urban Street Design Guide](#) – Pages: 109-116, 144

Crossing Guard



Description

Facilitated crossings are marked crossing locations along student routes where adult crossing guards or trained student patrols are stationed to assist students with safely crossing the street. Facilitated crossings may be located on or off campus. Determining whether a location is more appropriate for an adult crossing guard or student patrol may be based on location including distance from school, visibility, and traffic characteristics. Adult crossing guards and student patrols receive special training, and are equipped with high-visibility traffic vests and flags when on duty.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 25-26
- [MnDOT Minnesota Safe Routes to School: School Crossing Guard Brief Guide](#)
- MN MUTCD: [Part 7. Traffic Controls for School Areas](#) – Pages: 7D-1-2

Curb Extension / Bulb Out



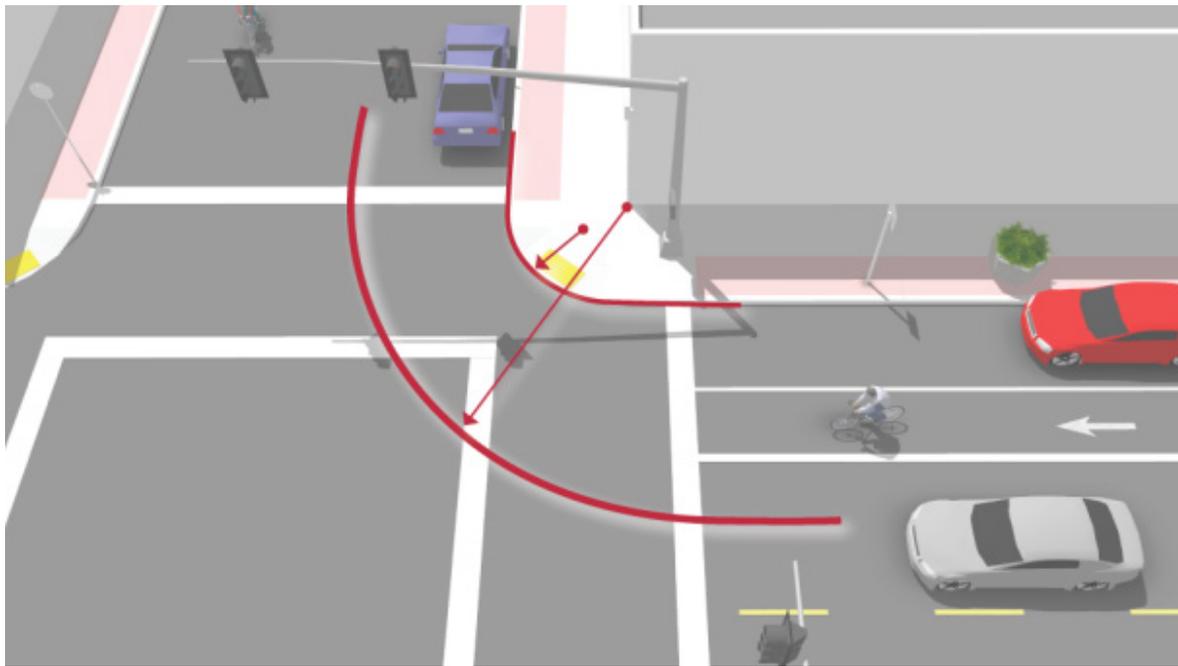
Description

Curb extensions extend the sidewalk and curb into the motor-vehicle parking lanes at intersection locations. Also called bump-outs, these facilities improve safety and convenience for people crossing the street by shortening the crossing distance and increasing visibility of people walking or biking to those driving.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 11-12
- [FHWA Effects of Traffic Calming Measures on Pedestrian and Motorist Behavior](#) – Pages: 6-11
- [FHWA Signalized Intersections: Informational Guide](#) – Pages: 190-192
- [NACTO Urban Street Design Guide](#) – Pages: 45-59

Curb Radius Reduction



Description

Curb radii designs are determined based on the design vehicle of the roadway. In general, vehicles are able to take turns more quickly around corners with larger curb radii. Minimizing curb radii forces drivers to take turns at slower speeds, making it easier and safer for people walking or biking to cross the street. An actual curb radius of five to ten feet should be used wherever possible, while appropriate effective turning radii range from 15 to 30 feet, depending on the roadway and land use context.

Resources

- [FHWA Signalized Intersections: Informational Guide](#) – Pages: 187-189
- [NACTO Urban Street Design Guide](#) – Pages: 117-120, 144-146

Curb Ramps



Description

Curb ramps provide access for people between roadways and sidewalks for people using wheelchairs, strollers, walkers, crutches, bicycles or who have mobility restrictions that make it difficult to step up or down from curbs. Curb ramps must be installed at intersections and mid-block crossings where pedestrian crossings are located, as mandated by federal law. Separate curb ramps should be provided for each direction of travel across the street.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 1-2
- [FHWA Signalized Intersections: Informational Guide](#) – Pages: 47-50
- [United States Access Board Proposed Accessibility Guidelines for Pedestrian Facilities in Public Right-of-Way](#) – Pages: 66-67, 78-83

HAWK Signals



Description

The High-Intensity Activated Crosswalk Beacon (HAWK), also referred to as a Pedestrian Hybrid Beacon System by MnDOT, remains dark until activated by pressing the crossing button. Once activated, the signal responds immediately with a flashing yellow pattern which transitions to a solid red light, providing unequivocal ‘stop’ guidance to motorists. HAWK signals have been shown to elicit high rates of motorist compliance.

Resources

- [MnDOT Minnesota’s Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 13-15
- [FHWA Safety Effectiveness of the HAWK Pedestrian Crossing Treatment](#)
- [FHWA Evaluation of Pedestrian and Bicycle Engineering Countermeasures: Rectangular Rapid-Flashing Beacons, HAWKs, Sharrows, Crosswalk Markings, and the Development of an Evaluation Methods Report](#) – Pages: 19-28

High-Visibility Crosswalks



Description

High-visibility crosswalks help to create a continuous route network for people walking and biking by alerting motorists to their potential presence at crossings and intersections. Crosswalks should be used at fully controlled intersections where sidewalks or shared-use paths exist.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 3-8
- [MnDOT Guidance for Installation of Pedestrian Crosswalks on Minnesota State Highways](#) – Page: 3
- MN MUTCD: [Part 3. Markings](#) – Pages: 3B-34-38
- MN MUTCD: [Part 7. Traffic Controls for School Areas](#) – Pages: 7A-1-3, 7B-5-8, 7C-1
- [NACTO Urban Street Design Guide](#) – Pages: 109-116

Leading Pedestrian Interval



Description

A Leading Pedestrian Interval (LPI) provides pedestrians with a three to seven second head start when entering an intersection with a corresponding green signal in the same direction of travel. LPIs enhance the visibility of pedestrians in the crosswalk, and reinforce their right-of-way over turning vehicles. LPIs are most useful in areas where pedestrian travel and turning vehicle volumes are both high.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 20-22
- [NACTO Urban Street Design Guide](#) – Page: 128

Median Refuge Island



Description

Median refuge islands (also known as median crossing islands) make crossings safer and easier by dividing them into two stages so that pedestrians and bicyclists only have to cross one direction of traffic at a time. Median refuges can be especially beneficial for slower walkers including children or the elderly. Crossing medians may also provide traffic calming benefits by visually narrowing the roadway.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 9-10, 43-44
- [FHWA Effects of Traffic Calming Measures on Pedestrian and Motorist Behavior](#) – Pages: 17-20
- [FHWA Proven Safety Countermeasures: Medians and Pedestrian Crossing Islands in Urban and Suburban Areas](#)
- MN MUTCD: [Part 3. Markings](#) – Page: 3I-2
- [NACTO Urban Street Design Guide](#) – Page: 116

Raised Crosswalk



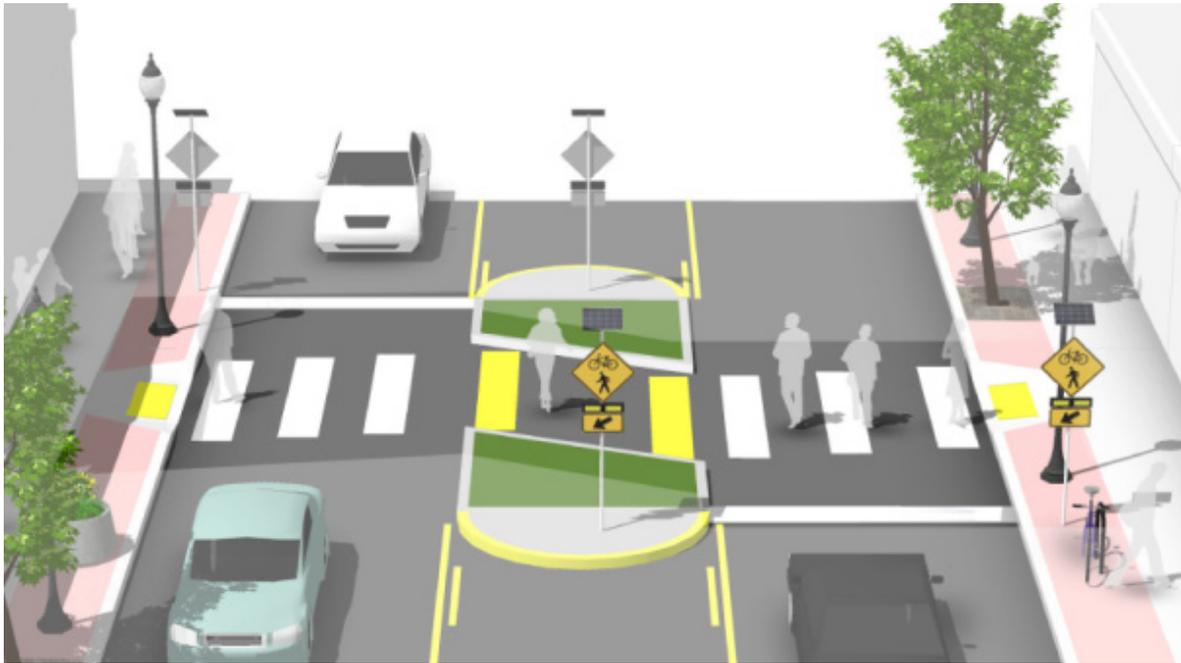
Description

Raised crosswalks are wide and gradual speed humps placed at pedestrian and bicyclist crossings. They are typically as high as the curb on either side of the street, eliminating grade changes for people crossing the street. Raised crosswalks help to calm approaching traffic and improve visibility of people crossing.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 3-4
- [FHWA Effects of Traffic Calming Measures on Pedestrian and Motorist Behavior](#) – Pages: 12-15
- MN MUTCD: [Part 3. Markings](#) – Pages: 3B-46-49
- [NACTO Urban Street Design Guide](#) – Page: 54

Rectangular Rapid Flash Beacon



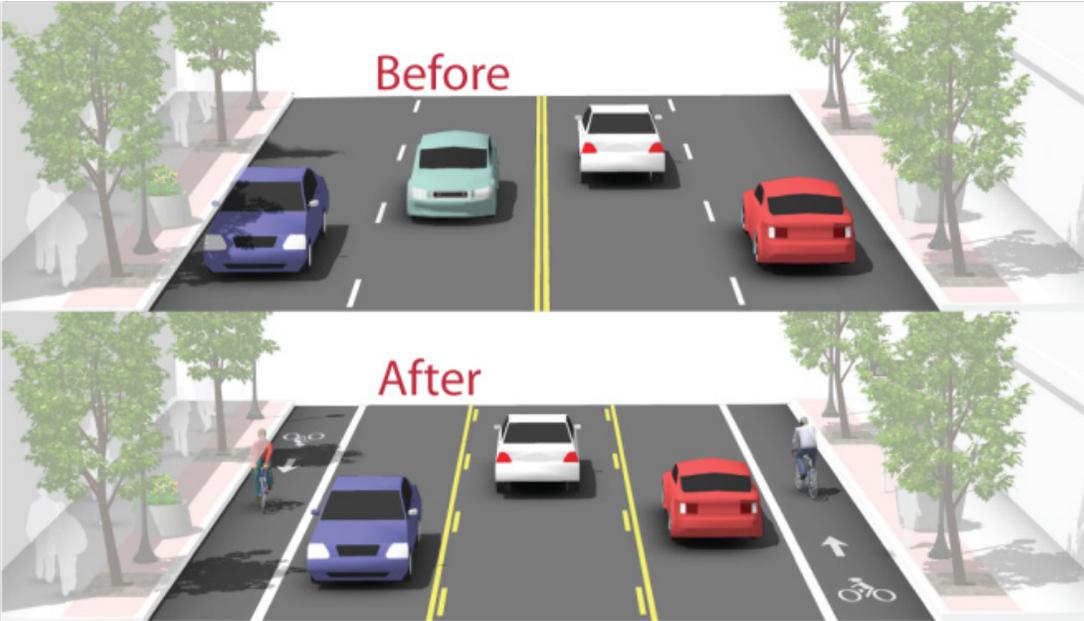
Description

An RRFB uses an irregular stutter flash pattern with bright amber lights (similar to those on emergency vehicles) to alert drivers to yield to people waiting to cross. The RRFB offers a higher level of driver compliance than other flashing yellow beacons, but lower than the HAWK signal.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 16-17
- [FHWA Effects of Yellow Rectangular Rapid-Flashing Beacon on Yielding at Multi-lane Uncontrolled Crosswalks](#)
- [FHWA Evaluation of Pedestrian and Bicycle Engineering Countermeasures: Rectangular Rapid-Flashing Beacons, HAWKs, Sharrows, Crosswalk Markings, and the Development of an Evaluation Methods Report](#) – Pages: 13-18

Road Diet



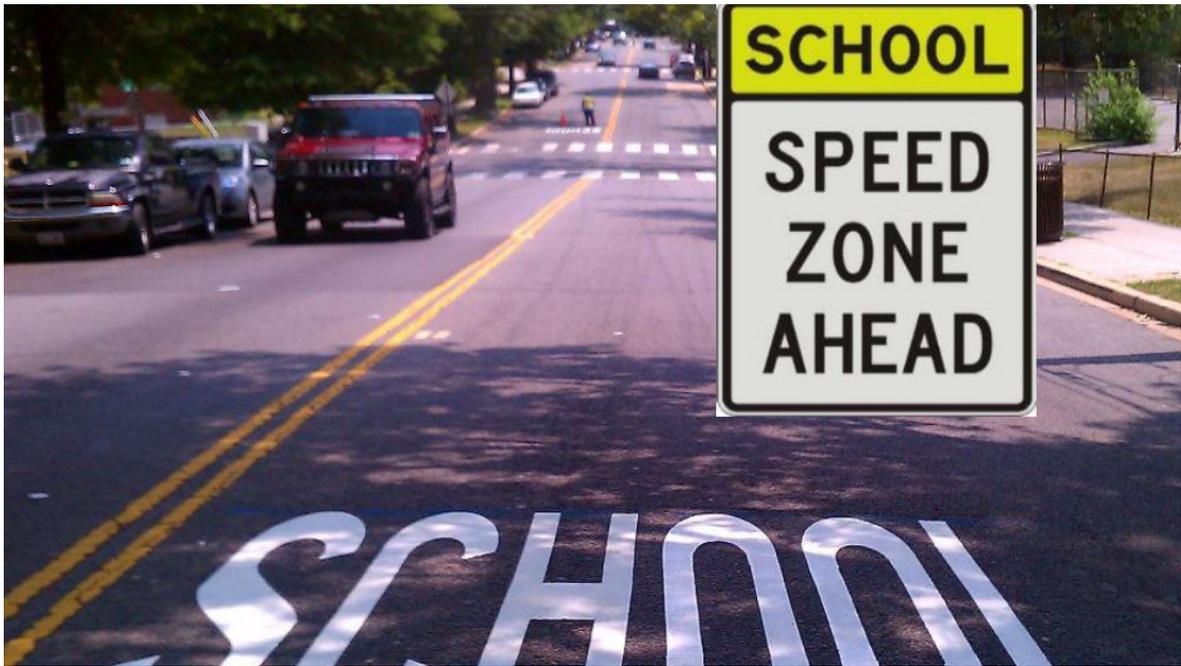
Description

A classic road diet converts an existing four-lane roadway to a three-lane cross-section consisting of two through lanes and a center two-way left turn lane. Road diets improve safety by including a protected left-turn lane, calming traffic, reducing conflict points, and reducing crossing distance for pedestrians. In addition, road diets provide an opportunity to allocate excess roadway for alternative uses such as bike facilities, parking, transit lanes, and pedestrian or landscaping improvements.

Resources

- [MnDOT Minnesota’s Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 29-31
- [FHWA Road Diet Desk Reference](#)
- [FHWA Road Diet Informational Guide](#)
- [NACTO Urban Street Design Guide](#) – Page: 14

School Speed Zone



Description

School speed zones reduce speed limits near schools, and alert motorists that they are driving near a school. School speed zones are defined as the section of road adjacent to school grounds, or where an established school crossing with advance school signs is present. Each road authority may establish school speed zone limits on roads under their jurisdiction. In general, school speed limits shall not be more than 30 mph below the established speed limit, and may not be lower than 15 mph. Speed violations within school speed zones are subject to a double fine.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 48-51
- [MnDOT School Zone Speed Limits](#)
- MN MUTCD: [Part 7. Traffic Controls for School Areas](#) – Section: 7E

Shared Used Path



Description

Shared-use paths provide off-road connections for people walking and biking. Paths are often located along waterways, abandoned or active railroad corridors, limited access highways, or parks and open spaces. Shared-use paths may also be located along high-speed, high-volume roads as an alternative to sidewalks and on-street bikeways; however, intersections with roadways should be minimal. Shared-use paths are generally very comfortable for users of all ages and abilities.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Page: 2
- [MnDOT Bikeway Facility Design Manual](#) – Pages: 123-168
- [AASHTO Guide for the Development of Bicycle Facilities](#) – Chapter 5

Sidewalks



Description

A well-connected sidewalk network is the foundation of pedestrian mobility and accessibility. Sidewalks provide people walking with space to travel within the public right-of-way that is separated from roadway vehicles. Sidewalks are associated with significant reductions in motor vehicle / pedestrian collisions.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 1-2
- [AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities](#)
- [NACTO Urban Street Design Guide](#) – Pages: 37-44
- [United States Access Board Proposed Guidelines for Pedestrian Facilities in Public Right-of-Way](#)

Traffic Circles (Mini-Roundabouts)



Description

Traffic circles are raised circular islands constructed in the center of residential intersections. They may take the place of a signal or four-way stop sign, and calm vehicle traffic speeds by forcing motorists to navigate around them without requiring a complete stop. Signage should be installed with traffic circles directing motorists to proceed around the right side of the circle before passing through or making a left turn.

Resources

- [MnDOT Minnesota's Best Practice for Pedestrian and Bicycle Safety](#) – Pages: 43-44
- [FHWA Technical Summary: Mini-Roundabouts](#)
- [FHWA Technical Summary: Roundabouts](#) – Page: 7 (*mention of school area siting*)
- MN MUTCD: [Part 3. Markings](#) – Pages: 3C1-15
- [NACTO Urban Street Design Guide](#) – Page: 99

Resources

- American Association of State Highway and Transportation Officials (AASHTO), 2012. Guide for the Development of Bicycle Facilities. 4th Edition. Web: https://bookstore.transportation.org/collection_detail.aspx?ID=116
- American Association of State Highway and Transportation Officials (AASHTO), 2004. Guide for the Planning, Design, and Operation of Pedestrian Facilities. 1st Edition. Web: https://bookstore.transportation.org/item_details.aspx?id=119
- Huybers, Sherry et al. “Reducing Conflicts Between Motor Vehicles and Pedestrians: The Separate and Combined Effects of Pavement Markings and a Sign Prompt.” Journal of Applied Behavior Analysis. 37.4 (2004): 445-456. Web: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1284522/pdf/15669404.pdf>
- Minnesota Department of Transportation (MnDOT), 2005. Guidance for Installation of Pedestrian Crosswalks on Minnesota State Highways. Web: http://www.dot.state.mn.us/metro/trafficeng/files/ped_guide.pdf
- Minnesota Department of Transportation (MnDOT), 2013. Minnesota’s Best Practices for Pedestrian and Bicycle Safety. Report 2013-22. Web: <http://www.dot.state.mn.us/research/TS/2013/201322.pdf>
- Minnesota Department of Transportation (MnDOT), 2015. Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD). Web: <http://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html>
- Minnesota Department of Transportation (MnDOT), 2007. MnDOT Bikeway Design Manual. Web: <http://www.dot.state.mn.us/bike/pdfs/manual/manual.pdf>
- Minnesota Department of Transportation (MnDOT), 2015. Safe Routes to School Crossing Guard Guide. Web: http://www.dot.state.mn.us/mnsaferoutes/assets/downloads/MN_SRTS_CROSSING%20GUARD%20GUIDE.pdf
- Minnesota Department of Transportation (MnDOT), School Zone Speed Limits. Web: <http://www.dot.state.mn.us/speed/pdf/schoolspeedlimits.pdf>
- National Association of City Transportation Officials (NACTO), 2013. Urban Street Design Guide. Island Press. Web: <http://nacto.org/publication/urban-street-design-guide/>
- United States Access Board, 2011. Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way. Web: <https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way>
- U.S. Department of Transportation Federal Highway Administration (FHWA), 2010. Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multi-lane Uncontrolled Crosswalks. Report FHWA-HRT-10-043. Web: http://nacto.org/docs/usdg/pedestrian_and_bicycle_engineering_countermeasures_fitpatrick.pdf

- U.S. Department of Transportation Federal Highway Administration (FHWA), 2001. The Effects of Traffic Calming Measures on Pedestrian and Motorist Behavior. Report FHWA-RD-00-104. Web: http://www.pedbikeinfo.org/collateral/PSAP_Training/gettraining_references_EffectsofTrafficCalming.pdf
- U.S. Department of Transportation Federal Highway Administration (FHWA), 2015. Road Diet Desk Reference. Report FHWA-SA-15-046. Web: http://safety.fhwa.dot.gov/road_diets/desk_ref/sa_15_046.pdf
- U.S. Department of Transportation Federal Highway Administration (FHWA), 2014. Road Diet Informational Guide: FHWA Safety Program. Report FHWA-SA-14-028. Web: http://safety.fhwa.dot.gov/road_diets/info_guide/rdig.pdf
- U.S. Department of Transportation Federal Highway Administration (FHWA), 2010. Safety Effectiveness of the HAWK Pedestrian Crossing Treatment. Report FHWA-HRT-10-042. Web: <http://nacto.org/wp-content/uploads/2010/08/FHWA-10-042-Safety-Effectiveness-of-the-HAWK-Pedestrian-Crossing-Treatment.pdf>
- U.S. Department of Transportation Federal Highway Administration (FHWA), 2004. Signalized Intersections: Informational Guide. Report FHWA-HRT-04-091. Web: <http://www.fhwa.dot.gov/publications/research/safety/04091/04091.pdf>
- U.S. Department of Transportation Federal Highway Administration (FHWA), 2010. Technical Summary: Mini-Roundabouts. Report FHWA-SA-10-007. Web: <http://safety.fhwa.dot.gov/intersection/innovative/roundabouts/fhwas10007/fhwas10007.pdf>
- U.S. Department of Transportation Federal Highway Administration (FHWA), 2010. Technical Summary: Roundabouts. Report FHWA-SA-10-006. Web: <http://safety.fhwa.dot.gov/intersection/innovative/roundabouts/fhwas10006/fhwas10006.pdf>

