

ATTACHMENT A:

# SCHOOL ZONE STANDARDS AND GUIDELINES REVIEW

# TECHNICAL MEMORANDUM

To: Lonnie Burklund, PE, PTOE, Mark Lutjeharms, PE, PTOE (City of Lincoln)  
From: Emily Koehle, PE, Sagar Onta, PE, PTOE, Christina Fink, PE (Toole Design Group)  
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Project: Lincoln School Zone Study  
Subject: Attachment A: School Zone Standards and Guidelines Review

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## INTRODUCTION

This document includes information compiled from national standards, research, best practices, and practices from peer cities regarding school-related crosswalk treatments, school zones, and reduced-speed zones. The information in this document was used to develop the School Zone Standards which include School-Related Crosswalk Standards and Reduced-Speed Zone Standards.

## RESOURCES

The School-Related Crosswalk Standards and Reduced-Speed Zone Standards, contained within the School Zone Standards document for the Lincoln School Zone Study were developed using national standards, research, and best practices. Some of the key resources used in the development of these recommendations include:

- Federal Highway Administration (FHWA), *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD)<sup>1</sup>: “The MUTCD contains the national standards governing all traffic control devices. All public agencies and owners of private roads open to public travel across the nation rely on the MUTCD to bring uniformity to the roadway. The MUTCD plays a critical role in improving safety and mobility of all road users. The MUTCD is the law governing all traffic control devices. Non-compliance with the MUTCD ultimately can result in the loss of federal-aid funds as well as in a significant increase in tort liability.”
- FHWA, *Guide to Improving Pedestrian Safety at Uncontrolled Crossing Locations*<sup>2</sup>: “This guide assists State or local transportation or traffic safety departments that are considering developing a policy or guide to support the installation of countermeasures at uncontrolled pedestrian crossing locations.”

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<sup>1</sup> <https://mutcd.fhwa.dot.gov/kno-overview.htm>

<sup>2</sup> [https://www.fhwa.dot.gov/innovation/everydaycounts/edc\\_4/guide\\_to\\_improve\\_uncontrolled\\_crossings.pdf](https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf)

FHWA, *Safe Transportation for Every Pedestrian (STEP) Countermeasure Tech Sheets*<sup>3</sup>: The six countermeasures identified in these tech sheets are identified in the *Guide to Improving Pedestrian Safety at Uncontrolled Crossing Locations*. The Tech Sheets provide a summary of features, considerations, and costs associated with each countermeasure.

- FHWA, *20 Proven Safety Countermeasures that offer significant and measurable impacts to improving safety*<sup>4</sup>: “In 2008, FHWA began promoting certain infrastructure-oriented safety treatments and strategies, chosen based on proven effectiveness and benefits, to encourage widespread implementation by State, tribal, and local transportation agencies to reduce serious injuries and fatalities on American highways. This became known as the Proven Safety Countermeasures initiative. The list was updated in 2012 and again in 2017.”
- FHWA, *Pedestrian Safety Guide and Countermeasure Selection System*<sup>5</sup>: “The *Pedestrian Safety Guide and Countermeasure Selection System* is intended to provide practitioners with the latest information available for improving the safety and mobility of those who walk. The online tools provide the user with a list of possible engineering, education, or enforcement treatments to improve pedestrian safety and/or mobility based on user input about a specific location.”
- National Association of City Transportation Officials (NACTO), *Urban Street Design Guide*<sup>6</sup>: “The Urban Street Design Guide charts the principles and practices of the nation’s foremost engineers, planners, and designers working in cities today. The Guide outlines both a clear vision for complete streets and a basic road map for how to bring them to fruition.”
- *Uniform Vehicle Code (UVC)*<sup>7</sup>: “This publication is designed as a comprehensive guide for developing standard state motor vehicle and traffic laws. It is based on experience under various state laws throughout the United States.”

# SECTION ONE: SCHOOL ZONE DESIGNATION

## School Zone Sign

- MUTCD Sect. 7B.08 School Sign and Plaques
  - “School Zone – the S1-1 sign can be used to identify the location of the beginning of a designated school zone.”
- MUTCD Sect. 7B.09 School Zone Sign and Plaques
  - If a school zone has been designated under State or local statute, a School (S1-1) sign shall be installed to identify the beginning point(s) of the designated school zone.

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<sup>3</sup> [https://www.fhwa.dot.gov/innovation/everydaycounts/edc\\_4/STEP-tech-sheets.pdf](https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/STEP-tech-sheets.pdf)

<sup>4</sup> <https://safety.fhwa.dot.gov/provencountermeasures/>

<sup>5</sup> <http://pedbikesafe.org/PEDSAFE/index.cfm>

<sup>6</sup> <https://nacto.org/publication/urban-street-design-guide/>

<sup>7</sup> <https://mutcd.fhwa.dot.gov/ser-pubs.htm>

# SECTION TWO: REDUCED-SPEED ZONES

- MUTCD Sect. 7B.15
  - “A School Speed Limit assembly or a School Speed Limit (S5-1) sign shall be used to indicate the speed limit where a reduced school speed limit zone has been established based upon an engineering study or where a reduced school speed limit is specified for such areas by statute.
  - The School Speed Limit assembly or School Speed Limit sign shall be placed at or as near as practical to the point where the reduced school speed limit zone begins. If a reduced school speed limit zone has been established, a School (S1-1) sign shall be installed in advance of the first School Speed Limit sign assembly or S5-1 sign that is encountered in each direction as traffic approaches the reduced school speed limit zone.
  - “The beginning point of a reduced school speed limit zone should be at least 200 feet in advance of the school grounds, a school crossing, or other school related activities; however, this 200-foot distance should be increased if the reduced school speed limit is 30 mph or higher.”
  - “Changeable message signs may be used to inform drivers of the school speed limit. If the sign is internally illuminated, it may have a white legend on a black background. Changeable message signs with flashing beacons may be used for situations where greater emphasis of the special school speed limit is needed.”
- MUTCD Sect. 7B.16
  - “A Reduced School Speed Limit Ahead (S4-5, S4-5a) sign should be used to inform road users of a reduced speed zone where the speed limit is being reduced by more than 10 mph, or where engineering judgment indicates that advance notice would be appropriate.”
- MUTCD Sect. 4D.26
  - “The duration of a yellow change interval shall not vary on a cycle-by-cycle basis within the same signal timing plan. The duration of a red clearance interval shall not be decreased or omitted on a cycle-by-cycle basis within the same signal timing plan.”
  - “The duration of a yellow change interval or a red clearance interval may be different in different signal timing plans for the same controller unit.”
- FHWA: *Methods and Practices for Setting Speed Limits*
  - School Zone Speed Limits
    - Reduced speed limits should be considered for school zones during the hours when children are going to and from school. Usually such school speed zones are only considered for schools located adjacent to highways or visible from highways. However, school-age pedestrian activity should be the primary basis for implementing reduced school zone speed limits. This includes irregular traffic and pedestrian movements that may result from children being dropped off and picked up from school.
    - According to the MUTCD, the reduced speed zone should begin either at a point 200 ft (120 m) in advance of the school grounds, a school crossing, or other school-related activities.
  - Injury Minimization
    - Speed limits are set according to the crash types that are likely to occur, the impact forces that result, and the tolerance of the human body to withstand these forces.
    - There is a sound scientific link between speed limits and serious crash prevention. Places a high priority on road safety.
    - Roads with a mix of motorized and unprotected users (i.e. pedestrians and cyclists) = 20 mph

# SECTION THREE: SCHOOL-RELATED CROSSWALK TREATMENTS

The section below includes a list of recommended crossing treatments and applicable standards, research, or best practices that was used in the development of the School-related Crosswalk Standards and Reduced-Speed Zone Standards.

## I. SIGNING AND PAVEMENT MARKING TREATMENTS

### I.a. High Visibility Marked Crosswalk

- UVC Sect.1-118 – Crosswalk
  - “(a) That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or, in the absence of curbs, from the edges of the traversable roadway; and in the absence of a sidewalk on one side of the roadway, that part of a roadway included within the extension of the lateral lines of the existing sidewalk at right angles to the centerline.
  - (b) Any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface.”
- Nebraska Revised Statute 60-6,153. Pedestrians' right-of-way in crosswalk; traffic control devices<sup>8</sup>
  - “(1) Except at a point where a pedestrian tunnel or overhead pedestrian crossing has been provided, when traffic control signals are not in place or not in operation, the driver of a vehicle shall yield the right-of-way to a pedestrian crossing the roadway within a crosswalk who is in the lane in which the driver is proceeding or is in the lane immediately adjacent thereto by bringing his or her vehicle to a complete stop.
  - (2) No pedestrian shall suddenly leave a curb or other place of safety and walk or run into the path of a vehicle which is so close that it is impossible for the driver to stop.
  - (3) Whenever any vehicle is stopped at a marked crosswalk or at any unmarked crosswalk at an intersection to permit a pedestrian to cross the roadway, the driver of any other vehicle approaching from the rear shall not overtake and pass such stopped vehicle.”
- MUTCD Sect. 7C.02 Crosswalk Markings
  - “Crosswalks should be marked at all intersections on established routes to a school where there is substantial conflict between motorists, bicyclists, and student movements; where students are encouraged to cross between intersections; where students would not otherwise recognize the proper place to cross; or where motorists or bicyclists might not expect students to cross.
  - Crosswalk lines should not be used indiscriminately. An engineering study considering the factors described in Section 3B.18 should be performed before a marked crosswalk is installed at a location away from a traffic control signal or an approach controlled by a STOP or YIELD sign.
  - Because non-intersection school crossings are generally unexpected by the road user, warning signs should be installed for all marked school crosswalks at non-intersection locations. Adequate visibility of students by approaching motorists and of approaching motorists by students should be provided by parking prohibitions or other appropriate measures.”
- MUTCD Sect. 3B.18 Crosswalk Markings
  - “New marked crosswalks alone, without other measures designed to reduce traffic speeds, shorten crossing distances, enhance driver awareness of the crossing, and/or provide active warning of pedestrian presence, should not be installed across uncontrolled roadways where the speed limit exceeds 40 mph and either:

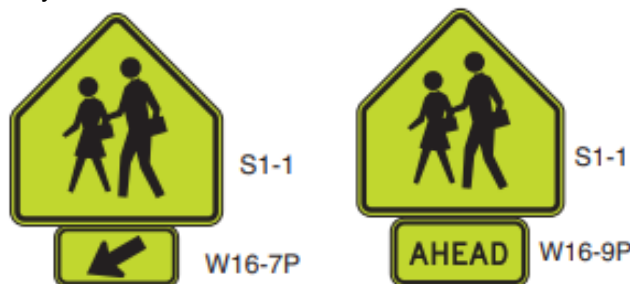
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<sup>8</sup> <https://nebraskalegislature.gov/laws/statutes.php?statute=60-6,153>

- A. The roadway has four or more lanes of travel without a raised median or pedestrian refuge island and an ADT of 12,000 vehicles per day or greater; or
  - B. The roadway has four or more lanes of travel with a raised median or pedestrian refuge island and an ADT of 15,000 vehicles per day or greater.”
- FHWA White Paper, *An Overview and Recommendations of High-Visibility Crosswalk Marking Styles*<sup>9</sup>
  - “We conclude that, because high-visibility markings are more easily detected by motorists and have been shown to lead to a reduction in pedestrian-vehicle collisions when compared to transverse line crosswalks, transportation agencies should install high-visibility markings at uncontrolled crossing locations whenever a determination is made to provide marked crosswalks. Installing the most visible crosswalk marking styles is important to increase the likelihood that approaching motorists will see marked crosswalks in time to become aware of the possibility of pedestrians crossing the street ahead. At crossing locations controlled by traffic signals or stop signs, the key recommendation is to mark all legs of the intersection with a crosswalk in order to indicate to pedestrians and motorists the preferred locations for pedestrians to cross.”
  - Research has found a statistically significant reduction in pedestrian-vehicle collisions at intersections with high-visibility pavement markings compared to standard pavement markings. Other research found a statistically significant improvement in the percentage of motorists who yielded to pedestrians in crosswalks with high-visibility striping, as well as an increase in the yielding or stopping distance prior to a high-visibility crosswalk.

### I.b. School Crossing Assembly

- MUTCD Sect. 7B.12 School Crossing Assembly
  - “If used, the School Crossing assembly shall be installed at the school crossing or as close to it as possible and shall consist of a School (S1-1) sign supplemented with a diagonal downward pointing arrow (W16-7P) plaque to show the location of the crossing.
  - The School Crossing assembly shall not be used at crossings other than those adjacent to schools and those on established school pedestrian routes.
  - The School Crossing assembly shall not be installed on approaches controlled by a STOP or YIELD sign.”
- MUTCD Sect. 7B.11 School Advance Crossing Assembly
  - The School Advance Crossing assembly shall consist of a School (S1-1) sign supplemented with an AHEAD (W16-9P) plaque or an XX FEET (W16-2P or W16-2aP) plaque. 02
  - Except as provided in Paragraph 3, a School Advance Crossing assembly shall be used in advance of the first School Crossing assembly that is encountered in each direction as traffic approaches a school crosswalk.
  - Paragraph 3: The School Advance Crossing assembly may be omitted where a School Zone (S1-1) sign is installed to identify the beginning of a school zone in advance of the School Crossing assembly.



<sup>9</sup> [http://www.pedbikeinfo.org/cms/downloads/PBIC\\_WhitePaper\\_Crosswalks.pdf](http://www.pedbikeinfo.org/cms/downloads/PBIC_WhitePaper_Crosswalks.pdf)

### I.c. Pedestrian Warning Sign

- MUTCD Sect. 2C.50 Non-Vehicular Warning Signs
  - Non-Vehicular Warning (W11-2) signs may be used to alert road users in advance of locations where unexpected entries into the roadway might occur or where shared use of the roadway by pedestrians might occur.
  - The crossing location identified by a W11-2 sign may be defined with crosswalk markings (see Section 3B.18).



W11-2\*

\* A fluorescent yellow-green background color may be used for this sign or plaque.

### I.d. In-Street Pedestrian Crossing Signs



R1-6b

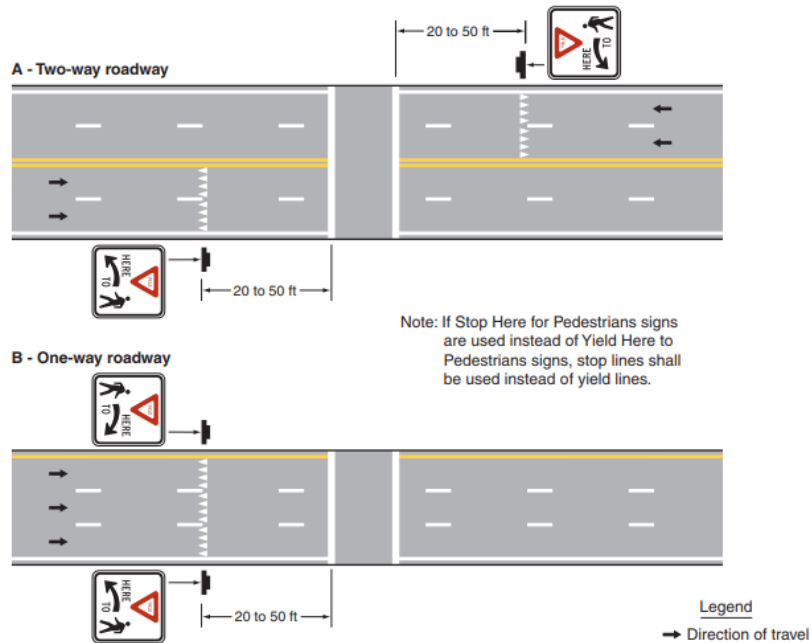
- MUTCD Sect. 2B.12
  - “The In-Street Pedestrian Crossing (R1-6 or R1-6a) sign (see Figure 2B-2) or the Overhead Pedestrian Crossing (R1-9 or R1-9a) sign (see Figure 2B-2) may be used to remind road users of laws regarding right-of-way at an unsignalized pedestrian crosswalk.”
  - “If used, the In-Street Pedestrian Crossing sign shall be placed in the roadway at the crosswalk location on the center line, on a lane line, or on a median island. The In-Street Pedestrian Crossing sign shall not be post-mounted on the left-hand or right-hand side of the roadway.”
  - “If an island (see Chapter 3I) is available, the In-Street Pedestrian Crossing sign, if used, should be placed on the island.”
  - “The In-Street Pedestrian Crossing sign may be used seasonably to prevent damage in winter because of plowing operations, and may be removed at night if the pedestrian activity at night is minimal.”
- MUTCD Sect. 7B.12 School Crossing Assembly
  - “The In-Street Pedestrian Crossing (R1-6 or R1-6a) sign (see Section 2B.12 and Figure 7B-6) or the In-Street School children Crossing (R1-6b or R1-6c) sign (see Figure 7B-6) may be used at unsignalized school crossings. If used at a school crossing, a 12 x 4-inch SCHOOL (S4-3P) plaque (see Figure 7B-6) may be mounted above the sign. The STATE LAW legend on the R1-6 series signs may be omitted.”

### I.e. Advance Yield Marking and Sign

- MUTCD Sect. 3B.16 Stop and Yield Signs
  - “Yield lines may be used to indicate the point behind which vehicles are required to yield in compliance with a YIELD (R1-2) sign or a Yield Here To Pedestrians (R1-5 or R1-5a) sign.”
  - “If yield or stop lines are used at a crosswalk that crosses an uncontrolled multi-lane approach, the yield lines or stop lines should be placed 20 to 50 feet in advance of the nearest crosswalk line, and parking should be prohibited in the area between the yield or stop line and the crosswalk.”

- If yield (stop) lines are used at a crosswalk that crosses an uncontrolled multi-lane approach, Yield Here To (Stop Here For) Pedestrians (R1-5 series) signs (see Section 2B.11) shall be used.”

Figure 3B-17. Examples of Yield Lines at Unsignalized Midblock Crosswalks



### I.f. Rectangular Rapid-Flashing Beacon (RRFB)



- Pedestrian Safety Guide and Countermeasure Selection System: Rectangular Rapid-Flashing Beacon (RRFB)<sup>10</sup>
  - “The RRFB is a treatment option at many types of established pedestrian crossings. RRFBs are particularly effective at multilane crossings with speed limits less than 40 mph.”
  - “RRFBs are placed on both sides of a crosswalk below the pedestrian crossing sign and above the arrow indication pointing at the crossing. The flashing pattern can be activated with pushbuttons or automated (e.g., video or infrared) pedestrian detection, and should be unlit when not activated.”

<sup>10</sup> [http://pedbikesafe.org/PEDSAFE/countermeasures\\_detail.cfm?CM\\_NUM=54](http://pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=54)



- “RRFB should be reserved for locations with significant pedestrian safety issues, as over-use of RRFB treatments may diminish their effectiveness.”
- “The installation of RRFBs can reduce pedestrian crashes by 47%.”

### I.g. Stop line

- MUTCD Sect. 3B.16 Stop and Yield Signs
  - “Stop lines should be used to indicate the point behind which vehicles are required to stop in compliance with a traffic control signal.”
  - “If used, stop and yield lines should be placed a minimum of 4 feet in advance of the nearest crosswalk line at controlled intersections.”
  - “Stop lines at midblock signalized locations should be placed at least 40 feet in advance of the nearest signal indication.”

### I.h. Parking restrictions

- MUTCD Sect. 3B.19 Parking Space Markings
  - “Marking of parking space boundaries encourages more orderly and efficient use of parking spaces where parking turnover is substantial. Parking space markings tend to prevent encroachment into fire hydrant zones, bus stops, loading zones, approaches to intersections, curb ramps, and clearance spaces for islands and other zones where parking is restricted.”
- UVC
  - The UVC is the primary document for determining curb parking regulations. The standard for most local jurisdictions state that:
    - No person shall: “Stand or park a vehicle, whether occupied or not, except momentarily to pick up or discharge a passenger or passengers:
      - within 20 feet of a crosswalk at an intersection;
      - within 30 feet of any flashing signal, stop sign, yield sign or traffic-control signal located at the side of a roadway.”
- FHWA Safety Countermeasures: Remove/Restrict Parking<sup>11</sup>
  - “As the speed of travel on the thru street increases, the drivers' stopping sight distance increases. Therefore, the parking restriction area near the intersection has to be increased. For 35 to 45 mph, it is recommended that parking be restricted to 50 feet from the crosswalk. Above 45 mph, parking should be restricted to 100 feet from the crosswalk.”
- FHWA, Guide to Improving Pedestrian Safety at Uncontrolled Crossing Locations
  - “The agency should also strongly consider implementing parking restrictions on the crosswalk approach at all established pedestrian crossings (both approaches) so there is adequate sight distance for motorists on the approaches to the crossings and ample sight distance for pedestrians attempting to cross. The minimum setback is 20 feet where speeds are 25 mph or less, and 30 feet between 26 mph and 35 mph. If this cannot be done, the curbs should be “bulbed out” to allow the pedestrian to see past the parked vehicle along the street. Adjacent bus stops should be placed downstream of the crosswalk and not on the crosswalk approach.”
- MUTCD Sect. 7B.17 Parking and Stopping Signs
  - “Parking and stopping regulatory signs may be used to prevent parked or waiting vehicles from blocking pedestrians’ views, and drivers’ views of pedestrians, and to control vehicles as a part of the school traffic plan.”
- Lincoln Municipal Code Sect. 10.32.310 Parking Near Street Intersections
  - “Except when in compliance with the directions of a police officer or official traffic control device, it shall be unlawful for any person to park, place, or leave standing any vehicle upon a street or

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<sup>11</sup> <https://safety.fhwa.dot.gov/saferjourney1/library/countermeasures/56.htm>

highway within twenty-five feet of the approach to any traffic stop sign or signal, and upon a street or highway within twenty-five feet of a crosswalk, or if none, then within twenty-five feet of the intersection of property lines at an intersection of any street or highway. (Ord. 15641 §31; July 9, 1990: P.C. §10.28.080: Ord. 8364 §3; April 13, 1964: prior Ord. 5699 §607; April 12, 1954).”

- Lincoln Municipal Code Sect. 10.32.350 Parking Near Schools
  - “It shall be unlawful for any person to park a motor vehicle at the curb adjacent to any school grounds upon which are located school buildings used for school purposes during the part of each day that such schools are in session for a period of time longer than ten minutes; provided, that during such parking period the driver of such vehicle shall remain in the vehicle. (Ord. 15641 §35; July 9, 1990: P.C. §10.28.120: Ord. 5699 §611; April 12, 1954).”

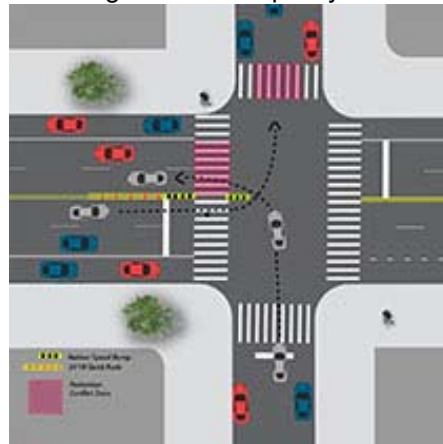
## II. GEOMETRIC TREATMENTS

### II.a. Accessible curb ramps

- Pedestrian Safety Guide and Countermeasure Selection System: Curb Ramps<sup>12</sup>
  - “Curb ramps must be installed at all intersections and midblock locations where there are pedestrian crossings, as mandated by federal legislation (1973 Rehabilitation Act and ADA 1990).”

### II.b. Hardened centerline (rubber curbs with delineators)

- *Don't Cut Corners: Left Turn Pedestrian & Bicyclist Crash Study*<sup>13</sup>
  - Benefits of hardened centerlines:
    - “Hardened centerline and guiding radius tighten and calm left turns
    - Increases visibility of pedestrians in the crosswalk for motorists
    - Modifies turning angle from cross street onto receiving roadway to create safer, slower left turns with no change in traffic capacity.”



### II.c. Curb extensions

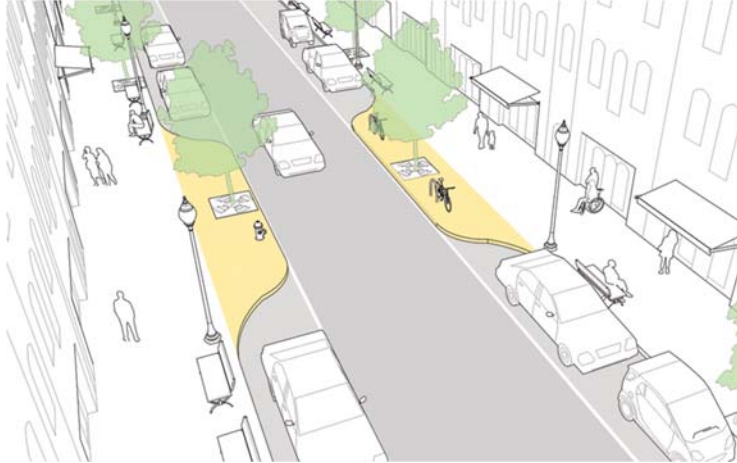
- FHWA Safety Countermeasure: Curb Extensions<sup>14</sup>
  - “Improves safety for pedestrians and motorists at intersections; increases visibility and reduces speed of turning vehicles.
  - Encourages pedestrians to cross at designated locations.
  - Prevents motor vehicles from parking at corners.”

<sup>12</sup> [http://pedbikesafe.org/PEDSAFE/countermeasures\\_detail.cfm?CM\\_NUM=3](http://pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=3)

<sup>13</sup> <https://www1.nyc.gov/html/dot/downloads/pdf/left-turn-pedestrian-and-bicycle-crash-study.pdf>

<sup>14</sup> <https://safety.fhwa.dot.gov/saferjourney1/Library/countermeasures/23.htm>

- NACTO: Curb Extensions<sup>15</sup>
  - “Curb extensions decrease the overall width of the roadway and can serve as a visual cue to drivers that they are entering a neighborhood street or area.
  - Curb extensions increase the overall visibility of pedestrians by aligning them with the parking lane and reducing the crossing distance for pedestrians, creating more time for preferential treatments such as leading pedestrian interval and transit signal priority.”



## II.d. Pedestrian refuge island

- FHWA STEP Countermeasure Tech Sheet
  - “Refuge islands are highly desirable for midblock pedestrian crossings on roads with four or more travel lanes, especially where speed limits are 35 mph or greater and/or where annual average daily traffic (AADT) is 9,000 or higher. They are also a candidate treatment option for uncontrolled pedestrian crossings on 3-lane or 2-lane roads that have high vehicle speeds or volumes. When installed at a midblock crossing, the island should be supplemented with a marked high-visibility crosswalk.”
  - “Pedestrian refuge islands can reduce pedestrian crashes by 32%.”



- NACTO: Pedestrian Safety Islands<sup>16</sup>
  - “Pedestrian safety islands should be at least 6 feet wide, but have a preferred width of 8–10 feet. Where a 6-foot wide median cannot be attained, a narrower raised median is still preferable to nothing. The minimum protected width is 6 feet, based on the length of a bicycle or a person pushing a stroller.”

<sup>15</sup> <https://nacto.org/publication/urban-street-design-guide/street-design-elements/curb-extensions/>

<sup>16</sup> <https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/crosswalks-and-crossings/pedestrian-safety-islands/>

## II.e. Raised crosswalk

- FHWA STEP Countermeasure Tech Sheet
  - “In addition to their use on local and collector streets, raised crosswalks can be installed in campus settings, shopping centers, and pick-up/drop-off zones (e.g., airports, schools, transit centers).”
  - “Raised crosswalks can reduce pedestrian crashes by 45%.”
  - “Raised crosswalks are typically installed on 2-lane or 3-lane roads with speed limits of 30 mph or less and annual average daily traffic (AADT) below about 9,000. Raised crossings should generally be avoided on truck routes, emergency routes, and arterial streets.
  - Drainage can be an issue. Raised crosswalks may be installed with curb extensions where parking exists. They may also be used at intersections, particularly at the entrance of the minor street.”



## II.f. Road diet

- FHWA: *Building Safer Routes to School*<sup>17</sup>
  - “Road Diets are a proven safety countermeasure that keep traffic flowing while reducing crashes, reducing high-risk speeding, and addressing safety concerns. Implementing a Road Diet is an easy and cost effective way to manage and improve mobility and accessibility for all users, including pedestrians, bicyclists, and those using public transportation. This is done by reconfiguring roadways using pavement marking modifications.”
- FHWA: *Road Diet Informational Guide*<sup>18</sup>
  - “Four-lane undivided highways have a history of relatively high crash rates as traffic volumes increase and as the inside lane is shared by higher speed through traffic and left-turning vehicles.
  - One option for addressing this safety concern is a "Road Diet." A Road Diet involves converting an existing four-lane undivided roadway segment to a three-lane segment consisting of two through lanes and a center two-way left-turn lane (TWLTL). The reduction of lanes allows the roadway cross section to be reallocated for other uses such as bike lanes, pedestrian refuge islands, transit stops, or parking.”
  - “A Road Diet can be a low-cost safety solution, particularly in cases where only pavement marking modifications are required to make the traffic control change. In other cases, the Road Diet may be planned in conjunction with reconstruction or simple overlay projects, and the change in cross section allocation can be incorporated at no additional cost.”
- FHWA: *Safety: Road Diets (Roadway Reconfiguration)*<sup>19</sup>

<sup>17</sup> [https://safety.fhwa.dot.gov/road\\_diets/resources/pdf/safer\\_route\\_to\\_schoolv1\\_052616.pdf](https://safety.fhwa.dot.gov/road_diets/resources/pdf/safer_route_to_schoolv1_052616.pdf)

<sup>18</sup> [https://safety.fhwa.dot.gov/road\\_diets/guidance/info\\_guide/index.cfm](https://safety.fhwa.dot.gov/road_diets/guidance/info_guide/index.cfm)

<sup>19</sup> [https://safety.fhwa.dot.gov/road\\_diets/](https://safety.fhwa.dot.gov/road_diets/)

- “The resulting benefits include a crash reduction of 19 to 47 percent, reduced vehicle speed differential, improved mobility and access by all road users, and integration of the roadway into surrounding uses that results in an enhanced quality of life. A key feature of a Road Diet is that it allows reclaimed space to be allocated for other uses, such as turn lanes, bus lanes, pedestrian refuge islands, bike lanes, sidewalks, bus shelters, parking or landscaping.”
- FHWA: Road Diet FAQ<sup>20</sup>
  - “Several agencies have developed guidelines for selecting candidate Road Diet locations to mitigate any negative effect on traffic operations. FHWA has summarized average daily traffic (ADT) volume threshold guidelines for four-lane roadways:
    - Less than 10,000 ADT: A great candidate for Road Diets in most instances. Capacity will most likely not be affected.
    - 10,000-15,000 ADT: A good candidate for Road Diets in many instances. Agencies should conduct intersection analyses and consider signal retiming in conjunction with implementation.
    - 15,000-20,000 ADT: A good candidate for Road Diets in some instances; however, capacity may be affected depending on conditions. Agencies should conduct a corridor analysis.
    - Greater than 20,000 ADT: Agencies should complete a feasibility study to determine whether the location is a good candidate. Some agencies have had success with Road Diets at higher traffic volumes.”

### III. TRAFFIC SIGNAL TREATMENTS

#### III.a. Pedestrian countdown signals

- MUTCD Sect. 4E.03 Application of Pedestrian Signal Heads
  - “Pedestrian signal heads shall be used in conjunction with vehicular traffic control signals under any of the following conditions:
    - If a traffic control signal is justified by an engineering study and meets either Warrant 4, Pedestrian Volume or Warrant 5, School Crossing;
    - At an established school crossing at any signalized location;”
- MUTCD Sect. 4E.07 Countdown Pedestrian Signals
  - “All pedestrian signal heads used at crosswalks where the pedestrian change interval is more than 7 seconds shall include a pedestrian change interval countdown display in order to inform pedestrians of the number of seconds remaining in the pedestrian change interval.”

#### III.b. Evaluate pedestrian clearance time

- MUTCD Sect. 4E.06 Pedestrian Intervals and Signal Phases
  - “Where pedestrians who walk slower than 3.5 feet per second, or pedestrians who use wheelchairs, routinely use the crosswalk, a walking speed of less than 3.5 feet per second should be considered in determining the pedestrian clearance time.
  - The total of the walk interval and pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the pedestrian detector (or, if no pedestrian detector is present, a location 6 feet from the face of the curb or from the edge of the pavement) at the beginning of the WALKING PERSON (symbolizing WALK) signal indication to travel at a walking speed of 3 feet per second to the far side of the traveled way being crossed or to the median if a two-stage pedestrian crossing sequence is used. Any additional time that is required to satisfy the conditions of this paragraph should be added to the walk interval.”

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<sup>20</sup> [https://safety.fhwa.dot.gov/road\\_diets/resources/pdf/fhwasa17021.pdf](https://safety.fhwa.dot.gov/road_diets/resources/pdf/fhwasa17021.pdf)

### III.c. Turning Vehicles Yield to Peds Sign

- MUTCD Sect. 2B.53 Traffic Signal Signs
  - “In order to remind drivers who are making turns to yield to pedestrians, a Turning Vehicles Yield to Pedestrians (R10-15) sign may be used.”



R10-15

- Evaluating the effectiveness of turning traffic must yield to pedestrians (R10-15)<sup>21</sup>
  - “The countermeasure “Turning traffic must yield to pedestrians” (Manual on Uniform Traffic Control Devices (MUTCD) code sign R10-15) is used to address problems such as pedestrians not waiting for signals or an acceptable gap before crossing the streets resulting in conflicts between right turning vehicles and pedestrians. The aim of this paper is to evaluate the effectiveness of this installation... The result shows that motorists yielding behavior while turning either on red or green increased during the after study period. A significant reduction was observed in vehicles blocking the crosswalk while a significant increase in vehicles stopped completely before turning on red ( $P < 0.001$ ). Average pedestrian delay increased during the after study period from 44 sec/pedestrian to 61 sec/pedestrian whereas the average vehicle delay increased from 67 sec/vehicle to 76 sec/vehicle. The installation of R10-15 effectively increases the yielding behavior of turning traffic at green in presence of pedestrians which also leads to increase in both pedestrian and vehicle delay.”

### III.d. Pedestrian recall

- *Signal Timing Manual: 7.5.1.3 Walk Modes*
  - “Rest in Walk dwells in the pedestrian walk interval while the coordinated phase is green, regardless of pedestrian calls. This mode is often used when there are high pedestrian volumes, such as in downtown environments or locations near schools.”
  - “The appropriate walk mode may depend on the time of day. During the middle of the night, rest in don’t walk might be the most appropriate because of the low volume of pedestrians. However, a high volume of pedestrians during the day may make rest in walk (or extended walk) the most appropriate for that time period.”

### III.e. Left-turn phasing

- Pedestrian Safety Guide and Countermeasure Selection System: Left Turn Phasing<sup>22</sup>
  - “One of the most common conflicts at signalized intersections is the competition between vehicles permissively turning left and pedestrians crossing during the concurrent pedestrian signal phase. Drivers typically focus on on-coming traffic to identify gaps for left turns and may not pay due attention to pedestrians approaching or in the parallel crosswalk. Furthermore, permissive left turns at congested intersections contribute to drivers accepting smaller gaps, turning at higher speeds, and “sneaking” through the intersection during the yellow or all-red signal intervals.

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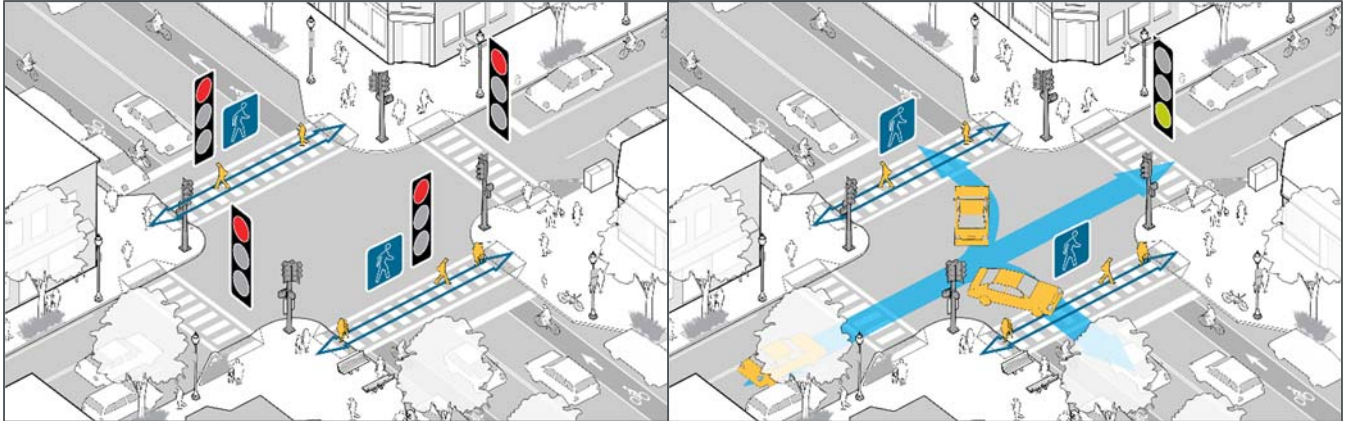
<sup>21</sup> [https://digitalscholarship.unlv.edu/fac\\_articles/234/](https://digitalscholarship.unlv.edu/fac_articles/234/)

<sup>22</sup> [http://pedbikesafe.org/PEDSAFE/countermeasures\\_detail.cfm?CM\\_NUM=51](http://pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=51)

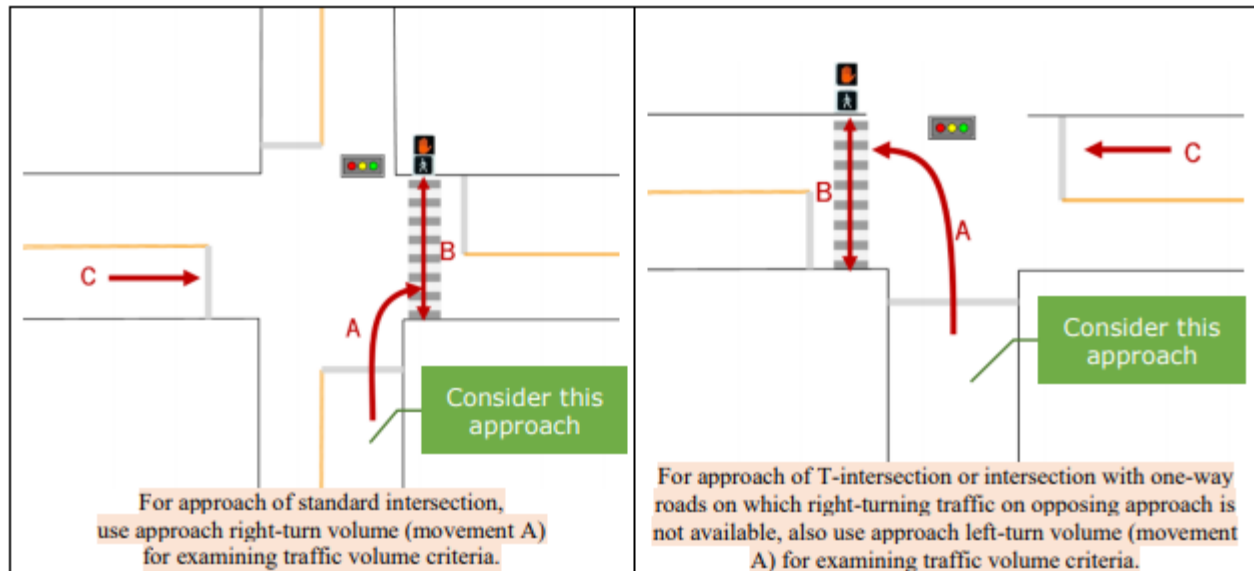
Implementing protected left turn phasing can reduce conflicts with pedestrians crossing parallel to vehicle traffic.”

- *Signal Timing Manual: 7.6.1 Phase Sequence*
  - Modern controllers allow left-turn phase sequences to be varied by time of day. This has traditionally been done only for protected left-turn operations, but the use of FYA indications allows this to be extended to protected-permitted operations (see Chapter 4 for more information on FYAs). The practitioner should always consider user expectations and the operational objectives when choosing different phase sequences for different times of day.

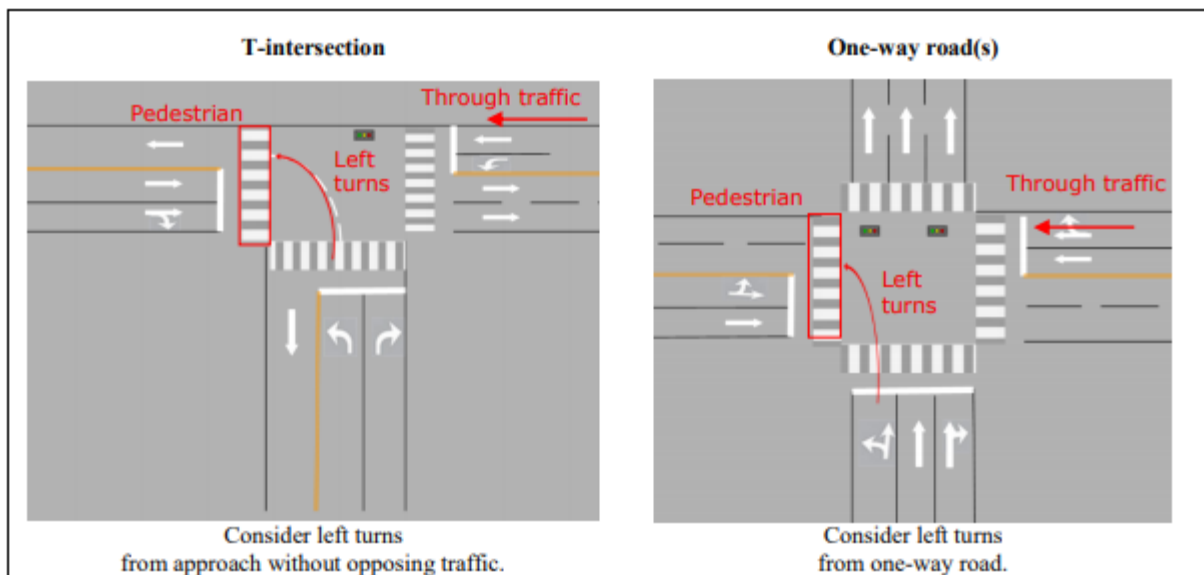
### III.f. Leading Pedestrian Interval (LPI)



- MUTCD Sect. 4E.06 Pedestrian Intervals and Signal Phases
  - “At intersections with high pedestrian volumes and high conflicting turning vehicle volumes, a brief leading pedestrian interval, during which an advance WALKING PERSON (symbolizing WALK) indication is displayed for the crosswalk while red indications continue to be displayed to parallel through and/or turning traffic, may be used to reduce conflicts between pedestrians and turning vehicles.
  - If a leading pedestrian interval is used, the use of accessible pedestrian signals should be considered.”
  - “If a leading pedestrian interval is used, it should be at least 3 seconds in duration and should be timed to allow pedestrians to cross at least one lane of traffic or, in the case of a large corner radius, to travel far enough for pedestrians to establish their position ahead of the turning traffic before the turning traffic is released.
  - If a leading pedestrian interval is used, consideration should be given to prohibiting turns across the crosswalk during the leading pedestrian interval.”
- *Development of Statewide Guidelines for Implementing Leading Pedestrian Intervals in Florida*
  - These guidelines combined best practices and research for implementing LPIs and determined a list of eight warrants, similar to the MUTCD traffic signal warrants, for implementing an LPI at an intersection. Warrant 8, School Crossing, is applicable for this study.
    - “A School Crossing Warrant is intended for application at locations at which school students crossing a street is the principal reason to consider implementing an LPI. For the purpose of this warrant, “school students” include elementary school through university students.
    - The need for an LPI shall be considered at the studied approach of an intersection when an engineering study finds that the following condition is satisfied at an intersection with a school crossing (see Figures 6-1 and 6-2 for movement definition):
      - Approach turning vehicle volume (movement A)  $\geq 50$ /hour (consider LPI for the period 1 hour before and 30 minutes after school start time, and the period 30 minutes before and 1 hour after school end time).”



**Figure 6-1 Traffic movement on approach for LPI suitability assessment.**



**Figure 6-2 Consideration of left turns on approach.**

### III.g. Right-Turn-on-Red (RTOR) restrictions

- MUTCD Sect. 4E.06 Pedestrian Intervals and Signal Phases
  - If a leading pedestrian interval is used, consideration should be given to prohibiting turns across the crosswalk during the leading pedestrian interval.
- Pedestrian Safety Guide and Countermeasure Selection System: Right-Turn-on-Red Restrictions<sup>23</sup>
  - "Prohibiting RTOR should be considered where exclusive pedestrian phases or high pedestrian volumes are present. For areas where a right-turn-on-red restriction is needed during certain

<sup>23</sup> [http://pedbikesafe.org/PEDSAFE/countermeasures\\_detail.cfm?CM\\_NUM=49](http://pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=49)



times, time-of-day restrictions may be appropriate. A variable-message NO TURN ON RED sign is also an option.”

### III.h. Advance traffic control signs

- MUTCD Sect. 2C.36 Advance Traffic Control Signs
  - “The Advance Traffic Control symbol signs include the Stop Ahead (W3-1), Yield Ahead (W3-2), and Signal Ahead (W3-3) signs. These signs shall be installed on an approach to a primary traffic control device that is not visible for a sufficient distance to permit the road user to respond to the device. The visibility criteria for a traffic control signal shall be based on having a continuous view of at least two signal faces for the distance specified in Table 4D-2.”
  - When a BE PREPARED TO STOP sign is used in advance of a traffic control signal, it shall be used in addition to a Signal Ahead sign and shall be placed downstream from the Signal Ahead (W3-3) sign.
  - The BE PREPARED TO STOP sign may be supplemented with a warning beacon (see Section 4L.03).
  - When the warning beacon is interconnected with a traffic control signal or queue detection system, the BE PREPARED TO STOP sign should be supplemented with a WHEN FLASHING (W16-13P) plaque.

**Table 4D-2. Minimum Sight Distance for Signal Visibility**

85th-Percentile Speed	Minimum Sight Distance
20 mph	175 feet
25 mph	215 feet
30 mph	270 feet
35 mph	325 feet
40 mph	390 feet
45 mph	460 feet
50 mph	540 feet
55 mph	625 feet
60 mph	715 feet

Note: Distances in this table are derived from stopping sight distance plus an assumed queue length for shorter cycle lengths (60 to 75 seconds).



W3-3



W3-4



W16-13P

### III.i. Turn restrictions

- NACTO: *Transit Street Design Guide: Turn Restrictions*<sup>24</sup>
  - Part-time turn prohibitions, usually applied during peak multi-modal traffic periods, are a useful tool for minimizing delays on streets without dedicated turn space. While peak-period left-turn prohibitions are a conventional strategy to increase general-traffic throughput—potentially resulting in higher traffic volumes over time—peak-period turn restrictions on left turns or right turns can substantially improve the performance and safety of either a peak-only transit lane or full-time transit lane.
- MUTCD FAQ<sup>25</sup>

<sup>24</sup> <https://nacto.org/publication/transit-street-design-guide/intersections/signals-operations/turn-restrictions/>

<sup>25</sup> [https://mutcd.fhwa.dot.gov/knowledge/faqs/faq\\_part4.htm#phb](https://mutcd.fhwa.dot.gov/knowledge/faqs/faq_part4.htm#phb)

- “The FHWA has been discouraging “half signals” for several decades because of the issues such designs cause when the interruption of the major-street traffic flow by a pedestrian actuation is used by side-street drivers as their opportunity to turn onto the major street, in conflict with the crossing pedestrians. Hybrid beacons placed at or adjacent to an intersection with a STOP or YIELD sign controlled side street is a half signal with the same operational and safety issues. The provision in Section 4F.02 is also consistent with the half-signal prohibitions that were adopted in Sections 4C.05 and 4C.06. Please note that these provisions in 4C.05, 4C.06, and 4F.02 are Guidance, not Standards.
- Thus, based on an engineering study or engineering judgment, a jurisdiction can decide to install the device at such an intersection if it determines that is the best location for it, considering all pertinent factors, and/or there are mitigating measures, such as blank-out No Right Turn/No Left Turn signs for the side street or making the side street one-way away from the intersection. The decisions should be documented in the jurisdictions’ files as basis for deviating from a Guidance statement in the MUTCD. It should also be noted that the National Committee on Uniform Traffic Control Devices (NCUTCD) has recommended to the FHWA that the Section 4F.02 guidance against installing pedestrian hybrid beacons within 100 feet of an intersection should be removed from the MUTCD, because a study of hybrid beacons at intersections in Tucson, Arizona, did not find significant operational or safety issues. The FHWA will give consideration to proposing the removal of the 100 feet guidance for the next edition of the MUTCD.”

### **III.j. Evaluate Need for Traffic Control Signal**

- MUTCD Sect 4C.01: Studies and Factors for Justifying Traffic Control Signals
  - “An engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location shall be performed to determine whether installation of a traffic control signal is justified at a particular location.
  - The investigation of the need for a traffic control signal shall include an analysis of factors related to the existing operation and safety at the study location and the potential to improve these conditions, and the applicable factors contained in the following traffic signal warrants:
    - Warrant 1, Eight-Hour Vehicular Volume
    - Warrant 2, Four-Hour Vehicular Volume
    - Warrant 3, Peak Hour
    - Warrant 4, Pedestrian Volume
    - Warrant 5, School Crossing
    - Warrant 6, Coordinated Signal System
    - Warrant 7, Crash Experience
    - Warrant 8, Roadway Network
    - Warrant 9, Intersection Near a Grade Crossing
    - The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.”
  - “A traffic control signal should not be installed unless one or more of the factors described in this Chapter are met.
  - A traffic control signal should not be installed unless an engineering study indicates that installing a traffic control signal will improve the overall safety and/or operation of the intersection.”

#### **Warrant 5, School Crossing**

- MUTCD Sect. 4C.06 Warrant 5, School Crossing
  - “The School Crossing signal warrant is intended for application where the fact that schoolchildren cross the major street is the principal reason to consider installing a traffic control signal. For the purposes of this warrant, the word “schoolchildren” includes elementary through high school students.
  - The need for a traffic control signal shall be considered when an engineering study of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size

of groups of schoolchildren at an established school crossing across the major street shows that the number of adequate gaps in the traffic stream during the period when the schoolchildren are using the crossing is less than the number of minutes in the same period (see Section 7A.03) and there are a minimum of 20 schoolchildren during the highest crossing hour.

- Before a decision is made to install a traffic control signal, consideration shall be given to the implementation of other remedial measures, such as warning signs and flashers, school speed zones, school crossing guards, or a grade-separated crossing.
- The School Crossing signal warrant shall not be applied at locations where the distance to the nearest traffic control signal along the major street is less than 300 feet, unless the proposed traffic control signal will not restrict the progressive movement of traffic.
- If this warrant is met and a traffic control signal is justified by an engineering study, then:
  - If it is installed at an intersection or major driveway location, the traffic control signal should also control the minor-street or driveway traffic, should be traffic-actuated, and should include pedestrian detection.
  - If it is installed at a non-intersection crossing, the traffic control signal should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs and should be pedestrian-actuated. If the traffic control signal is installed at a non-intersection crossing, at least one of the signal faces should be over the traveled way for each approach, parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the crosswalk or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance, and the installation should include suitable standard signs and pavement markings.
  - Furthermore, if it is installed within a signal system, the traffic control signal should be coordinated.”
- MUTCD Sect. 2B.04
  - Because the potential for conflicting commands could create driver confusion, YIELD or STOP signs shall not be used in conjunction with any traffic control signal operation, except in the following cases:
    - A. If the signal indication for an approach is a flashing red at all times;
    - B. If a minor street or driveway is located within or adjacent to the area controlled by the traffic control signal, but does not require separate traffic signal control because an extremely low potential for conflict exists; or
    - C. If a channelized turn lane is separated from the adjacent travel lanes by an island and the channelized turn lane is not controlled by a traffic control signal.”

# PEER CITIES

## SALT LAKE CITY, UT

- **School zone establishment:** Utah has statewide laws about school zones, as a supplement to the MUTCD which includes school crosswalk zones and reduced speed school zones.
  - Warrant process for establishing crosswalk: minimum of 10 children using crosswalk and daily vehicle traffic of 500 vehicles.
  - Once a crosswalk is established, conduct an engineering study to consider if a reduced speed zone is needed, including traffic volumes, gaps in traffic, posted speed limit, presence of signals, and school type.<sup>26</sup>
- **Signage and markings:** An MUTCD supplement also includes signage, markings, school zone process, and crossing supervision guidelines.<sup>27</sup>

## SIOUX FALLS, SD

- **Speed restrictions and timing:** 15mph maximum limit when passing any school during arrival, recess, departure; on streets adjacent to schools; within 50 feet of a school crossing (76.003)<sup>28</sup>
- **Discretion to establish school speed zones:** City Engineer may establish safety zones at their discretion (80.002)<sup>29</sup>
- **School zone enforcement:** Extensive policing efforts documented at beginning of each school year. Penalties include class 2 misdemeanor, 30 days in jail/\$500 fine<sup>30 31 32</sup>

## LANSING, MI

- **Michigan school zone regulations:** School zones extend 1,000 ft from school property lines. Speed limits are in effect 30 minutes before arrival and after dismissal. Speed limits are to be no less than 25mph and no more than 20mph slower than the otherwise established speed limit. Superintendent may request a school crossing zone if students must cross a state trunk line highway or county highway that has a speed limit of 35 miles per hour or more to attend that school.<sup>33</sup>

## CHAMPAIGN, IL

- **Illinois school zone regulations:** School zones limits are 20mph no matter the speed of the road, effective 7am to 4pm when school is in session. No passing in a school zone; pedestrians have right of way in crosswalk. “Jeff’s Law” states that a driver is deemed to have been driving recklessly if someone is injured or killed when he or she was speeding in a school zone.<sup>34</sup>

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<sup>26</sup> <http://digitallibrary.utah.gov/awweb/awarchive?type=file&item=21276>

<sup>27</sup> <https://www.udot.utah.gov/main/uconowner.gf?n=865661998245827>

<sup>28</sup> [http://library.amlegal.com/nxt/gateway.dll/South%20Dakota/siouxfalls\\_sd/cityofsiouxfallssouthdakotacodeofordinan?f=templates\\$fn=default.htm\\$3.0\\$vid=amlegal:siouxfalls\\_sd](http://library.amlegal.com/nxt/gateway.dll/South%20Dakota/siouxfalls_sd/cityofsiouxfallssouthdakotacodeofordinan?f=templates$fn=default.htm$3.0$vid=amlegal:siouxfalls_sd)

<sup>29</sup> [http://library.amlegal.com/nxt/gateway.dll/South%20Dakota/siouxfalls\\_sd/cityofsiouxfallssouthdakotacodeofordinan?f=templates\\$fn=default.htm\\$3.0\\$vid=amlegal:siouxfalls\\_sd](http://library.amlegal.com/nxt/gateway.dll/South%20Dakota/siouxfalls_sd/cityofsiouxfallssouthdakotacodeofordinan?f=templates$fn=default.htm$3.0$vid=amlegal:siouxfalls_sd)

<sup>30</sup> <http://www.keloland.com/news/article/education/school-zone-enforcement>

<sup>31</sup> <http://www.keloland.com/news/article/news/police-set-to-enforce-school-zone-speed-limits>

<sup>32</sup> <http://www.kdlt.com/2017/09/05/sioux-falls-police-saturate-school-zones-first-day/>

<sup>33</sup> <http://www.legislature.mi.gov/documents/2015-2016/publicact/pdf/2016-PA-0446.pdf>

<sup>34</sup> <https://patch.com/illinois/lakeforest/speeding-school-zone-illinois-laws-fines>

- **Champaign crosswalk pavement markings:** In general, crosswalks are provided at signalized intersections for pedestrian movements controlled by pedestrian indications and in the vicinity of schools along school safe-walk route crossings. For more specifics and other applications of crosswalks, consult Public Works Departmental Policy.<sup>35</sup>
- **Discretion to establish school speed zones:** “The Director of Public Works, subject to the written approval of the City Manager, may establish traffic control measures on streets immediately adjacent to a school facility. All measures shall be implemented only after the City Engineer has certified in writing that such measure will improve traffic flow or relieve congestion, and will have a positive effect on safety”. City must also enter an agreement with the school for installing signage, and notifying neighborhood residents and allowing for public comment.<sup>36</sup>
- **School zone speed limits:** No person shall drive a motor vehicle at a speed in excess of twenty (20) miles per hour while passing a school zone or while traveling upon any public thoroughfare on or across which children pass going to and from school during school days when school children are present. Appropriate signs shall be posted to indicate this restriction.<sup>37</sup>

## URBANA, IL

- **Discretion to establish school speed zones:** City traffic engineer has discretion to designate crosswalks and safety zones “of such kind and character and at such places as he may deem necessary for the protection of pedestrians”; speed limit may be lowered after a traffic study to no lower than the state minimum limits.<sup>38</sup>

## OVERLAND PARK, KS

- **School crossing guidelines:** Types of school crossings and presence of a crossing guard are established according to the available “safe gap” and volume of pedestrians crossing.<sup>39</sup>
- **School speed limit signage:** School speed limit signs are installed at the beginning of the school year and removed at the end of the school year.<sup>40</sup>
- **Discretion to establish school speed zones:** The City Traffic Engineer has the discretion to determine speed limits and enforcement times for school zones; the minimum speed for school zones is 20mph.<sup>41</sup>

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<sup>35</sup> <http://champaignil.gov/wp-content/uploads/2008/08/c12-chapter-12-traffic-control-and-regulatory-signage.pdf>

<sup>36</sup> [https://library.municode.com/il/champaign/codes/code\\_of\\_ordinances?nodeId=MUCO\\_CH33TRMOVE\\_ARTIIDRRE\\_S33-19.3SAIEIN](https://library.municode.com/il/champaign/codes/code_of_ordinances?nodeId=MUCO_CH33TRMOVE_ARTIIDRRE_S33-19.3SAIEIN)

<sup>37</sup> [https://library.municode.com/il/champaign/codes/code\\_of\\_ordinances?nodeId=MUCO\\_CH33TRMOVE\\_ARTIIDRRE\\_S33-19.5SAHASPLI](https://library.municode.com/il/champaign/codes/code_of_ordinances?nodeId=MUCO_CH33TRMOVE_ARTIIDRRE_S33-19.5SAHASPLI)

<sup>38</sup> [https://library.municode.com/il/urbana/codes/code\\_of\\_ordinances?nodeId=COOR\\_CH23LOTRCO\\_ARTIVTRNTDE\\_S23-48CITRENDECRESSAZO](https://library.municode.com/il/urbana/codes/code_of_ordinances?nodeId=COOR_CH23LOTRCO_ARTIVTRNTDE_S23-48CITRENDECRESSAZO)

<sup>39</sup> <http://www.opkansas.org/wp-content/uploads/downloads/school-crossing-and-traffic-control.pdf>

<sup>40</sup> <http://www.opkansas.org/wp-content/uploads/downloads/school-crossing-and-traffic-control.pdf>

<sup>41</sup> <http://online.encodeplus.com/regs/overlandpark-ks/doc-viewer.aspx#secid-3098>

ATTACHMENT B:

# STATISTICAL ANALYSIS METHODOLOGY AND RESULTS