



CITY OF LINCOLN

SCHOOL ZONE STANDARDS

April 2020



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CONTENTS

Introduction	4
Section One: School Zone Designation	6
Section Two: Reduced-Speed Zone Standards	9
Section Three: School Crosswalk Standards	11
Primary Walking Route Methodology	11
On-Street Parking & the Primary Walking Route Network	12
Types of Crossings	13
Recommended Crossing Treatments	13
A - Signalized Intersection Crossing	14
B - Stop-Controlled Approach Crossing	16
C - Signalized Mid-Block Crossing	18
D - Uncontrolled Crossing	20
Section Four: Crossing Treatment Details	24
Treatment Categories	24
1. Signing and Pavement Marking Treatments	25
2. Geometric Treatments	34
3. Traffic Signal Treatments	41
Attachment A: School Zone Standards and Guidelines Review	
Attachment B: Statistical Analysis Methodology and Results	
Attachment C: Crossing Guard Programs: General Overview and Program Costs	
Attachment D: School Zone Standards Case Study Application	

INTRODUCTION



The streets near schools as well as those along the primary walking routes to and from any school are critical public infrastructure where safety of children and other users of the facility is paramount. The complexity of activity on these streets, especially those adjacent to the school during the drop-off and pick-up times, require careful and deliberate assessment to ensure that street design, accompanying traffic control devices and traffic calming measures are appropriate to assure safety for all users.

The School Zone Standards presented in this document are the product of the Lincoln School Zone Study that was undertaken to develop recommendations for school zones, school-related crosswalk treatments, and reduced-speed zones that could be applied consistently throughout the City of Lincoln. Therefore, all school zone features and crosswalk treatments described in these standards shall only be installed by the Lincoln Transportation and Utilities Department. The School Zone Study evaluated various elements related to school zones with guidance from a



citizen panel made up of community members representing geographic diversity throughout Lincoln, each with a special interest in the topic of school zone safety. These elements are documented in a series of Technical Memorandum Attachments, described below.

School Zone Standards and Guidelines Review Technical Memorandum

The School Zone Standards are based on national standards, research, and best practices which are documented in the School Zone Standards and Guidelines Review Technical Memorandum, provided in Attachment A.

Statistical Analysis Methodology and Results Technical Memorandum

The standards presented in this document are also based on an evaluation of the characteristics of motor vehicle speeds on existing reduced-speed school zones at various schools in Lincoln. The data collection, data analysis, and findings from the speed study are documented in the Statistical Analysis Methodology and Results Technical Memorandum, provided in Attachment B.

Crossing Guard Programs: General Overview and Program Costs Technical Memorandum

An additional element which may be considered to enhance safety of children is the use of crossing guards within the school zone. Crossing guards can play an important role in keeping children safe as they cross the street at key locations. Attachment C, Crossing Guard Programs: General Overview and Program Costs Technical Memorandum, discusses the general considerations and tradeoffs for different types of crossings guard programs as well as details on funding and cost.

School Zone Standards Case Study Application Technical Memorandum

The Draft School Zone Standards were applied at five case study schools throughout the City and revisions were made to the draft Standards based on the application at the case study schools. Details on this process are documented in the School Zone Standards Case Study Application Technical Memorandum, provided in Attachment D.

Section One

SCHOOL ZONE DESIGNATION

For the purposes of these recommendations, the school zone is identified as the school property boundary plus all streets and intersections adjacent to the school property. Details on the purpose, context, and application of the School Zone sign are described in the section below.

School Zone Sign

Purpose

The School Zone sign alerts street users that they are approaching a school, where additional care is needed to ensure safety for all users.

Context

School Zone signs should be installed at all school zones to identify the area as a school zone and to identify school crossing locations.

Application

The application of the School Zone sign (S1-1), School Speed Limit Sign Assembly (S4-3P, R2-1), School Advance Crossing Assembly (S1-1, W16-9P), and School Crossing Assembly (S1-1, W16-7P), shown in Figure 1, must interact in a way to clearly convey the message to motorists that they are approaching a school zone, indicate the required speed reduction, and warn of locations where students may be crossing. It is necessary to convey these messages without creating visual clutter or overusing signs, that they may lose their effectiveness. When multiple school zones are located in close proximity, these signs should be applied in a manner that supports a cohesive network between the school zones without creating visual clutter or overusing signs

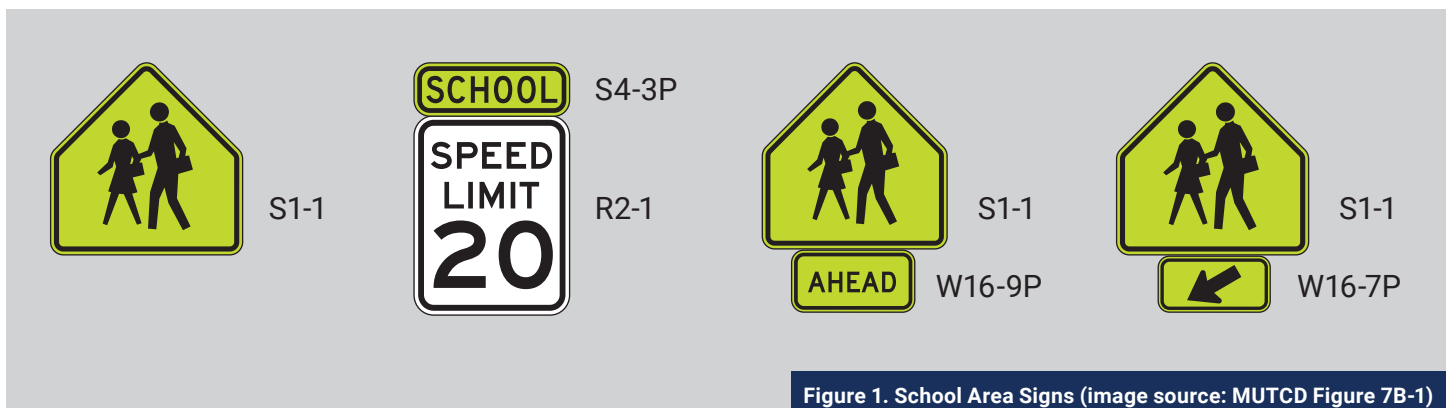


Figure 1. School Area Signs (image source: MUTCD Figure 7B-1)

as noted above. The application of these signs differs depending on the location of the school boundary. Details on the specific application of the School Speed Limit Sign Assembly can be found in “Section Two: Reduced-Speed Zones” and the School Crossing Assembly can be found in the “Crossing Treatment Details” section of this document. Details of the interaction of the three signs in different contexts are given below and provided in Figure 2.

When the school boundary occurs at a **signalized intersection**:

- School Zone sign: The School Zone sign should be installed 300 feet in advance of the signal when approaching the school zone.
- School Speed Limit Sign Assembly: The School Speed Limit Sign Assembly should be installed 200 feet in advance of the signal when approaching the school zone.
- School Crossing Assembly: The School Crossing Assembly should be installed at the location of the marked crosswalk, or as close as possible to the marked crosswalk. If space does not exist at the intersection, the School Advance Crossing Assembly (S1-1, W16-9P) should be installed up to 100 feet in advance of the signalized crosswalk.

When the school boundary occurs at a **four-way stop-controlled intersection**, or on the **stop-controlled approach of a two-way stop-controlled intersection**:

- School Zone sign: The School Zone sign should be installed 300 feet in advance of the stop sign when approaching the school zone.
- School Speed Limit Sign Assembly: The School Speed Limit Sign Assembly should be installed 200 feet in advance of the intersection when approaching the school zone.

- School Crossing Assembly: The School Crossing Assembly should be omitted in this condition.

When the school boundary occurs on the **uncontrolled approach of a two-way stop-controlled intersection with a marked crosswalk**, or at a **mid-block location with a marked crosswalk**:

- School Zone sign: The School Zone sign should be installed 300 feet in advance of the intersection or crosswalk when approaching the school zone.
- School Speed Limit Sign Assembly: The School Speed Limit Sign Assembly should be installed 200 feet in advance of the intersection when approaching the school zone.
- School Crossing Assembly: The School Crossing Assembly should be installed at the location of the marked crosswalk.

When the school boundary occurs at a **mid-block location without a marked crosswalk**:







- School Zone sign: The School Zone sign should be installed 300 feet in advance of the school boundary.
- School Speed Limit Sign Assembly: The School Speed Limit Sign Assembly should be installed 200 feet in advance of the school boundary.
- School Crossing Assembly: The School Crossing Assembly is not applicable in this condition.

The School Zone sign and School Speed Limit Sign Assembly may be installed at shorter distances from the school boundary than those stated above if the shorter distance would maximize the number of drivers that would see signs when approaching the school zone. Locations where the School Zone sign and School Speed Limit Sign Assembly should not be installed at shorter distances are in advance of any driveway/access to the school and in advance of locations where students would be expected to cross the street along the primary walking route.

The End School Zone sign (S5-2) should be installed on the departure leg of all intersections at the corners of the school property boundary or at the limit of the school property boundary, opposite of the School Speed Limit Sign Assembly.

If cross streets meet a street adjacent to the school boundary, the School Zone sign should be installed on the cross-street approach, up to 100 feet in advance of the intersection. The School Zone sign may be supplemented with an arrow (W16-5P or W16-6P) plaque to warn road users making a turn onto the cross street that they will encounter a school area soon after making the turn.

The School Crossing assembly should be installed at all designated crossings within the school zone or as close to it as possible consisting of a School (S1-1) sign supplemented with a diagonal downward pointing arrow (W16-7P) plaque to show the location of the crossing.

-  school zone
-  1 school zone sign, S1-1
-  2 school speed limit sign assembly, S4-3P, R2-1 & S4-1P
-  3 end school zone sign, S5-2
-  4 school crossing assembly, S1-1 & W16-7P signs
-  5 school advance crossing assembly, S1-1 & W16-9P signs

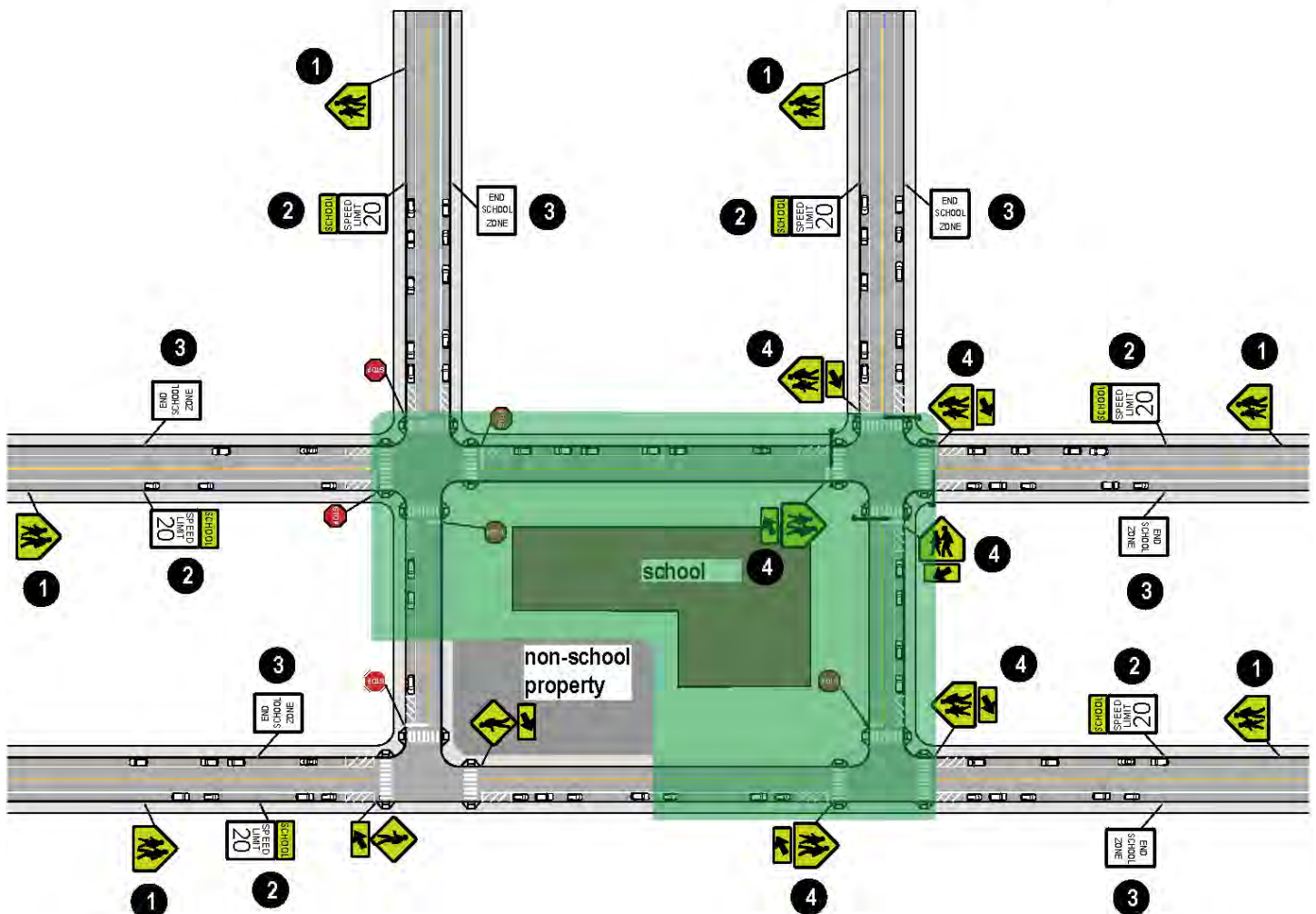


Figure 2. Example School Zone Signage

Section Two:

REDUCED-SPEED ZONE STANDARDS

Purpose

Higher speeds are associated with a greater likelihood of fatality or severe injury in the event of a crash between a vehicle and pedestrian. When a vehicle is traveling at a higher speed, the driver's cone of vision becomes smaller and requires a greater distance for the vehicle to come to a stop, as shown in Figure 3. The nature of school zones presents a confluence of several factors during a narrow window of time around arrival and dismissal of students, that make it dangerous space for all users, namely;

- a mix of child pedestrians who may make sudden and unexpected movements in front of vehicles,
- vehicles traveling to and from the school with several turning movements that increases the conflict points,
- background traffic of regular commuters, and
- school buses with larger blind-spots than regular vehicles.

Due to these reasons, slow speeds in school zones are critical for the safety of all users.

Context

Reduced-Speed Zones of 20 mph should be reserved for implementation and should be installed on all streets within the designated School Zone, i.e. all streets adjacent to the school property.

Application

The beginning point of a reduced speed zone should be at least 200 feet in advance of the school property.

The reduced speed zone may begin at a shorter distance from the school boundary if the shorter distance would maximize the number of drivers that would see signs when approaching the school zone, subject to the exceptions noted in Section One.

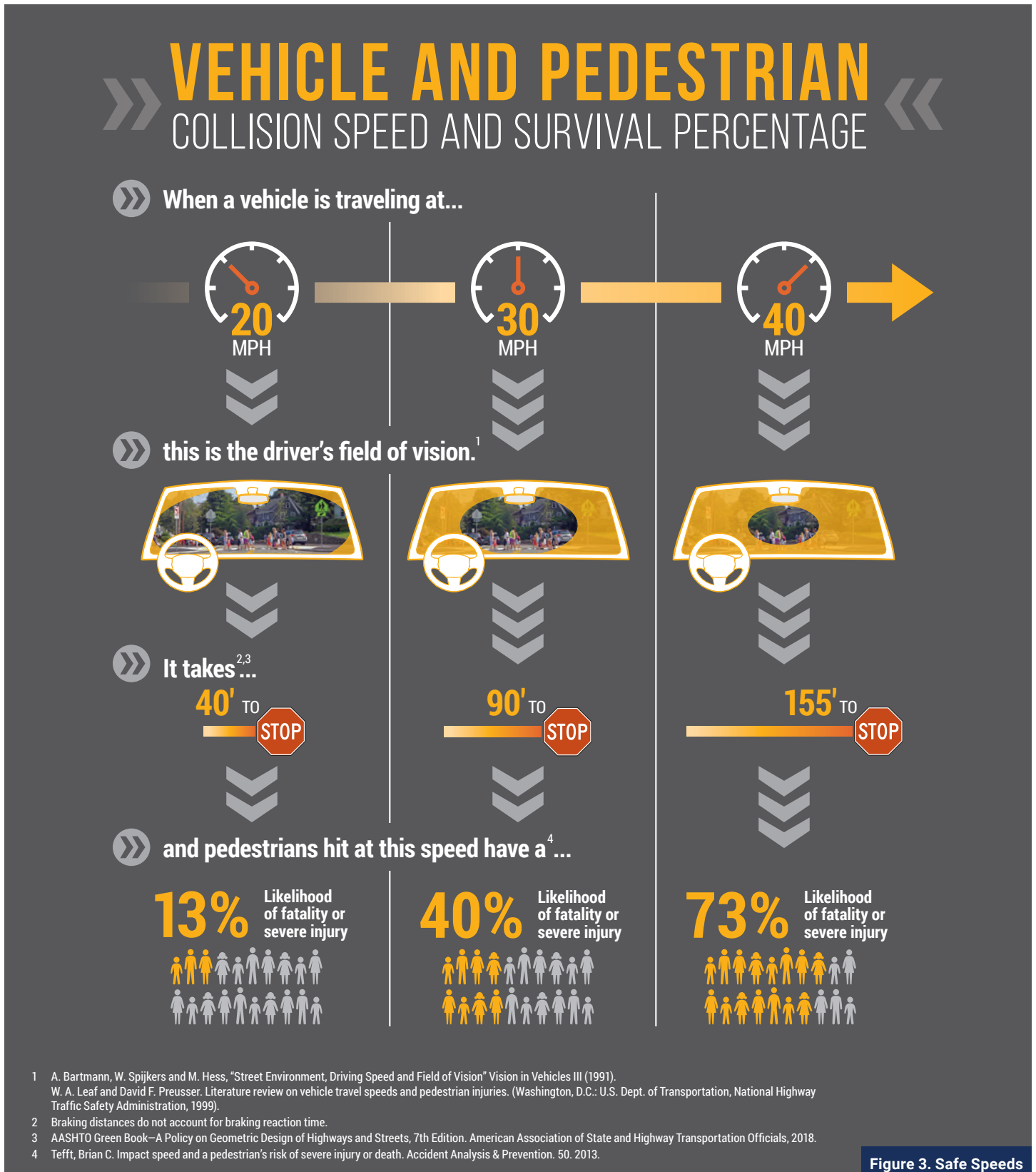
On streets adjacent to the school property, with a base posted speed limit of 25 mph, the reduced speed zone should be indicated with the School Speed Limit Sign Assembly (S3-3P, R2-1, S4-2P) indicating the reduced speed is in effect when children are present.

On streets adjacent to the school property, with a base posted speed limit of 30 mph or 35 mph, the reduced speed zone should be indicated with the School Speed Limit Sign Assembly mounted with flashing beacons indicating the time of the reduced speed limit, or 30 minutes prior to school arrival and 30 minutes after school dismissal.

On streets adjacent to the school property, with a base posted speed limit of 40 mph or higher, an engineering study should be conducted to evaluate appropriate measures for potential reductions to the base posted speed limit in advance of the school zone, before implementing a reduced-speed school zone. The engineering study should address existing street and vehicular traffic characteristics, the street network, building orientation, pedestrian entrances, and walking routes. If a reduction to the base posted speed limit alone is unlikely to reduce operating speeds, additional physical measures should be investigated in the engineering study.

A different signal timing plan may be implemented during the reduced-speed period for traffic signals within the reduced-speed zone to account for the

for the reduced speeds in the calculation of the yellow change and red clearance intervals.



Section Three:

SCHOOL CROSSWALK STANDARDS

A school crosswalk is considered to be any crosswalk within the school zone or on a school's primary walking route network. The purpose of the primary walking route network is to identify the routes to the school which serve the greatest number of students and where school crosswalk treatments should be installed.

Primary Walking Route Methodology

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The method described below provides a standardized process to identify the primary walking route network that can be replicated throughout the City. Steps one and two may be omitted if those applying the standards have adequate local knowledge to identify the primary walking route network. Otherwise, the following steps should be followed to identify the primary walking route network and school crosswalks for a given school:

1. Identify the 5-student threshold walking route network using the following data-based process:
 - a. Establish the potential school walk zone as the area covering a one-half mile radius from the school.
 - b. Identify all students attending the school and living within the potential school walk zone based on school attendance data provided by Lincoln Public Schools.
 - c. Use GIS analysis to identify the shortest walking route to school for each student within the potential school walk zone. Sum the number of student trips on each street segment within the potential school walk zone.
 - d. Select street segments with five or more walking students as the 5-student threshold walking route network.
2. Refine the 5-student threshold walking route network. The network may be refined based on the factors below:
 - a. Proximity to arterial and collector streets: Primary walking routes should include arterial and collector streets that lead to the school. Routes should begin at intersections with arterial or collector street, rather than mid-block or at intersections of two local streets.
 - b. Location of signalized intersections: Primary walking routes may begin at signalized intersections.

- c. Funnel points: Primary walking routes may begin where two segments of the 5-student threshold network come together.
 - d. Number of crossings along the route:
 - Segments of the 5-student threshold network should be excluded from the primary walking route network if no crossings exist along the segment.
 - Segments may be excluded if crossings along the segment have a very low potential for conflict, e.g. cul-de-sac intersections, T-intersections, local-to-local street intersections, etc.
 - e. On-site circulation: The entry/exit points and arrival/dismissal procedure may impact student circulation around the school and should be considered in the primary walking route network to minimize undesirable crossing locations.
3. Apply local knowledge and engineering judgment to finalize the primary walking route network.
 4. Create a database of all school crosswalks on the primary walking route network and apply the standards listed below to identify recommended crossing treatments.

On-Street Parking & the Primary Walking Route Network

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The regulations established in sections 10.32.310 and 10.32.350 of the Lincoln Municipal Code and the Manual on Uniform Traffic Control Devices regarding Parking Near Street Intersections and Parking Near Schools shall be applied to streets and intersections on the Primary Walking Route Network and in School Zones. These regulations prohibit parking on the curb adjacent to school grounds when school is in session for a period longer than ten minutes and during such parking period the driver must remain in the vehicle and prohibit parking within 25 feet of the approach to any traffic stop sign or crosswalk and 30 feet to any traffic signal.

Otherwise, the presence of on-street parking on residential streets reduces the effective width of the street which can result in lower speeds and a traffic calming effect for the street. Based on the potential for traffic calming that comes with on-street parking in residential areas, on-street parking should be permitted on both sides of the street along the Primary Walking Route Network.

Types of Crossings

Preferred crossing treatments vary depending on the type of vehicular traffic control that is present at a crossing. The vehicular traffic control has been grouped into the following four types of crossings:

- A. Signalized Intersection Crossing
- B. Stop-Controlled Approach Crossing
- C. Signalized Mid-Block Crossing (Note: An intersection in which the pedestrian crossing and the major street are signalized but the minor street remains stop-controlled is also considered a Signalized Mid-Block Crossing. There is one Crossing Treatment specific to this type of crossing.)
- D. Uncontrolled Crossing (Note: At a two-way stop-controlled intersection, the major street crossings are considered Uncontrolled Crossings.)

Recommended Crossing Treatments

The purpose of these standards is to enhance the safety of children walking to and from school. The following design principles are critical to achieving this goal:

- Reduce the number of conflicts between different modes of transportation (walking, bicycling, driving, etc.)
- Reduce vehicle speeds at conflict points
- Increase the predictability of pedestrian and motorist movements
- Increase visibility between pedestrians and motorists
- Increase the likelihood of motorist yielding to pedestrians

Each of the recommended crossing treatments has been identified to address one or more of these principles. The recommended crossing treatments by crossing type are given below. Details on each of the crossing treatments are provided in the “Crossing Treatment Details” section of this report. Each crossing treatment has an identifying number (e.g. “[1.a]”) that can be used for easy reference to the “Crossing Treatment Details” portion of the document.

A - Signalized Intersection Crossing

A signalized intersection crossing is a pedestrian crossing that occurs at a signalized intersection where the primary purpose for the signalization is not the pedestrian crossing. The following crossing treatments apply at signalized intersection crossings. The Standard Crossing Treatment is required at all crossings and the remaining treatments are listed for consideration. An example signalized intersection concept is shown in Figure 4. More information on the context of a given treatment can be found in the “Crossing Treatment Details” section of the document.

CROSSING TREATMENT	DESIGN GUIDANCE
Standard Crossing Treatment – Tier 1	
High visibility marked crosswalk [1.a]	Required, see details
School Crossing Assembly [1.b] – Within School Zone	1 – Advance traffic control signs required when sight distance is limited
Accessible curb ramps [2.a]	
Stop line [1.g]	
Parking restrictions [1.h]	
Pedestrian countdown signals [3.a]	
Evaluate pedestrian clearance time [3.b]	
Advance traffic control signs [3.h] ¹	
Treatments for Consideration – Tier 2	
Leading Pedestrian Interval (LPI) [3.f]	Where there are permitted right turns (or left turns at T-intersections or from one-way streets) across the school crossing and the turning vehicle volume is greater than 50 vehicles per hour during one hour overlapping with school arrival or dismissal
Right-Turn-on-Red (RTOR) restrictions [3.g]	Required in combination with LPI
Left-turn phasing [3.e]	Where there are two opposing vehicle lanes, may be implemented by time of day
Other Treatments– Tier 3	
Hardened centerline [2.b]	Where left turns are permitted across a crosswalk
Curb Extensions [2.c]	Where there is an on-street parking lane or an otherwise wide street
Turning Vehicles Yield to Peds Sign [3.c]	Where turning movements (left-turn or right-turn) are permitted across a crosswalk
Pedestrian recall [3.d]	With the coordinated signal phase
Left-turn phasing [3.e]	Where there is one opposing vehicle lane, may be implemented by time of day

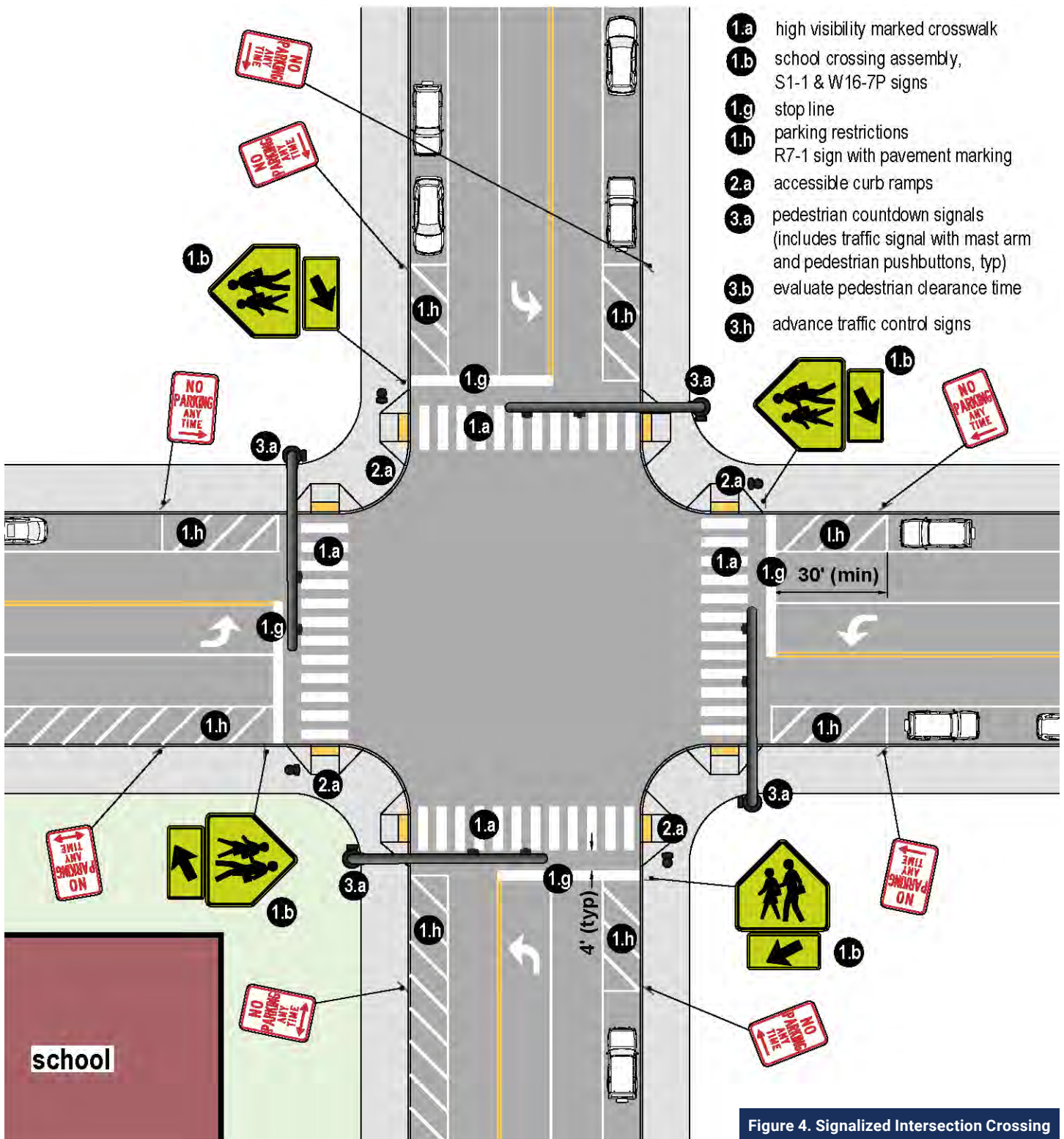


Figure 4. Signalized Intersection Crossing

B - Stop-Controlled Approach Crossing

A stop-controlled approach crossing is a pedestrian crossing across any leg of an all-way stop-controlled intersection or across the stop-controlled approach of a two-way stop-controlled intersection. The following crossing treatments apply at stop-controlled approach crossings. The Standard Crossing Treatment is required at all crossings and the remaining treatments are listed for consideration. An example stop-controlled intersection concept is shown in Figure 5. More information on the context of a given treatment can be found in the “Crossing Treatment Details” portion of the document.

CROSSING TREATMENT	DESIGN GUIDANCE
Standard Crossing Treatment – Tier 1	
High visibility marked crosswalk [1.a] Accessible curb ramps [2.a] Stop line [1.g] Parking restrictions [1.h]	Required for all crosswalks in the School Zone or crosswalks on the Primary Walking Route when the bi-directional vehicular volume across the crossing location exceed 1,500 vehicles per day or 150 vehicles per hour during one hour overlapping with school arrival or dismissal.
Treatments for Consideration – Tier 2	
High visibility marked crosswalk [1.a] Accessible curb ramps [2.a] Stop line [1.g] Parking restrictions [1.h]	Treatments may be considered on for all remaining crosswalks on the Primary Walking Route that do not meet the volume thresholds noted above, or on residential streets where volumes are typically not collected.
Other Treatments– Tier 3	
Hardened centerline [2.b]	Where left turns are permitted across a crosswalk
Curb Extensions [2.c]	Where there is an on-street parking lane or an otherwise wide street
Pedestrian Refuge Island [2.d]	Where there is space available to provide a refuge, and multi-lane streets with over 9,000 vehicles per day
Raised Crosswalk [2.e]	On two or 3-lane streets with speed limits of 30 mph or less and less than 9,000 vehicles per day

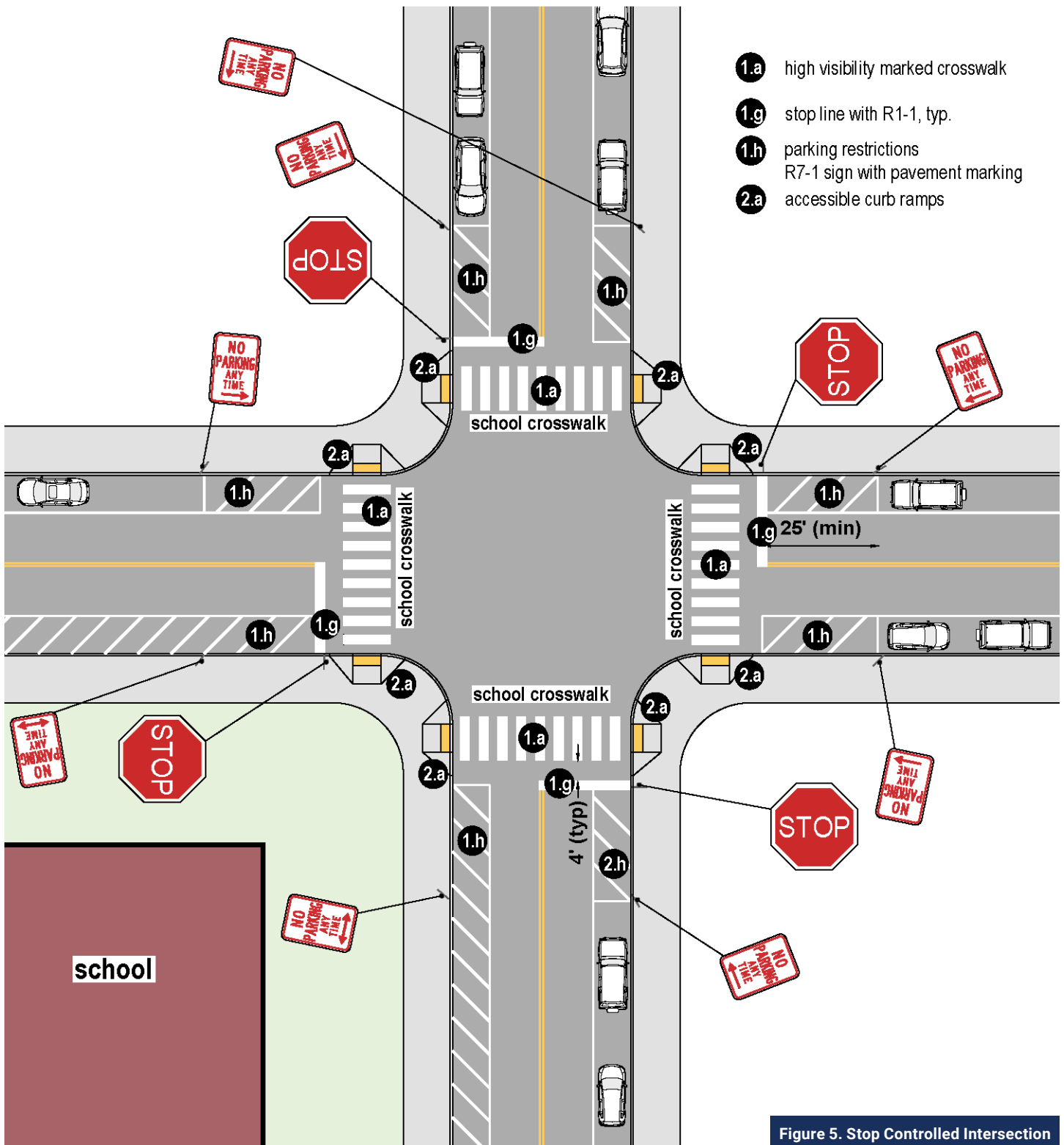


Figure 5. Stop Controlled Intersection

C - Signalized Mid-Block Crossing

A signalized mid-block crossing is a pedestrian crossing at a pedestrian actuated traffic signal. The pedestrian crossing and the major street are signal controlled. This type of crossing may occur at an intersection in which the minor street is stop-controlled and an extremely low potential for conflict exists for the minor street (refer to MUTCD Sections 2B.07 and 4C.05). In order to install or upgrade a Signalized Mid-Block Crossing Signal, the need for the traffic control signal must be evaluated through the MUTCD Signal Warrant Analysis, specifically Signal Warrant 5, School Crossing. If a signal is not warranted, adjust the Primary Walking Route to cross at existing signalized intersection or warranted signalized mid-block crossing if within 300 feet of desired crossing location. Otherwise, the location should be reviewed for additional treatments to create an acceptable crossing at the location. The Standard Crossing Treatment is required at all crossings and the remaining treatments are listed for consideration. An example signalized mid-block crossing concept is shown in Figure 6. More information on the context of a given treatment can be found in the “Crossing Treatment Details” portion of the document.

CROSSING TREATMENT	DESIGN GUIDANCE
Standard Crossing Treatment – Tier 1	
Need for Traffic Control Signal [3.j] High visibility marked crosswalk [1.a] School Crossing Assembly [1.b] – Within School Zone Accessible curb ramps [2.a] Stop line [1.g] Parking restrictions [1.h] Pedestrian countdown signals [3.a] Evaluate pedestrian clearance time [3.b] Turn restrictions [3.i] ¹ Advance traffic control signs [3.h] ²	Required 1 – Turn restrictions required if the crossing occurs at an intersection in which the minor street is stop-controlled 2 – Advance traffic control signs required when sight distance is limited
Treatments for Consideration – Tier 2	
N/A	
Other Treatments – Tier 3	
Curb Extensions [2.c]	Where there is an on-street parking lane or an otherwise wide street

- 1.a high visibility marked crosswalk
- 1.b school crossing assembly, S1-1 & W16-7P signs
- 1.g stop line
- 1.h parking restrictions R7-1 sign with pavement marking
- 2.a accessible curb ramps
- 3.a pedestrian countdown signals (includes traffic signal with mast arm and pedestrian pushbuttons, typ)
- 3.b evaluate pedestrian clearance time
- 3.j evaluate need for traffic control signal

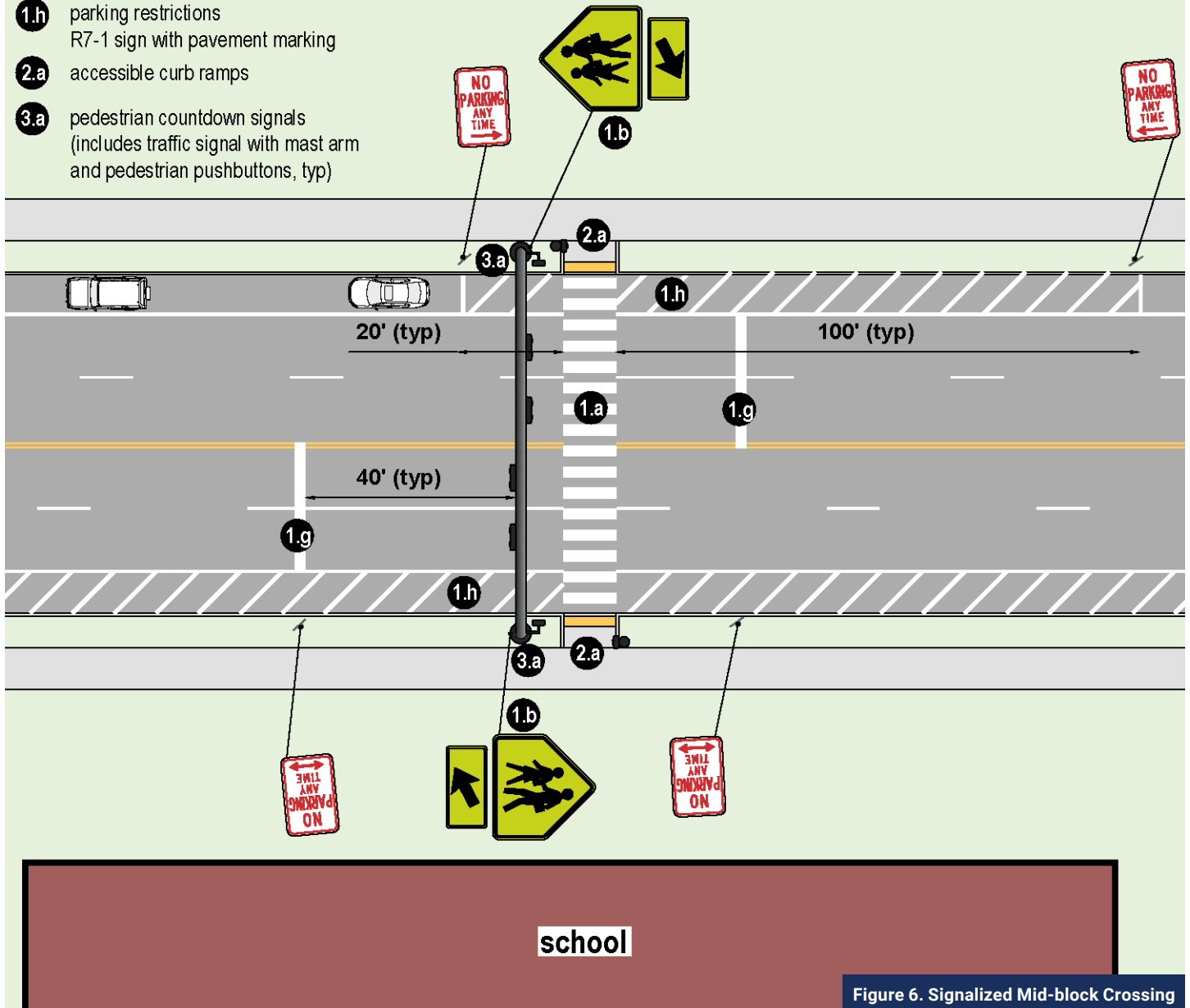


Figure 6. Signalized Mid-block Crossing

D - Uncontrolled Crossing

An uncontrolled crossing is a pedestrian crossing at a mid-block location in which the street is not controlled by a traffic signal or stop sign, or a pedestrian crossing across the uncontrolled approach of a two-way stop-controlled intersection. The following crossing treatments apply at uncontrolled crossings. The Standard Crossing Treatment is required at all crossings and the remaining treatments are listed for consideration. An example uncontrolled crossing concept is shown in Figure 7. More information on the context of a given treatment can be found in the “Crossing Treatment Details” portion of the document.

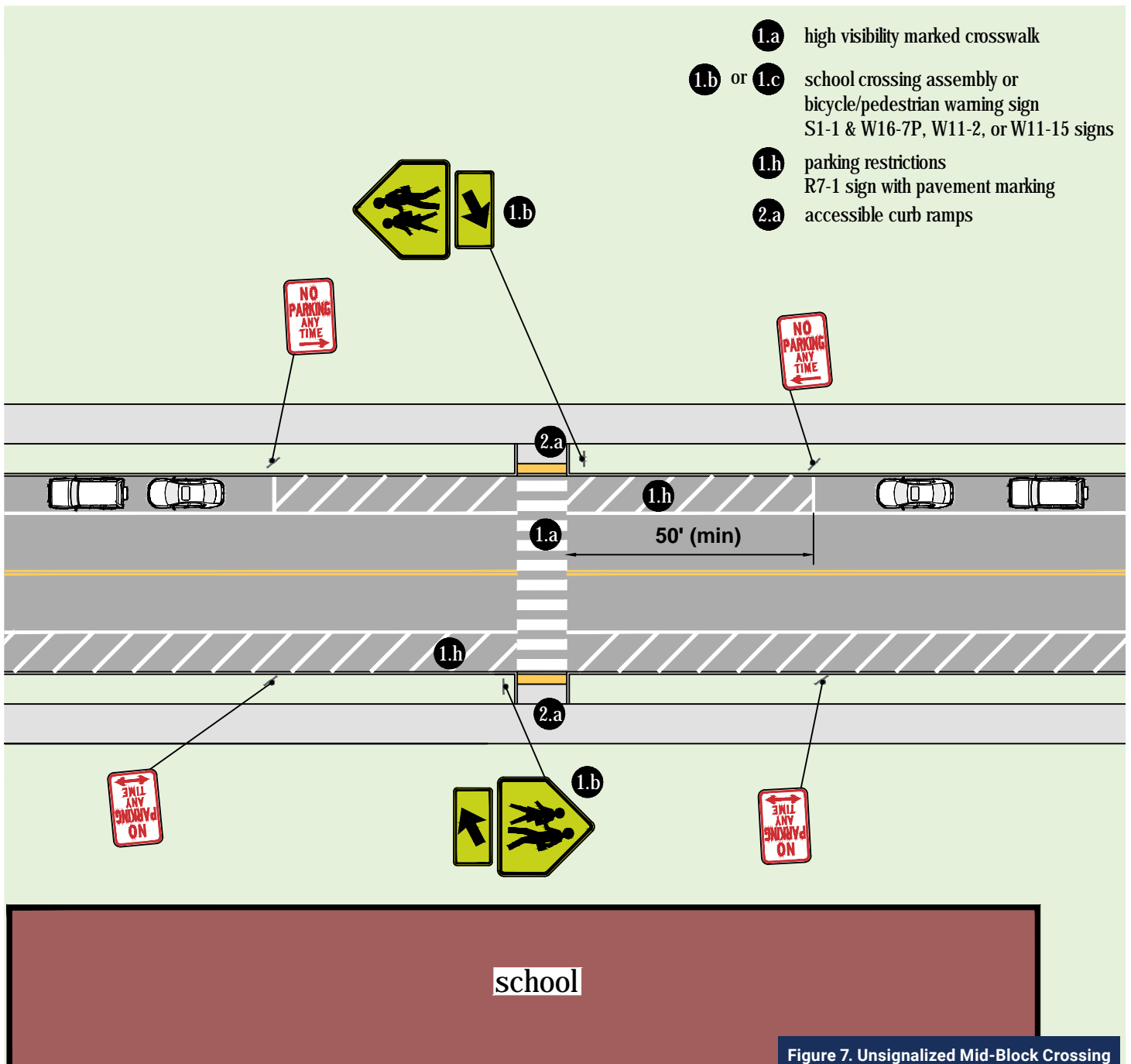


Figure 7. Unsignalized Mid-Block Crossing

D - Uncontrolled Crossing

The **Standard Crossing Treatment** at an Uncontrolled Crossing includes:

- High visibility marked crosswalk [1.a]
- School Crossing Assembly [1.b] / Pedestrian Warning Sign [1.c]¹
- Accessible curb ramps [2.a]
- Parking restrictions [1.h]

Table 1: Crossing Treatments - Uncontrolled Crossing, 24-hour vehicle volume < 9,000²

Number of Lanes	Posted Speed Limit ³			
	≤25 mph	30 mph	35 mph	≥40 mph ⁴
2 lanes	Standard Crossing Treatment	Standard Crossing Treatment	Standard Crossing Treatment	Need for Traffic Control Signal [3.j]⁵
	In-Street Pedestrian Crossing Signs [1.d]	In-Street Pedestrian Crossing Signs [1.d]	Curb Extensions [2.c]	
	Curb Extensions [2.c]	Curb Extensions [2.c]	Pedestrian Refuge Island [2.d]	
	Pedestrian Refuge Island [2.d]	Pedestrian Refuge Island [2.d]		
	Raised Crosswalk [2.e]	Raised Crosswalk [2.e]		
3 lanes	Standard Crossing Treatment	Standard Crossing Treatment	Standard Crossing Treatment	Need for Traffic Control Signal [3.j]⁵
	Advance Yield Marking and Sign [1.e]	Advance Yield Marking and Sign [1.e]	Advance Yield Marking and Sign [1.e]	
	In-Street Pedestrian Crossing Signs [1.d]	In-Street Pedestrian Crossing Signs [1.d]	Pedestrian Refuge Island [2.d]	
	RRFB [1.f]	RRFB [1.f]	Need for Traffic Control Signal [3.j] ⁵	
	Curb Extensions [2.c]	Curb Extensions [2.c]	RRFB [1.f]	
	Pedestrian Refuge Island [2.d]	Pedestrian Refuge Island [2.d]	Curb Extensions [2.c]	
4+ lanes	Standard Crossing Treatment	Standard Crossing Treatment	Need for Traffic Control Signal [3.j]⁵	Need for Traffic Control Signal [3.j]⁵
	Advance Yield Marking and Sign [1.e]	Advance Yield Marking and Sign [1.e]	Road Diet [2.f]	Road Diet [2.f]
	Road Diet [2.f]	Pedestrian Refuge Island [2.d]		
	RRFB [1.f]	Road Diet [2.f]		
	Curb Extensions [2.c]	RRFB [1.f]		
	Pedestrian Refuge Island [2.d]	Curb Extensions [2.c]		

KEY: Standard⁶ – Tier 1, Treatments for Consideration – Tier 2, Other Treatments – Tier 3

- 1 Within School Zone use School Crossing Assembly. Outside School Zone use Pedestrian Warning Sign (W11-2). Use Bicycle/Pedestrian Warning Sign (W11-15) at all uncontrolled trail crossings.
- 2 There is no lower volume limit for use of this table for uncontrolled crossings in the School Zone. On the Primary Walking Route, when the 24-hour vehicle volume across the crossing location is less than 1,500 vehicles per day, or if the crossing occurs on a residential street where volumes are typically not collected, the Standard Crossing Treatment may be considered as Treatments for Consideration, rather than Required.
- 3 Crossing Treatment selection should be based on standard Posted Speed Limit (not Reduced-Speed Zone Speed Limit).
- 4 Refer to Section Two: Reduced-Speed Zone Standards for recommendations on speed reduction measures within the school zone.
- 5 If signal is warranted, see Signalized Mid-Block Crossing. If signal is not warranted, adjust Primary Walking Route to cross at existing Signalized Intersection Crossing or Signalized Mid-Block Crossing if within 300 feet of desired crossing location, otherwise review additional treatments to create an acceptable crossing.
- 6 If required crossing treatment is not feasible, adjust Primary Walking Route to within 300 feet of the desired crossing location and review crossing treatments.

D - Uncontrolled Crossing (Cont.)

The **Standard Crossing Treatment** at an Uncontrolled Crossing includes:

- High visibility marked crosswalk [1.a]
- School Crossing Assembly [1.b] / Pedestrian Warning Sign [1.c]¹
- Accessible curb ramps [2.a]
- Parking restrictions [1.h]

Table 2: Crossing Treatments - Uncontrolled Crossing, 24-hour vehicle volume 9,000–15,000

Number of Lanes	Posted Speed Limit ²			
	≤25 mph	30 mph	35 mph	≥40 mph ³
2 lanes	Standard Crossing Treatment	Standard Crossing Treatment	Standard Crossing Treatment	Need for Traffic Control Signal [3.j]⁴
	In-Street Pedestrian Crossing Signs [1.d]	In-Street Pedestrian Crossing Signs [1.d]	Curb Extensions [2.c]	
	Curb Extensions [2.c] Pedestrian Refuge Island [2.d]	Curb Extensions [2.c] Pedestrian Refuge Island [2.d]	Pedestrian Refuge Island [2.d]	
3 lanes	Standard Crossing Treatment	Standard Crossing Treatment	Standard Crossing Treatment	Need for Traffic Control Signal [3.j]⁴
	Pedestrian Refuge Island [2.d]	Curb Extensions [2.c] or Pedestrian Refuge Island [2.d]	Pedestrian Refuge Island [2.d]	
	Advance Yield Marking and Sign [1.e]	Advance Yield Marking and Sign [1.e]	RRFB [1.f] or	
	In-Street Pedestrian Crossing Signs [1.d]	In-Street Pedestrian Crossing Signs [1.d]	Need for Traffic Control Signal [3.j]⁴	
	RRFB [1.f] Curb Extensions [2.c]	RRFB [1.f]		
4 lanes	Standard Crossing Treatment	Need for Traffic Control Signal [3.j]⁴	Need for Traffic Control Signal [3.j]⁴	Need for Traffic Control Signal [3.j]⁴
	Advance Yield Marking and Sign [1.e]	Road Diet [2.f]	Road Diet [2.f]	Road Diet [2.f]
	Pedestrian Refuge Island [2.d]			
	RRFB [1.f]			
	Curb Extensions [2.c] Road Diet [2.f]			

KEY: Standard⁵ – Tier 1, Treatments for Consideration – Tier 2, Other Treatments – Tier 3

1 Within School Zone use School Crossing Assembly. Outside School Zone use Pedestrian Warning Sign (W11-2). Use Bicycle/Pedestrian Warning Sign (W11-15) at all uncontrolled trail crossings.
 2 Crossing Treatment selection should be based on standard Posted Speed Limit (not Reduced-Speed Zone Speed Limit).
 3 Refer to Section Two: Reduced-Speed Zone Standards for recommendations on speed reduction measures within the school zone.
 4 If signal is warranted, see Signalized Mid-Block Crossing. If signal is not warranted, adjust Primary Walking Route to cross at existing Signalized Intersection Crossing or Signalized Mid-Block Crossing if within 300 feet of desired crossing location, otherwise review additional treatments to create an acceptable crossing.
 5 If required crossing treatment is not feasible, adjust Primary Walking Route to within 300 feet of the desired crossing location and review crossing treatments.

D - Uncontrolled Crossing (Cont.)

The **Standard Crossing Treatment** at an Uncontrolled Crossing includes:

- High visibility marked crosswalk [1.a]
- School Crossing Assembly [1.b] / Pedestrian Warning Sign [1.c]¹
- Accessible curb ramps [2.a]
- Parking restrictions [1.h]

Table 3: Crossing Treatments - Uncontrolled Crossing, 24-hour vehicle volume > 15,000

Number of Lanes	Posted Speed Limit ²			
	≤25 mph	30 mph	35 mph	≥40 mph ³
2 lanes	Standard Crossing Treatment	Standard Crossing Treatment	Standard Crossing Treatment	Need for Traffic Control Signal [3.j]⁴
	In-Street Pedestrian Crossing Signs [1.d]	In-Street Pedestrian Crossing Signs [1.d]	RRFB [1.f]	
	RRFB [1.f]	RRFB [1.f]	Curb Extensions [2.c]	
	Curb Extensions [2.c]	Curb Extensions [2.c]	Pedestrian Refuge Island [2.d]	
	Pedestrian Refuge Island [2.d]	Pedestrian Refuge Island [2.d]		
3 lanes	Standard Crossing Treatment	Standard Crossing Treatment	Need for Traffic Control Signal [3.j]⁴	Need for Traffic Control Signal [3.j]⁴
	Advance Yield Marking and Sign [1.e]	Advance Yield Marking and Sign [1.e]		
	Pedestrian Refuge Island [2.d]	Pedestrian Refuge Island [2.d]		
	In-Street Pedestrian Crossing Signs [1.d]	In-Street Pedestrian Crossing Signs [1.d]		
	RRFB [1.f]	RRFB [1.f]		
4 lanes	Need for Traffic Control Signal [3.j]⁴	Need for Traffic Control Signal [3.j]⁴	Need for Traffic Control Signal [3.j]⁴	Need for Traffic Control Signal [3.j]⁴
	Road Diet [2.f]	Road Diet [2.f]	Road Diet [2.f]	Road Diet [2.f]

KEY: Standard⁵ – Tier 1, Treatments for Consideration – Tier 2, Other Treatments – Tier 3

1 Within School Zone use School Crossing Assembly. Outside School Zone use Pedestrian Warning Sign (W11-2). Use Bicycle/Pedestrian Warning Sign (W11-15) at all uncontrolled trail crossings.
 2 Crossing Treatment selection should be based on standard Posted Speed Limit (not Reduced-Speed Zone Speed Limit).
 3 Refer to Section Two: Reduced-Speed Zone Standards for recommendations on speed reduction measures within the school zone.
 4 If signal is warranted, see Signalized Mid-Block Crossing. If signal is not warranted, adjust Primary Walking Route to cross at existing Signalized Intersection Crossing or Signalized Mid-Block Crossing if within 300 feet of desired crossing location, otherwise review additional treatments to create an acceptable crossing.
 5 If required crossing treatment is not feasible, adjust Primary Walking Route to within 300 feet of the desired crossing location and review crossing treatments.

Section 4:

CROSSING TREATMENT DETAILS

Details of the individual crossing treatments including the purpose, types of crossings, context, and application are described in the section below.

Treatment Categories



Potential crossing treatments have been grouped into the following categories:

1. Signing and Pavement Marking Treatments
2. Geometric Treatments
3. Traffic Signal Treatments

Note: Figures shown on the crossing treatment detail sheets are meant to portray the single treatment being described. All elements in the figures may not be in line with these standards.

1. Signing and Pavement Marking Treatments



Figure 8. High visibility continental marked crosswalk (image source: City of Lincoln)

1.A. HIGH VISIBILITY MARKED CROSSWALK

PURPOSE

Crosswalk markings provide guidance to pedestrians, delineate paths at intersections or mid-block locations, and alert street users of pedestrian crossing points. Legal pedestrian crossings exist at every intersection where sidewalks are present, whether marked or unmarked. Crosswalk markings legally establish the crosswalk at non-intersection locations.

High-visibility continental crosswalk markings improve visibility compared to transverse line markings. High-visibility crosswalk markings reduce pedestrian-vehicle collisions, improve in the percentage of motorists who yield to pedestrians, and increase the yielding or stopping distance prior to the crosswalk at intersections with high-visibility pavement markings compared to standard pavement markings.

Types of Crossings

- Signalized Intersection Crossing
- Stop-Controlled Approach Crossing
- Signalized Mid-Block Crossing
- Uncontrolled Crossing

Context

All crosswalks along the primary walking route at fully signalized and signalized mid-block crossings should have marked crosswalks.

Crosswalks along the primary walking route at stop-controlled approach crossings or uncontrolled crossings should have a marked crossing where the bi-directional vehicular volume across the crossing location exceed 1,500 vehicles per day or 150 vehicles per hour during one hour overlapping with school arrival or dismissal. At locations where the volumes are lower than this threshold, marked crosswalks may be considered.

At uncontrolled crossings with vehicle speeds above 30 mph, three or more travel lanes, or a 24-hour vehicle volume above 9,000 a marked crosswalk should be supplemented with additional treatments.

Application

Crosswalks should be marked with high visibility continental style pavement markings.



Figure 9. School Crossing Assembly (image source: Toole Design)

1.B. SCHOOL CROSSING ASSEMBLY

PURPOSE

The School Crossing sign assembly indicates the location of a school crossing and alerts street users that they are approaching a school crosswalk, where additional care is needed.

Types of Crossings

- Signalized Intersection Crossing
- Signalized Mid-Block Crossing
- Uncontrolled Crossing

Context

The School Crossing assembly should be installed at all marked crosswalks within the school zone, except on approaches controlled by a STOP or YIELD sign, or at uncontrolled crossings with shared-use paths or trails that occur in the school zone (see section 1.c).

Application

At signalized mid-block and uncontrolled crossings, the School Crossing Assembly should be installed at the school crossing or as close to it as possible consisting of a School (S1-1) sign supplemented with a diagonal downward pointing arrow (W16-7P) plaque to show the location of the crossing. At signalized intersection crossings, the School Crossing Assembly should be installed at the school crossing or as close to it as possible consisting of a School (S1-1) sign supplemented with a diagonal downward pointing arrow (W16-7P) plaque to show the location of the crossing. If the School Crossing Assembly at the crossing would result in visual clutter, or otherwise cannot be located properly, the School Advance Crossing Assembly consisting of a School (S1-1) sign supplemented with an AHEAD sign (W-16-9P) should be installed up to 100 feet in advance of the crosswalk.



Figure 10. Pedestrian Warning Sign (image source: City of Lincoln)

1.C. PEDESTRIAN WARNING SIGN

PURPOSE

The Pedestrian Warning sign alerts street users of locations where pedestrian crossings may not be expected by motorists.

Types of Crossings

- Uncontrolled Crossing

Context

The Pedestrian Warning sign should be installed at all uncontrolled crosswalks along the school walking route, outside of the school zone where there are greater than 1,500 vehicles per day. The combined Bicycle/Pedestrian Warning sign should be used at locations where bicyclists and pedestrians might be crossing the street, such as a shared-use path or trail crossing. If a shared-use path or trail crossing occurs inside the school zone, the Bicycle/Pedestrian Warning sign should be used instead of the School Crossing assembly.

Application

The Pedestrian Warning sign or Bicycle/Pedestrian Warning sign should be installed at the crossing or as close to it as possible consisting of a pedestrian (W11-2) sign or bicycle/pedestrian (W11-15) sign supplemented with a diagonal downward pointing arrow (W16-7P) plaque to show the location of the crossing.



Figure 11. In-Street Pedestrian Crossing sign (image source: City of Lincoln)

1.D. IN-STREET PEDESTRIAN CROSSING SIGNS

PURPOSE

In-Street Pedestrian Crossing signs remind street users of laws regarding right-of-way at an uncontrolled pedestrian crosswalk. In-Street Pedestrian Crossing signs increase driver yielding when placed at marked crosswalks.

Types of Crossings

- Uncontrolled Crossing

Context

In-Street Pedestrian Crossing signs should be considered for installation at uncontrolled crossings on 2-lane or 3-lane streets with speed limits of 30 mph or less within the school zone. It may be installed along the primary walking route outside of the school zone where there is adequate refuge island to prevent the sign from being damaged by turning vehicles. This treatment may not be as visually prominent on higher-speed, higher-volume, and/ or multilane streets; therefore, it may be less effective (drivers may not notice the signs in time to stop in advance of the crosswalk). For such streets, more robust treatments will be needed.

Application

At uncontrolled crossings, In-Street Pedestrian Crossing signs (R1-6) should be placed in the middle of the street on the centerline, lane line, or refuge island. The signs may be used seasonally to prevent damage in winter and may be removed at night if the pedestrian activity at night is minimal.



Figure 12. Advance Yield Marking and Sign (images source: City of Lincoln, Toole Design)

1.E. ADVANCE YIELD MARKING AND SIGN

PURPOSE

An advance yield line and “Yield Here to Pedestrians” sign indicates the point where vehicles should yield and give priority to conflicting pedestrian traffic at an uncontrolled crosswalk. The advance yield marking and sign improves the visibility of pedestrians and reduces the likelihood of multiple-threat crashes. They also allow pedestrians to see if a vehicle is stopping or not stopping, allowing them to act accordingly.

Types of Crossings

- Uncontrolled Crossing

Context

Advance Yield Marking and signs should be considered for installation at uncontrolled crossings on the school walking route that cross street with three or more travel lanes.

Application

Advance Yield Marking and signs should be considered for installation at uncontrolled crossings on the school walking route that cross street with three or more travel lanes.



Figure 13. Rectangular Rapid-Flashing Beacon (image source: Toole Design)

1.F. RECTANGULAR RAPID-FLASHING BEACON (RRFB)

PURPOSE

The RRFB is a device used in combination with the School Crossing Assembly or Pedestrian Warning sign to provide a high-visibility strobe-like warning to drivers when pedestrians use a crosswalk. Research has indicated that RRFBs increase motorist yielding for people trying to cross the street when they activate a rectangular rapid flashing beacon.

Types of Crossings

- Uncontrolled Crossing

Context

RRFBs should be considered for installation on streets with posted speed limits of 35 mph or less. RRFBs should be considered for installation at uncontrolled crossings on the school walking route or in the school zone that cross streets with posted speed limits of 35 mph or less and three or more travel lanes, or two travel lanes with greater than 15,000 ADT.

Application

The RRFB is currently not included in the MUTCD but the FHWA has issued interim approval for the optional use of the RRFB (IA-21). IA-21 provides additional information about the conditions of use, including dimensions, placement, accessibility features, and flashing requirements. When an RRFB is installed, Advance Yield Marking and Signs [1.e] should also be installed.



Figure 14. Stop line (images source: City of Lincoln)

1.G. STOP LINE

PURPOSE

A stop line indicates the point behind which vehicles are required to stop in compliance with a traffic control signal or stop sign. Stop lines discourage drivers from stopping too close to the crosswalk at an intersection.

Types of Crossings

- Signalized Intersection Crossing
- Stop-Controlled Approach Crossing
- Signalized Mid-Block Crossing

Context

Stop lines should be installed at locations where a driver is required to stop in advance of a crossing on the school walking route such as a traffic signal or stop sign.

Application

Stop lines should be placed a minimum of 4 feet in advance of the nearest crosswalk line at fully signalized or stop-controlled intersections. At signalized mid-block locations stop lines should be placed at least 40 feet in advance of the nearest signal indication.



Figure 15. Stop line (images source: City of Lincoln)

1.H. PARKING RESTRICTIONS

PURPOSE

When vehicles park too close to a pedestrian crossing they can limit sight distance between oncoming vehicles and pedestrians. Parking restrictions near crosswalks ensure that there is adequate sight distance for motorists as they approach a crossing and ample sight distance for pedestrians attempting to cross.

Types of Crossings

- Signalized Intersection Crossing
- Signalized Mid-Block Crossing
- Stop-Controlled Approach Crossing
- Uncontrolled Crossing

Context

All school crossings along the primary walking route should have parking restrictions in place in advance of the crossing. The distance of the restriction should be based on the 85th percentile speed of the streets or 5 mph greater than the posted speed limit.

In accordance with the Lincoln Municipal Code Section 10.32.350, parking is restricted along the curb adjacent to any school grounds.

Application

Per the MUTCD and Uniform Vehicle Code, the minimum setback for parking restrictions shall be 30 feet from a crosswalk on the approach to a signalized intersection. Parking should be restricted for at least 100 feet in advance and 20 feet beyond a signalized mid-block crossing. Parking should be restricted 25 feet from a stop-controlled approach crossing. To improve sight distance, particularly for children, at uncontrolled crossings the minimum setback for parking restrictions should be at least 50 feet where speeds are 25 mph or less, 75 feet between 26 mph and 35 mph, and 100 feet for speeds above 35 mph. Parking should be restricted in areas between an advance yield marking and the crosswalk.

No Parking signs should be installed to convey the parking restrictions. If motorists are not complying with the parking restrictions, pavement marking and vertical delineators should be installed, and combined with enforcement by the Lincoln Police Department, to enforce the restriction.

2. Geometric Treatments



Figure 16. Accessible curb ramps (image source: Toole Design)

2.A. ACCESSIBLE CURB RAMPS

PURPOSE

Curb ramps (wheelchair ramps) provide access between the sidewalk and street for people using wheelchairs, strollers, walkers, hand carts, bicycles, and for pedestrians who have trouble stepping up and down high curbs.

Types of Crossings

- Signalized Intersection Crossing
- Stop-Controlled Approach Crossing
- Signalized Mid-Block Crossing
- Uncontrolled Crossing

Context

Curb ramps should be installed at all intersections and midblock locations where pedestrian crossings exist, as mandated by Federal legislation.

Application

Curb ramps should be installed in accordance with Lincoln's ADA Transition Plan and Federal regulations. Consider wider curb ramps within the school zone to accommodate larger groups of pedestrians on foot and bicycle.



Figure 17. Hardened centerline (image source: NYCDOT¹)

2.B. HARDENED CENTERLINE (RUBBER CURBS WITH DELINEATORS)

PURPOSE

Hardened centerlines use rubber curb with delineators installed on the centerline of the receiving lane to prevent left-turning motorists from crossing the centerline while making a turn. Hardened centerlines tighten the turning radius reducing the speed of left-turning vehicles, increase visibility of pedestrians in the crosswalk, and reduce the size of the conflict area between pedestrians and motorists.

Types of Crossings

- Signalized Intersection Crossing
- Stop-Controlled Approach Crossing

Context

Hardened centerlines should be considered for installation at signalized intersections where left-turns are permitted across a crosswalk. Hardened centerlines should also be considered for installation on the stop-controlled approaches at two-way stop-controlled intersections to address left-turns from the uncontrolled street.

Application

The hardened centerline treatment consists of multiple pieces of rubber or plastic curb and bollards installed on the centerline starting from the crosswalk.

1 <https://www1.nyc.gov/html/dot/html/about/leftturnstudy.shtml>



Figure 18. Curb extensions (images source: City of Lincoln)

2.C. CURB EXTENSIONS

PURPOSE

Curb extensions, also referred to as bulbouts, extend the sidewalk into the street or parking lane, narrowing the effective street width and decreasing the crossing distance. They increase the visibility of pedestrians at crossings and prevent vehicles from parking near the crosswalks. Curb extensions may also provide more room for pedestrians to gather at the corner before crossing. They tighten the turning radius reducing the speed of turning vehicles and encourage motorists to travel more slowly along the street due to the narrowing of the street.

Types of Crossings

- Signalized Intersection Crossing
- Stop-Controlled Approach Crossing
- Signalized Mid-Block Crossing
- Uncontrolled Crossing

Context

Curb extensions should be considered for crossings on streets where there is an on-street parking lane, or other feature that permits space for the curb extension installation.

Application

Curb extensions shall not extend into travel lanes and should not extend across bicycle lanes. Curb extension design needs to consider larger vehicles such as school buses from encroaching onto the curb extension. Curb extensions may be constructed from lower cost materials such as bollards, temporary curb, planters, or pavement markings. A low-cost solution for curb extensions can be designed without impacts to drainage or curb ramps. The existing drainage along the curb can be maintained by creating chase drains or drainage channels with a metal cover along the existing drainage lines on the curbs.



Figure 19. Pedestrian Refuge Island (image source: City of Lincoln)

2.D. PEDESTRIAN REFUGE ISLAND

PURPOSE

Pedestrian refuge islands are raised islands located in the median that allow pedestrians to navigate one direction of traffic and provide a location to safely wait for a gap in the opposite direction of traffic. Pedestrian refuge islands simplify crossings by allowing pedestrians to cross just one direction of travel at a time. The refuge islands can be designed in a way requiring people to face oncoming traffic which may increase visibility and eye contact.

Types of Crossings

- Stop-Controlled Approach Crossing
- Uncontrolled Crossing

Context

Pedestrian refuge islands should be considered at all crossings along the school walking route where there is space available to provide a refuge (i.e. presence of two-way left-turn lane, left-turn lane on the opposite approach, wide-median, etc.). Strong consideration should be given to multi-lane streets with traffic volumes over 9,000 vehicles per day.

Application

Pedestrian refuge islands shall be at least 6 feet in width to meet the requirements of the Americans with Disabilities Act and should be 8 feet wide for pedestrian comfort. The refuge island can be designed with a Z-crossing requiring people to face oncoming traffic which may increase visibility and eye contact.



Figure 20. Raised crosswalk (images source: City of Lincoln)

2.E. RAISED CROSSWALK

PURPOSE

A raised crosswalk is a higher section of pavement with a marked crosswalk. By incorporating vertical deflection into the vehicle path, this treatment results in reduced speeds. In addition to reducing vehicle speeds, raised crosswalks also increase visibility between pedestrians, bicyclists, and drivers at the crosswalk.

Types of Crossings

- Stop-Controlled Approach Crossing
- Uncontrolled Crossing

Context

Raised crosswalks should be considered on 2-lane or 3-lane streets with speed limits of 30 mph or less and 24-hour vehicle volume below 9,000.

Application

Raised crosswalks should be at the same height as the sidewalk. The crosswalk table is typically at least 10 feet wide and designed to allow the front and rear wheels of a passenger vehicle to be on top of the table at the same time. A low-cost solution for raised crosswalks can be designed without impacts to drainage or curb ramps. Existing drainage can be maintained by creating a chase drain or drainage channel with metal cover along the existing curb.



Figure 21. Road Diet (image source: City of Lincoln)

2.F. ROAD DIET

PURPOSE

A typical road diet involves converting an existing four-lane undivided street into three-lanes with one through lane in each direction and a center two-way left-turn lane. The three-lane configuration also makes the street better suited for a pedestrian refuge island. Road diets result in a narrower travel way that makes the street easier to cross for pedestrians. The configuration with one through lane in each direction reduces vehicle speed differentials and weaving through traffic.

Types of Crossing

- Uncontrolled Crossing

Context

A road diet should be strongly considered on any four-lane undivided street within the school zone and should be considered on any four-lane undivided street on the primary walking route. The Federal Highway Administration gives the following 24-hour vehicle volume threshold guidelines for implementing road diets on four-lane streets:

- Less than 10,000 vehicles per day: A great candidate for Road Diets in most instances. Capacity will most likely not be affected.
- 10,000-15,000 vehicles per day: 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 vehicles per day: 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 vehicles per day: 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.

Application

In some cases, a road diet can be installed simply with pavement marking modifications. In other cases, a road diet can be incorporated into overlay projects, or in conjunction with reconstruction for more drastic changes to the cross section. The remaining unused space can be used for bike lanes, buffer space, parking, etc.

3. Traffic Signal Treatments



Figure 22. Pedestrian Countdown Signal (image source: City of Lincoln)

3.A. PEDESTRIAN COUNTDOWN SIGNALS

PURPOSE

Pedestrian countdown signals provide guidance to pedestrians regarding the signal interval in which crossing is permitted and when crossing is prohibited. The countdown signal indication informs the pedestrian how much time is left in the crossing interval.

Types of Crossings

- Signalized Intersection Crossing
- Signalized Mid-Block Crossing

Context

Pedestrian countdown signals should be installed at established school crossings at any signalized location.

Application

Pedestrian countdown signals should be installed in accordance with LTU's Traffic Engineering Standards.

3.B. EVALUATE PEDESTRIAN CLEARANCE TIME

PURPOSE

The pedestrian clearance interval is intended to allow pedestrians who started crossing during the walk interval to complete their crossing, reaching to opposite curb before the conflicting perpendicular vehicle movement is released. The duration of the pedestrian clearance interval must be sufficient to allow pedestrians to reach the opposite curb, else they may be within the crosswalk whenever the conflicting vehicle movement is released.

Types of Crossings

- Signalized Intersection Crossing
- Signalized Mid-Block Crossing

Context

At school crossings, where groups of children or pedestrians who may walk slower than 3.5 feet per second are expected to use the crosswalk, the pedestrian clearance interval should be evaluated.

Application

In accordance with the MUTCD:

The pedestrian clearance time should be sufficient to allow a pedestrian crossing in the crosswalk who left the curb or shoulder at the end of the WALKING PERSON (symbolizing WALK) signal indication to travel at a walking speed of 3.5 feet per second to at least the far side of the traveled way.

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. Any additional time that is required to satisfy the conditions of this paragraph should be added to the walk interval.

3.C. TURNING VEHICLES YIELD TO PEDS SIGN

PURPOSE

Turning Vehicles Yield to Peds signs remind drivers who are making turns to yield to pedestrians. The signs increase motorist yielding behavior when turning on either red or green permissive signal indications, increase the number of vehicles stopping completely before turning right on red, and decrease the occurrences of vehicles blocking the crosswalk.

Types of Crossings

- Signalized Intersection Crossing

Context

The Turning Vehicles Yield to Peds sign should be considered for installation on the approach to any signalized intersection in which the turning movement (left-turn or right-turn) is permitted across a crosswalk on the primary walking route.

Application

The Turning Vehicles Yield to Pedestrians (R10-15) sign should be installed in the path of vision of a turning driver.

3.D. PEDESTRIAN RECALL

PURPOSE

A traffic signal programmed with pedestrian recall will provide the walk indication for pedestrians with every cycle of the signal timing plan. This mode results in improved pedestrian compliance rates because pedestrians do not have to rely on activating the push button to receive the walk indication.

Types of Crossings

- Signalized Intersection Crossing

Context

Pedestrian recall should be considered for implementation for the pedestrian signal phases that are concurrent with the coordinated vehicular signal phases at fully signalized intersections on the primary walking route.

Application

Pedestrian recall may be implemented by time of day for 1 hour before and 30 minutes after school start time, and the period 30 minutes before and 1 hour after school end time.

3.E. LEFT-TURN PHASING

PURPOSE

One of the most common conflicts at signalized intersections occurs between vehicles turning left during the permissive portion of a signal phase 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. The workload for left-turning motorists looking for a gap in traffic increases when motorists are crossing two lanes of on-coming motor vehicle traffic. Additionally, at congested intersections permissive left-turns contribute to drivers accepting smaller gaps, turning at higher speeds, and “sneaking” through the intersection during the yellow or all-red signal intervals. Implementing protected left turn phasing reduces potential conflicts with pedestrians crossing parallel to vehicle traffic.

Types of Crossings

- Signalized Intersection Crossing

Context

Protected only left-turn phasing should be strongly considered when the left-turn movement conflicting with a crosswalk on the primary walking route must cross two lanes of oncoming traffic. Protected only left-turn phasing should be considered for all left-turn movements conflicting with crosswalks on the primary walking route.

Application

Protected only left-turn phasing may be implemented by time of day for 1 hour before and 30 minutes after school start time, and the period 30 minutes before and 1 hour after school end time. When protected only left-turn phasing is not implemented, flashing yellow arrows should be used to control left-turns during the permitted portion of the cycle.

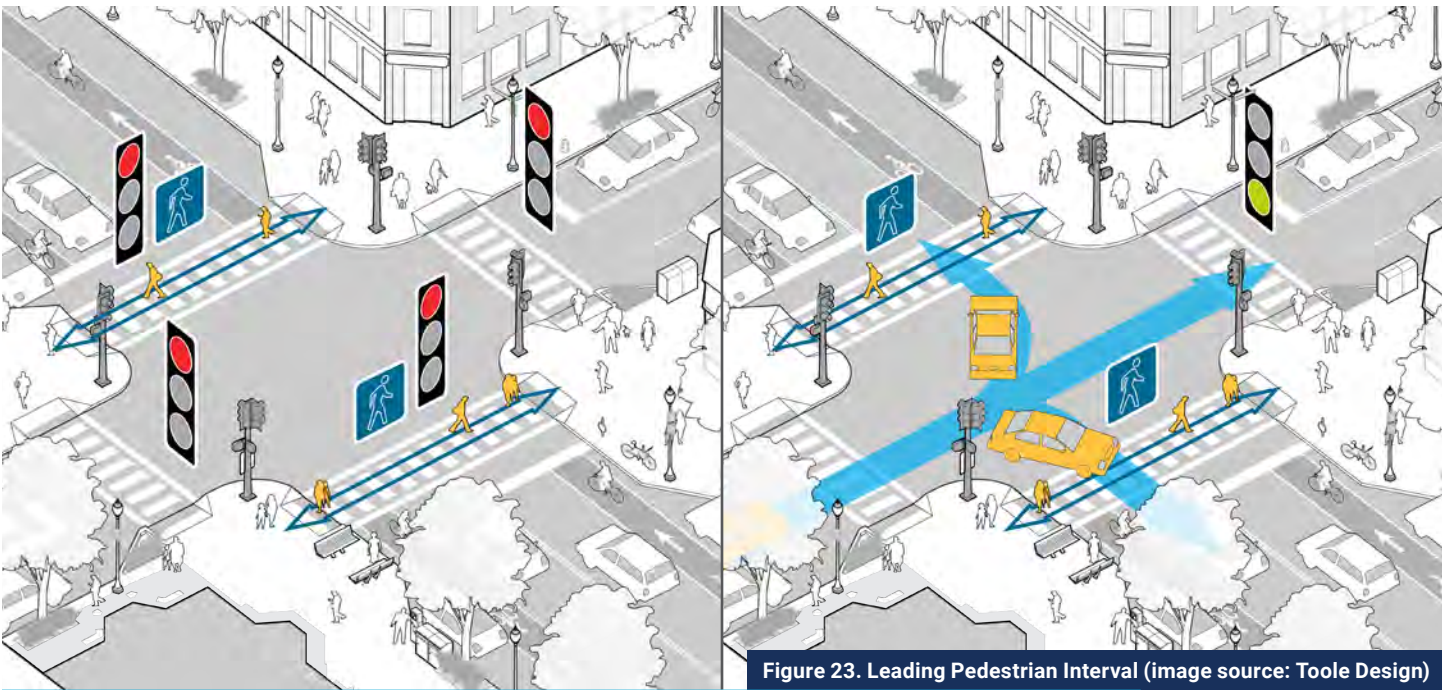


Figure 23. Leading Pedestrian Interval (image source: Toole Design)

3.F. LEADING PEDESTRIAN INTERVAL (LPI)

PURPOSE

A leading pedestrian interval (LPI) provides a crosswalk with an advance walk indication while red indications continue to be displayed for conflicting vehicle traffic. LPIs gives pedestrians an opportunity to establish themselves in the crosswalk before vehicles can turn across the crosswalk.

LPIs increase visibility of crossing pedestrians, reduce conflicts between pedestrians and vehicles, increase the likelihood of motorists yielding to pedestrians, and enhance the safety for pedestrians who may be slower to start into the intersection.

Types of Crossings

- Signalized Intersection Crossing

Context

LPIs should be considered for implementation with the pedestrian signal phase at fully signalized intersections on the primary walking route where there are permitted right or left turns across the school crossing and the turning vehicle volume is greater than 50 vehicles per hour.

Application

LPIs should be at least 3 seconds in duration and should allow a pedestrian leaving the curb to cross at least one vehicle travel lane. When determining the duration of an LPI, consideration should also be given for pedestrians leaving the push-button or level landing area, at six feet from the curb. In these cases, two (2) seconds should be added to the duration of the LPI. Turns across the crosswalk during the leading pedestrian interval should be prohibited through the use of static or blank-out “No Turn on Red” signage. If LPIs are used, the use of accessible pedestrian signals should also be considered.

The LPI may be implemented by time of day for 1 hour before and 30 minutes after school start time, and the period 30 minutes before and 1 hour after school end time.



Figure 24. Right Turn on Red (image source: City of Lincoln)

3.G. RIGHT-TURN-ON-RED (RTOR) RESTRICTIONS

PURPOSE

Right-Turn-on-Red restrictions remove the conflict between turning vehicles and pedestrians during the concurrent pedestrian signal phase.

Types of Crossings

- Signalized Intersection Crossing

Context

Right-turn-on-red restrictions shall be implemented in combination with an LPI. Right-turn-on-red restrictions should be considered when the right-turn-on-red movement would conflict with a crosswalk on the primary walking route. Right-turn-on-red restrictions may also be used on their own to address sight distance restrictions.

Application

No Turn on Red (R10-11a) signs may be static or dynamic. Dynamic, or blank-out, signs should be used to restrict right-turns during an LPI and if time of day right-turn-on-red restrictions are in place.

3.H. ADVANCE TRAFFIC CONTROL SIGNS

PURPOSE

Advance traffic control signs can alert drivers of an upcoming signal that may not be visible due to the geometry of the street.

Types of Crossings

- Signalized Intersection Crossing
- Signalized Mid-Block Crossing

Context

These signs shall be installed on an approach to a signalized intersection crossing or a signalized mid-block crossing that is not visible for a sufficient distance to permit the street user to respond to the signal. The minimum sight distance requirements based on the 85th percentile speeds are shown in the table below.

85th-Percentile Speed	Minimum Sight Distance ¹
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

Application

A Be Prepared to Stop (W3-4) sign supplemented with a When Flashing (W16-13P) sign should be installed at the minimum sight distance for signal visibility when the signal is otherwise not visible from that location. These signs shall be used in addition to a Signal Ahead (W3-3) sign and shall be placed downstream from the Signal Ahead (W3-3) sign. The flash should be timed for a sufficient duration prior to the red indication to allow for a vehicle to come to a stop upon the beginning of the flash. Advance traffic control signs combining the School Zone (S1-1) sign with a “Prepare to Stop When Flashing” sign should not be installed at a school crosswalk when there is sufficient sight distance to this signal.

1 MUTCD Section 4D.12



Figure 25. Turn restriction (images source: City of Lincoln)

3.1. TURN RESTRICTIONS

PURPOSE

Pedestrian crossings at intersections where the major street is signal controlled, and the minor street is stop controlled raise the concern that during the pedestrian phase in which the major-street traffic is stopped, drivers of the side-street will use the opportunity to turn onto the major street, in conflict with the crossing pedestrians. Turn restrictions from the side-street onto the major street during the pedestrian phase alleviate this conflict. In order to comply with Section 2B.07 of the MUTCD, an extremely low potential for conflict must exist for the minor street movement.

Types of Crossings

- Signalized Mid-Block Crossing (where the major street is signal controlled, and the minor street is stop controlled)

Context

Signalized mid-block crossings where the major street is signal controlled, and the minor street is stop controlled should include turn restrictions across the crosswalk during the pedestrian phase to remove conflicts between vehicles and pedestrians.

Application

Turn restrictions should be implemented through the use of blank out LED signs.

3.J. EVALUATE NEED FOR TRAFFIC CONTROL SIGNAL

PURPOSE

Traffic signals create gaps in the traffic flow to allow pedestrians to cross the street at locations where they would otherwise experience long delays or have difficulties crossing the street safely. Warrants in the MUTCD provide thresholds to consider in an engineering study to determine the need for a traffic signal, which are based on the number of pedestrians and vehicles crossing the intersection.

The MUTCD Traffic Signal Warrant 5, School Crossing warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic control signal.

Types of Crossings

- Signalized Mid-Block Crossing
- Uncontrolled Crossings

Context

Per MUTCD Sect. 4C.06, 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 and there are a minimum of 20 schoolchildren during the highest crossing hour.

Application

The MUTCD (Sect. 4C.06) recommends if a signal 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. However, signaling the minor-street or driveway may not be desirable due to the potential to increase motor vehicle traffic on a residential street. If it is installed at a non-intersection crossing, the MUTCD recommends that the traffic control signal be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs. Installing the pedestrian crossing 100 feet from the side streets may result in out of direction travel for pedestrians and decrease compliance. If there are concerns with motorists from the side street crossing the crosswalk or using the red light on the main street to turn across the crosswalk, turn restriction signs should be installed with the signal.

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