Safe Routes to School Briefing Sheets

School Area Traffic Control

INTRODUCTION

To achieve uniformity of traffic control in school areas, comparable traffic situations need to be treated in a consistent manner. Part 7 of the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) and the Institute of Transportation Engineers (ITE) *Traffic Control Devices Handbook* provide information on traffic control devices related to schools. The traffic tools used to manage traffic near and at schools include signs, pavement markings, beacons, and traffic signals.

SIGNS

School Sign

The basic sign for schools is the School (S1-1) sign. The 2009 MUTCD assigns various purposes to this sign. Figure 1 shows an example of the sign installation. It has four applications:

- To warn road users that they are approaching a school, a school crossing, or school-related facility adjacent to the highway;
- To identify the beginning of a school zone (some jurisdictions officially designate school zones and grant them special standing in law, such as increased fines imposed for speeding);
- When combined with an AHEAD or distance plaque, to warn road users that they are approaching a school crossing; and
- When combined with a diagonal downward-pointing arrow plaque, to indicate the location of a school crossing.

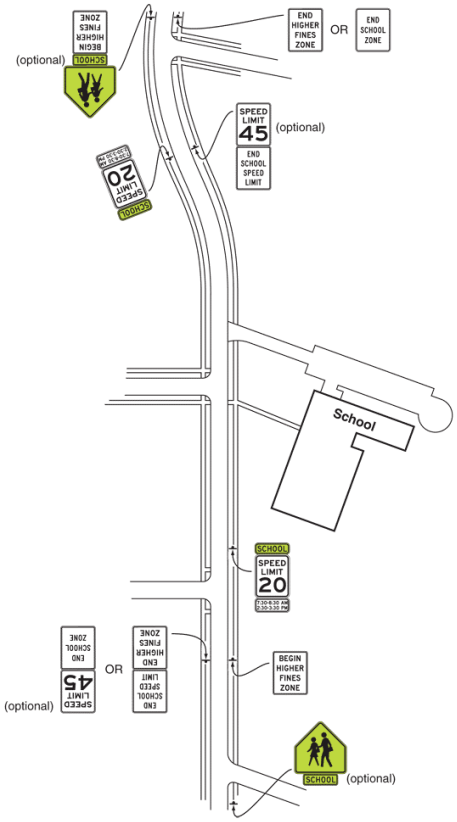


Figure 1. Example of school zone sign placement from MUTCD[1]

According to the MUTCD, school warning signs, including the "SCHOOL" portion of the School Speed Limit (S5-1) sign and including any supplemental plaques used in association with these warning signs, shall have a fluorescent yellow-green background with a black legend and border unless otherwise provided in the MUTCD for a specific sign.

Changeable Message Signs or Driver Feedback Signs

The 2009 MUTCD allows a changeable message sign (CMS) to be used in lieu of a static sign to display a reduced speed limit within a school zone. When illuminated, the CMS must conform to the basic shape, message, layout, and color of the static assembly, including the display of the SCHOOL message in fluorescent yellow-green pixels and the other messages in white pixels on a black background.

Driver feedback displays or signs are used to advise approaching motorists of the actual speeds at which they are traveling. These signs must display a yellow YOUR SPEED XX MPH or similar legend on a black background or the reverse of these colors. Experience has shown that driver feedback displays are more effective when used in conjunction with a speed limit sign and should be in use only during active school zone periods.

In-Street Pedestrian Crossing Signs

In-street pedestrian crossing signs (MUTCD R1-6 and R1-6a signs) are intended for use at uncontrolled crosswalks. The signs can be installed on the centerline or in the median with either a portable or fixed base. In some locations, these signs are present only when the crossing guard is present. Because the signs are located between the lanes, they can have a traffic-calming effect from the narrowing of the lanes. While research on the effectiveness of in-street school crossing signs is not available, research on the effectiveness of in-street pedestrian crossing signs has shown these signs to increase driver yielding[3–7] between 13 and 46 percent depending on the location. Field studies from TCRP Report 112/NCHRP Report 562[8] indicate that in-street signs have relatively high motorist yielding (ranging from 82 to 91 percent) for study sites on two-lane streets with posted speed limits of 25 or 30 mph (40 or 48 km/h). Lessons learned from the studies include:

- When drivers frequently strike the signs, consider placing the signs on median islands to extend their useful live; and.
- The characteristics of the roadway are associated with the effectiveness of the device. In-street pedestrian crossing signs are more effective with lower speed limits, narrower or fewer numbers of lanes, lower average daily traffic, and lower left-turn volumes.

PAVEMENT MARKINGS

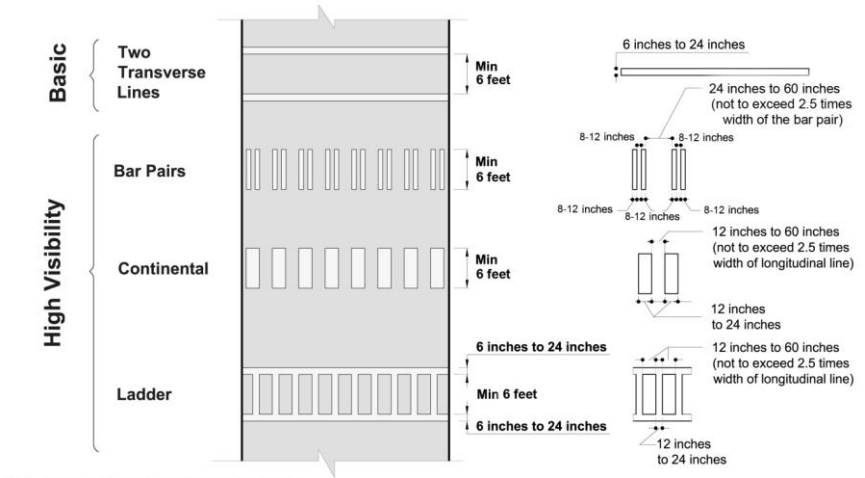
Advance Stop or Yield Line and Sign

The advance stop/yield line treatment places the traditional stop or yield line 20 to 50 ft. upstream of the crosswalk. The lines are often accompanied by STOP HERE FOR (or YIELD HERE TO) PEDESTRIAN signs. Advance yield lines address the issue of multiple-threat crashes on multilane roadways, where one vehicle stops for a pedestrian in the crosswalk but inadvertently screens the pedestrian from the view of drivers in other lanes. Several studies have documented that advance yield lines decrease pedestrian-vehicle conflicts and increase driver yielding at greater distances from the crosswalk.[9–12] Advance stop lines are to be used where the state law requires drivers to stop for pedestrians in a crosswalk. Advance yield lines are to be used where the state law requires drivers to yield to pedestrians in a crosswalk.

Marked Crosswalks

Crosswalk markings provide guidance for pedestrians by defining and delineating paths. Crosswalk markings are classified as basic or high visibility. Basic crosswalk markings consist of two transverse lines. High-visibility markings consist of longitudinal lines parallel to traffic flow with or without transverse lines. Figure 2 presents examples of crosswalk markings.

A late 1990s study on crosswalk pavement markings found that as traffic volumes, speeds, and street widths increase, greater crash frequency was present when only crosswalk markings (no signs or beacons) were used as compared with no crosswalk markings.[13,14] The study recommendations indicate that the issue should not be whether to provide crosswalk markings on these high-volume, high-speed streets. Instead, the recommendations point to the necessity of providing other treatments in addition to crosswalk markings that will make a street crossing safer for pedestrians. The implication is that marked crosswalks ALONE are not sufficient on multilane streets with high traffic volumes and speeds.



Note: At a non-intersection uncontrolled pedestrian crossing where the speed limit is greater than 35 mph, the high visibility crosswalk marking, if used, should not be less than 8 feet wide.

Figure 2. Crosswalk marking examples. Source: Texas Transportation Institute.

TCRP Report 112/NCHRP Report 562, in Appendix A, provides guidelines on pedestrian crossing treatments to consider at uncontrolled intersections.[8] It includes worksheets that can be used to select treatments based on total pedestrian delay at the crossing.

SIGNALS AND BEACONS

Rectangular Rapid-Flashing Beacon

The rectangular rapid-flashing beacon (RRFB) flashes in an eye-catching sequence to draw drivers' attention to the sign and the need to yield to a waiting pedestrian. Each side of a light-emitting diode flasher illuminates in a wig-wag sequence (left and then right) similar to the flash pattern of an emergency vehicle. A recent study[15] evaluated RRFBs at 22 sites and found that RRFBs were effective in encouraging drivers to yield to pedestrians. During the baseline period, the average yielding for all of the sites was 4 percent before installation of the RRFBs. Data collected over a 2-year period at 18 of the sites confirmed that the RRFBs continue to encourage drivers to yield to pedestrians, even over the longer term. By the 2-year follow-up, the researchers determined that the introduction of the RRFB was associated with yielding that ranged between 72 and 96 percent. Therefore, the evidence for change was overwhelming and persisted for the duration of the study.

In July 2008, the Federal Highway Administration (FHWA) issued an interim approval for optional use of RRFBs as warning beacons to supplement standard pedestrian or school crossing signs at crosswalks across uncontrolled approaches. (See http://mutcd.fhwa.dot.gov/resources/interim_approval/ia11/fhwamemo.htm.) Agencies need to obtain FHWA approval at the state or local level before using the RRFB.

The city of Garland, Texas, USA, has expanded the RRFB concept for use with a school crossing. Figure 3 shows the sign used in Garland. Data for one site showed that compliance rates of drivers yielding to staged pedestrians improved markedly with the RRFB device in place, from less than 1 percent before installation to approximately 80 percent after. Compliance rates of drivers during school zone periods were similar between the before and after periods, typically between 80 and 100 percent, because of the presence of a crossing guard.

Figure 3. Example of the rectangular rapid flashing beacon being used with school sign. Source: Texas Transportation Institute.

Pedestrian Hybrid Beacon

The pedestrian hybrid beacon (PHB) (also known as the HAWK) is located both on the roadside and on mast arms over the major approaches to an intersection (see Figure 4 for an example). The head of the PHB consists of two red lenses above a single yellow lens. It is normally "dark," but when activated by a pedestrian, it first displays a few seconds of flashing yellow followed by a steady yellow change interval, and then displays a steady red indication to drivers, which creates a gap for pedestrians to cross the roadway. During the flashing pedestrian clearance interval, the PHB changes to a wig-wag flashing red to allow drivers to proceed after stopping if the pedestrian has cleared the roadway, thereby reducing vehicle delays.

The device was developed in Tucson, Arizona, USA, which now has more than 100 installations, many at school crossings. A recent study conducted a before-and-after evaluation of the safety performance of the pedestrian hybrid beacon[16] and found:

Figure 4. Example of a Pedestrian Hybrid Beacon (HAWK) treatment in Tucson, AZ, USA. [16]

- A 29 percent reduction in total crashes (statistically significant);
- A 15 percent reduction in severe crashes (not statistically significant); and
- A 69 percent reduction in pedestrian crashes (statistically significant).

FHWA added the PHB to the 2009 MUTCD (Chapter 4F). The MUTCD includes guidelines for the installation of the PHB for low-speed roadways where speeds are 35 mph (56 km/h) or less, and for high-speed roadways where speeds are more than 35 mph (56 km/h).

Traffic Signal

Signal Warrant 5 (School Crossings) within the MUTCD is for the use of traffic control signals at established school crossings on major streets. Pedestrian signal heads/indications are required for traffic control signals installed at established school crossings. Where the pedestrian change interval is longer than 7 seconds, the signal must have a pedestrian countdown display to indicate the number of seconds remaining in the change interval.

OTHER SCHOOL AREA TRAFFIC CONTROLS

Other methods of traffic control may be used in school zones. Geometric features are also used and are discussed in ITE Briefing Sheets—*School On-site Design* and *School Site Selection and Off-site Access.* Reduced-speed school zones are discussed in ITE Briefing Sheet—*Reduced School Area Speed Limits*. Several signs and markings used around schools are discussed in Part 7 of the MUTCD.[1] Consult the MUTCD or ITE *Traffic Control Devices Handbook*[2] for details.

REFERENCES

1. Federal Highway Administration (FHWA). *Manual on Uniform Traffic Control Devices*. Washington, DC, USA: FHWA, 2009.
2. Institute of Transportation Engineers (ITE). *Traffic Control Devices Handbook, 2012 Draft*. Washington, DC, USA: ITE, 2012.
3. Pécheux, K., J. Bauer, and P. McLeod. *Pedestrian Safety and ITS-Based Countermeasures Program for Reducing Pedestrian Fatalities, Injury Conflicts, and Other Surrogate Measures Draft Zone/Area-Wide Evaluation Technical Memorandum.* Washington, DC, USA: United States Department of Transportation, ITS Joint Program Office, 2009. Accessed April 20, 2011. http://safety.fhwa.dot.gov/ped_bike/tools_solve/ped_scdproj/sys_impact_rpt/index.cfm#toc.
4. Ellis, Jr., R.D., R. Van Houten, and J. Kim. "In Roadway 'Yield to Pedestrians' Signs: Placement Distance and Motorist Yielding." *Transportation Research Record 2002*. Washington, DC, USA: Transportation Research Board, National Research Council, 2007, pp. 84-89.
5. Strong, C., and M. Kumar. *Safety Evaluation of Yield-to-Pedestrian Channelizing Devices*. Bozeman, MT, USA: Western Transportation Institute, Montana State University, 2006.
6. Strong, C., and D. Bachman. "Safety Evaluation of Yield-to-Pedestrian Channelizing Devices." TRB 87th Annual Meeting Compendium of Papers DVD. Washington, DC, USA: Transportation Research Board, 2008.
7. Pulugurtha, S., S.S. Nambisan, M.R. Dangeti, and V. Vasudevan. "An Evaluation of Effectiveness of Traffic Signs to Enhance Pedestrian Safety." 89th Annual Transportation Research Board Meeting Compendium of Papers CD. Washington, DC, USA: Transportation Research Board, 2011.
8. Fitzpatrick, K., S. Turner, M. Brewer, P. Carlson, B. Ullman, N. Trout, E. S. Park, J. Whitacre, N. Lalani, and D. Lord. TCRP Report 112/NCHRP Report 562: *Improving Pedestrian Safety at Unsignalized Crossings.*Washington, DC, USA: Transportation Research Board, 2006.
9. Center for Urban Transportation Research (CUTR). *Making Crosswalks Safer for Pedestrians: Application of a Multidisciplinary Approach to Improve Pedestrian Safety at Crosswalks in St. Petersburg, Florida.* Tampa, Florida, USA: CUTR, University of South Florida, July 2000.
10. Van Houten, R. "The Effects of Advance Stop Lines and Sign Prompts on Pedestrian Safety in a Crosswalk on a Multilane Highway." *Journal of Applied Behavioral Analysis* 21 (1988): 245-251.
11. Van Houten, R., and L. Malenfant. "The Influence of Signs Prompting Motorists to Yield before Marked Crosswalks on Motor Vehicle-Pedestrian Conflicts at Crosswalks with Flashing Amber." *Accident Analysis & Prevention* 24, No. 3 (1992): 217-225.
12. Van Houten, R., J.E.L. Malenfant, and D. McCusker. "Advance Yield Markings: Reducing Motor Vehicle-Pedestrian Conflicts at Multilane Crosswalks with Uncontrolled Approach." *Transportation Research Record 1773*. Washington, DC, USA: Transportation Research Board, National Research Council, 2001, pp. 69-74.
13. Zegeer, C.V., J.R. Stewart, and H. Huang. *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines*. Report No. FHWA-RD-01-075. Washington, DC, USA: Federal Highway Administration, March 2002.
14. Zegeer, C.V., J.R. Stewart, H. Huang, and P. Lagerway. "Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations: Analysis of Pedestrian Crashes in 30 Cities." *Transportation Research Record 1773*. *Transportation Research Record 1773*. Washington, DC, USA: Transportation Research Board, National Research Council, 2001, pp. 56-68.
15. Shurbutt, J., and R. Van Houten. *Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks*. Report No. FHWA-HRT-10-043. Washington, DC, USA: Federal Highway Administration, 2010.
16. Fitzpatrick, K., and E.S. Park. *Safety Effectiveness of the HAWK Pedestrian Crossing Treatment*. Report No. FHWA-HRT-10-042. Washington, DC, USA: Federal Highway Administration, 2010.