Alternative Treatments for At-Grade Pedestrian Crossings

IN RESPONSE TO A GROWING NEED FOR BETTER INFORMATION ON PEDESTRIAN CROSSING TREATMENTS TO BE COMPILED INTO A SINGLE COMPREHENSIVE DOCUMENT, THE ITE PEDESTRIAN AND BICYCLE TASK FORCE PREPARED AN INFORMATIONAL REPORT ON ALTERNATIVE TREATMENTS FOR PEDESTRIAN CROSSINGS, WHICH IS SUMMARIZED HERE.

BY THE ITE PEDESTRIAN AND BICYCLE TASK FORCE, NAZIR LALANI, CHAIR

IN MARCH 1999,[1] THE INSTITUTE of Transportation Engineers (ITE) initiated the formation of the Pedestrian and Bicycle Task Force to develop better information for transportation professionals on pedestrian and bicycle facilities. One of the projects identified by the task force members was the need to provide better information on alternative treatments for pedestrian crossings. This need was based on the results of recent research[2] by the U.S. Department of Transportation's (U.S. DOT's) Federal Highway Administration (FHWA) that studied marked crosswalks at uncontrolled locations where no stop signs or traffic signals were present.

Providing marked crosswalks using two white 12-inch (in.) lines and the warning signs prescribed by various manuals were found to result in higher pedestrian collisions compared to not providing marked crosswalks on multilane roads with more than one lane in each direction with average daily volumes (ADT) of 10,000 vehicles per day. On roads with one lane in each direction and average daily volumes of less than 10,000 vehicles per day, the FHWA study found no difference in collisions involving pedestrians at marked and unmarked crosswalks at uncontrolled intersections. To respond to this finding, some agencies removed marked crosswalks on higher volume multilane facilities. Other agencies addressed this issue by experimenting with alternative treatments to improve the safety of pedestrian crossings.

In response to a growing need for better information on pedestrian crossing treatments to be compiled into a single comprehensive document, the ITE Pedestrian and Bicycle Task Force prepared an informational report that includes the following information:

- Introduction (Section 1);
- Pedestrian Crossing Installation Guidelines (Section 2);
- Identifying Alternative Treatments (Section 3);
- Major Street Crossings at Uncontrolled Locations (Section 4);
- Residential Street Crossings (Section 5);
- Removal of Crosswalks (Section 6);
- Signal Controlled Crossings for Pedestrians (Section 7);
- Signalized Intersection Crossings (Section 8);
- School-Related Crossings (Section 9);
- Conclusions (Section 10);
- Glossary (Section 11);
- Abbreviations (Section 12);
- References (Section 13);
- Bibliography (Section 14); and
- Appendices (Section 15).

INFORMATIONAL REPORT SUMMARY

The 220-page information report comprises 15 sections covering over 70 treatments. The contents of each section are described below:

Introduction (Section 1)

Section 1 of the report summarizes the following information:

- Statistical data on pedestrian collisions in the United States;
- Studies on pedestrian collisions in Europe;
- A summary of studies on pedestrian collisions at marked crosswalks in the United States; and
- Areas for further study.

Pedestrian Crossing Installation Guidelines (Section 2)

Section 2 of the informational report has assembled pedestrian crossing installation criteria used by entities from several countries that are used to determine where and what type of pedestrian crossings are to be installed on various types of facilities. Some entities have developed formal "Warrants" whereas others have identified guidelines. Some countries list the factors that should be taken into consideration

when considering installation of pedestrian crossings. The various methods used are summarized here and the source of the information is referenced. The ITE Pedestrian and Bicycle Task Force has included this information that agencies may find useful in developing their own criteria or guidelines. Installation criteria are summarized from the following countries:

- United States;
- Canada;
- United Kingdom of Great Britain;
- New Zealand; and
- Australia.

Identifying Alternative Treatments (Section 3)

Section 3 of the informational report identifies the following sources of information regarding pedestrian crossings that were used to prepare the informational report:

Experts: Persons with expertise in traffic and transportation engineering were contacted and information was gathered through discussions and via e-mail and using the ITE Traffic Engineering Council and Transportation Planning Council List Serves.

Internet Surveys: Surveys were conducted via ITE List Serves to request information and pictures from ITE members who had tried different treatments to improve the safety of pedestrian crossings.

Task Force Members: Members of the ITE Pedestrian and Bicycle Task Force provided much of the information and pictures of specific treatments contained in this report.

Web Sites: Information from a variety of Web sites was also used in the preparation of this report.

References: Papers and texts listed in the Reference section of this report were used extensively to furnish data on the effectiveness of various pedestrian crossing treatments.

Bibliography: Information contained in the various source documents listed in the Bibliography section of this report was used to research a variety of treatments currently in use throughout North America and other parts of the world.

ALTERNATIVE TREATMENTS

Sections 4 through 9 of the complete informational report document various treatments currently in use by local agencies in the United States, Canada, Europe and Australia. The intent of the treatments is to reduce the potential for collisions involving pedestrians at locations where marked crosswalks are provided. The separate sections discuss treatments for:

- Major Street Crossings at Uncontrolled Locations (Section 5);
- Residential Street Crossings (Section 6);
- Signal Controlled Crossings for Pedestrians (Section 7);
- Signalized Intersection Crossings (Section 8); and
- School-Related Crossings (Section 9).

For each treatment, the following information is provided, where available:

- *Description*: Describes the specifics of each treatment.
- *Objective*: Describes what the specific treatment is designed to accomplish.
- *Cost*: Provides an estimate of the cost to implement a specific treatment based on information available at the time the report was prepared. This includes design costs, construction costs (including signing, striping and drainage) as well as costs associated with inspection and any contingencies, where applicable.
- *Applications*: Identifies the conditions under which a particular treatment is applied based on current practice.
- *Advantages*: Identifies advantages associated with a particular treatment. These are based on observations or studies conducted around the world and are not the opinions or recommendations of the ITE Pedestrian and Bicycle Task Force.
- *Disadvantages:* Identifies disadvantages associated with a particular treatment. These are based on observations or studies conducted around the world and are not the opinions or recommendations of the ITE Pedestrian and Bicycle Task Force. This section identifies treatments where indiscriminate application would diminish its impact.
- *Evaluation Studies:* Cites evaluation studies or reports for locations where specific treatments were tested. Studies were not available for all treatments.
- *Sample Sites:* Illustrates sites of treatments with photographs taken by digital cameras. Photographs sometimes illustrate sites where more than one treatment is being used.

Figure 1. Pedestrian crossing using traditional treatments in the United States. Crosswalk is striped with 12-in. white lines and posted with the standard signs.

Major Street Crossings at Uncontrolled Locations (Section 4)

For many years, marked crosswalks were installed with the minimum amount of signing and striping as illustrated in Figure 1. This approach does not provide warning of the possibility of crossing pedestrians, especially if paint-based markings are used as opposed to thermoplastic materials. ITE's *Recommended Practice for the Design and Safety of Pedestrian Facilities*[3] provides guidance on pedestrian crossings and describes some of the treatments that can improve safety for pedestrians using marked crosswalks.

Section 4 summarizes a variety of treatments currently used by agencies to improve safety of marked crosswalks at uncontrolled locations. Evaluation studies are cited where such information was found to be available. Treatments in this section include:

- Automated detection;
- Curb extensions;
- Curb ramps;
- Flags;
- Flashing beacons;
- In-roadway signs;
- Lane reductions;
- Markings/legends;
- Overhead signs;
- Pedestrian railings;
- Raised markers [with light emitting diodes (LEDs)];
- Refuge islands;
- Street lighting; and
- Tactile surfaces.

Figure 2. Uncontrolled pedestrian crossing in the United Kingdom includes refuge, flashing beacon, high visibility markings and pavement legends.

Figure 2 shows an example of a pedestrian crossing in the United Kingdom that includes high visibility markings, a refuge island, flashing beacons and pavement legends for pedestrians.

Residential Street Crossings (Section 5)

Most traffic calming measures such as speed humps, raised intersections, chokers and other features are implemented on residential streets to control traffic speeds and volumes. The treatments included in this section of the report are specifically those that are used at or near pedestrian crossings intended to improve their safety and include:

- Narrower striped lanes;
- Chicanes;
- Raised crosswalks;
- Raised intersections;
- Speed cushions; and
- Entry treatments.

ITE's publication entitled *Traffic Calming, State of the Practice*[4] provides a comprehensive catalogue of residential street treatments. Figure 3 shows a site in Canada where a raised intersection has been constructed.

Removal of Crosswalks (Section 6)

At the January 2000 Transportation Research Board (TRB) Annual Meeting, Zegeer[2] presented a paper on "Evaluation of Marked and Unmarked Crosswalks." The research on which this paper was based indicated that having marked crosswalks alone resulted in higher levels of pedestrian-related collisions at uncontrolled or unsignalized intersections compared to having no crosswalks on multilane streets (four or more travel lanes) having ADTs of 10,000 or more. This was true for both midblock and intersection locations. On two-lane roads and multilane roads with less than 10,000 ADT, this was not the case; there was no difference between marked and unmarked crosswalks at uncontrolled or unsignalized intersections. Because of this type of experience, some cities have been removing marked crosswalks as a treatment at uncontrolled locations on multilane streets during resurfacing projects, when such change is easiest to accomplish.

The opinion of many transportation professionals is that simple crosswalks striped with two 12-in. white lines at uncontrolled locations should be minimized on multilane streets. This is consistent with current practice in Great Britain where the use of Zebra crossings, which are marked with high visibility markings and flashing beacons, are being phased out on multilane higher-volume roadways because they experience a higher level of collisions. Pelican, Puffin and Toucan

Figure 3. Raised intersection in Canada.

crossings are gradually replacing this type of crossing. These signal-controlled crossings provide protected crossings for pedestrians and other nonmotorized forms of transportation while minimizing delay to vehicular traffic.

Because removing crosswalks is a treatment that has been used to address pedestrian safety issues, this section of the report summarizes the experience of the cities of Los Angeles, Ventura and Long Beach, in California, USA, that have removed marked crosswalks at uncontrolled locations on multilane streets. However, it should be recognized that removing crosswalks does not promote pedestrian mobility.

Signal Controlled Crossings for Pedestrians (Section 7)

Section 7 of the report summarizes the use of signals that are installed for pedestrian crossings. One of the applications is at intersections, such as in Canada where the pedestrian crossing is signalized but the intersection side street approaches are controlled by stop signs. Most of the applications in the United States, Canada, Australia and the United Kingdom are at midblock locations. These treatments have been placed in a separate section because they are not at signalized intersections and their operations are significantly different from pedestrian crossings at signalized intersections. The section discusses the following types of crossings:

- Half signals;
- Hawks;
- Midblock signals;
- Pedestrian intersection crossings;
- Pelicans;
- Puffins; and
- Toucans.

Figure 4 shows a site in Australia where a Puffin crossing is located.

Signalized Intersection Crossings (Section 8)

The treatments in Section 8 of the report have been used at pedestrian crossings at signalized intersections. The treatments are intended to make the crossings at signalized intersections more pedestrian friendly. Some of the treatments such as curb ramps, flags, signs, refuges and pavement legends are also used at uncontrolled crossings. However, these treatments have also been included here to illustrate their use at signalized intersections. The studies referenced in this section of the report are specifically related to the use of these treatments at signalized intersection applications. This section includes the following types of treatments:

- Accessible signals;
- Advance limit lines;
- Countdown indications;
- Curb extensions;
- Curb ramps;
- Driveway control;
- Flags;
- Flashing beacons;
- Islands;
- Moving eye indications;
- Overhead signs;
- Pavement markings;
- Pedestrian railing;
- Pushbutton signs and designs;
- Refuges;
- Signal phasing;
- Signal design; and
- Turn prohibitions.

Figure 5 shows a site in Denmark, where a pushbutton with a tactile map is used.

School-Related Crossings (Section 9)

The primary objective of this report was to identify treatments used at pedestrian crossings. No specific effort was made to identify treatments used at school-related crossings. However, in the course of preparing this report, information was discovered relating to treatments used at school-related crossings that are different from the standard treatments prescribed in most internationally accepted manuals. The treatments included here are by no means the only ones being used as alternatives or in addition to more standard treatments. Other treatments used at school-related crossings may be found and included in updates of this report.

- Flags;
- Ground-mounted fluorescent signs;
- Overhead fluorescent signs;
- Part-time closures;
- Portable barrels; and
- Portable signs.

Figure 6 shows a portable sign used at school crosswalks in Arizona, USA.

Conclusions (Section 10)

Based on the information reviewed and obtained from many different sources during the preparation of this technical report, the ITE Pedestrian and Bicycle Task Force drew the following conclusions concerning pedestrian crossings:

- Studies of pedestrian-related collisions conducted by various FHWA and TRB researchers indicate that designating marked crosswalks at uncontrolled locations on higher-volume, multilane facilities using traditional treatments leads to higher pedestrian-related collision rates than at unmarked crosswalks on similar facilities. This suggests that simply marking crosswalks with minimal striping and signing at uncontrolled locations may be insufficient on higher-volume multilane streets, where additional treatments may be necessary to better warn of the presence of pedestrians crossing the street and to facilitate their ability to cross wide streets.
- Installing marked crosswalks, especially at uncontrolled locations, by striping two lines across the roadway and posting a single sign in advance

Figure 4. Puffin crossing in Australia.

Figure 5. Pushbutton with tactile map on the side includes sound generator, tactile map, LED light and vibrating hardware for accessibility.

Figure 6. Portable sign at school crosswalk in Arizona.

of and at the crossing does not afford pedestrians effective protection from being struck by a vehicle while crossing in the marked crosswalk. This is especially the case on higher-volume, multilane facilities.

- A variety of low-cost signing and striping techniques currently are being used by agencies that can improve the safety of the majority of marked crosswalks at uncontrolled locations on multilane, higher-volume facilities. The effectiveness of many of these techniques has been documented in one or more studies.
- A number of higher-cost geometric design features, such as curb extensions and pedestrian refuge islands, can be used to improve the safety of marked crosswalks, especially those on higher-volume, multilane major streets.
- Areas of high pedestrian activity such as downtowns benefit most from being designed in ways that promote pedestrian activity and afford pedestrians a reasonable measure of comfort and safety when crossing streets by incorporating some of the design features included in this technical report. However, most of the treatments are applicable to crossings in most urban, suburban, or semirural areas. Pedestrian activity is essential for the economic survival of downtowns. Lower speeds that prevail in many downtowns allow the use of lower-cost, less-complex treatments such as signs and markings.
- Studies in some agencies indicate that removing uncontrolled marked crosswalks from higher-volume, multilane facilities at some locations seems to reduce the rate of pedestrian-related collisions, especially if the crosswalks are in close proximity to existing pedestrian crossings controlled by stop signs or traffic signals. However, pedestrian mobility is reduced.
- Studies cited by authors who have studied the effectiveness of the treatments discussed in this report suggest that improving crosswalks on higher-volume, multilane facilities, using treatments that studies have indicated to be effective, can reduce the rate of pedestrian-related collisions.
- Information contained in pedestrian-crossing-related publications from the United Kingdom appears to favor the use of midblock pedestrian signals on higher-volume, multilane streets rather than uncontrolled marked crosswalks.
- An increasing number of techniques, some of them based on intelligent transportation systems (ITS) technology, are available for improving pedestrians' understanding and use of pedestrian facilities at signalized intersections and midblock crossings. These techniques vary from simple signing and striping treatments to those involving the modification of signal operations using such techniques as leading intervals or ITS technology such as automated detection.

Sections 11–15

The remaining sections of the report provide a glossary, list of abbreviations, list of 85 references, bibliography and appendices, which contain guidelines and policies, provided by agencies.

Additional Information

A complete version of the ITE Pedestrian and Bicycle Task Force's Informational Report entitled *Alternative Treatments for At-Grade Pedestrian Crossings* may be obtained from the ITE Bookstore by calling +1 202-289-0222 and ordering Publ. No. LP-629 ($30 for ITE members; $40 for nonmembers; plus shipping). Additional information may be found in the ITE Bookstore ad in this issue on pages 61–64 or ITE's Web site at www.ite.org.

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Over 42 ITE members and six nonmembers participated in the preparation of the Informational Report entitled *Alternative Treatments for At-Grade Pedestrian Crossings*. ITE appreciates the efforts of this group of individuals during the preparation of this report. ■

Editor's Note: This feature and the informational report discussed in this feature were developed by the ITE Pedestrian and Bicycle Task Force. As of Aug. 1, 2001, the ITE International Board of Direction elevated the task force to permanent council status. If you are interested in joining ITE's new Pedestrian and Bicycle Council, please contact Russell W. Houston at ITE Headquarters at +1 202-289-0222, ext. 144, rhouston@ite.org.

References

1. Lalani, N. "International President's Message: ITE Emphasizes Pedestrian and Bicycle Issues." *ITE Journal* (March 1999): 12.

2. Zegeer, C., H. Huang and R. Stewart. "Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Crossing Locations." Draft Executive Summary, Highway Research Center, University of North Carolina, September 1999.

3. Zegeer, C.V. *Design and Safety of Pedestrian Facilities, A Recommended Practice*. Traffic Engineering Council Committee TENC-5A-5. Washington, DC, USA: ITE, 1998.

4. Ewing, R. *Traffic Calming, State of the Practice*. Report No. FHWA-RD-135. Washington, DC, USA: ITE under contract with the U.S. DOT's FHWA, 1999.

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