Pedestrian Safety at Intersections

Although intersections represent a very small percentage of U.S. surface road mileage, more than one in five pedestrian deaths is the result of a collision with a vehicle at an intersection. Annually, an average of 5,381 pedestrians died in traffic crashes between 1990 and 2002. [1]

Overview

The Year 2002 National Highway Traffic Safety Administration's pedestrian crash facts are as follows:

- 4,808 pedestrians were killed;
- 1,046 pedestrians, or 22 percent, of all pedestrians were killed at intersections;
- 71,000 pedestrians were injured;
- 31,000 pedestrians, or 44 percent, of all pedestrians were injured at intersections;
- A pedestrian is **killed or injured** in an intersection traffic crash every 16 minutes;
- 13 percent of pedestrian fatalities at intersections occur at night (between the hours of 6:00 p.m. and 6:00 a.m.);
- Pedestrians involved in crashes are more likely to be killed as vehicle speed increases. The fatality rate for a pedestrian hit by a car at 20 mph is 5 percent. The fatality rate rises to 80 percent when vehicle speed is increased to 40 mph; [2]
- People aged 70 and older account for 17 percent of all pedestrian fatalities;
- People aged 65 and older have about 2.5 as many pedestrian deaths per 100,000 people as younger groups; and
- 36 percent of pedestrian deaths among those aged 65 and older occurred at intersections. This compares to 20 percent for people of other ages.

Pedestrian Safety Problems at Intersections

Types of hazardous intersections for pedestrian crossings include high-volume, high-speed and multi-lane intersections with complex signal phasing or without any traffic control at all.

Pedestrians are at risk even at simple STOP- or YIELD-sign intersections because of the common disregard of traffic control devices by both motorists and pedestrians.

Roadways need to be designed to accommodate the needs of all road users. Roadway modifications that include widening streets, adding lanes and using traffic engineering solutions that increase vehicular efficiency can decrease pedestrian safety if not properly considered.

Many pedestrians, especially in large urban areas, violate pedestrian traffic control and place themselves at risk for collisions with motor vehicles. [3] About one-third of fatal crashes involving pedestrians are the result of pedestrians disobeying intersection traffic control or making misjudgments while attempting to cross a street. [4]

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Pedestrian and driver traffic control violations generally receive low levels of enforcement.

Intersection reconstruction projects and traffic control installations can increase the distance that one must walk to cross at an intersection. Intersection signal timings may be too short to permit safe intersection crossing. Assumptions of walking speeds for signal timing may be too fast for many pedestrians to cross to the other side of the curb. Also, there appears to be a poor understanding of pedestrian signal displays by pedestrians.

Crash data consistently show that crashes with pedestrians occur far more often with turning vehicles than with straight-through traffic. Left-turning vehicles are more often involved in pedestrian collisions than right-turning vehicles, partly because drivers are not clearly able to see pedestrians on the left. [5]

Right-turn-on-red (RTOR) can potentially contribute to pedestrian crashes because it creates conflicts between pedestrians and motor vehicles and can reduce pedestrian opportunities to cross intersections, even though pedestrians have the right-of-way over the right-turning vehicles.

Pedestrian visibility to drivers is worse during hours of darkness, especially in areas where there is poor lighting on the road. This is a common shortcoming of rural and suburban intersections. Studies of pedestrian and driver reactions indicate that pedestrians generally perceive that they are visible to drivers before they are visible.

Pedestrian Safety Countermeasures

The following section provides possible pedestrian safety countermeasures within the following categories: crosswalk improvements, intersection design/physical improvements, intersection operations and signal hardware/technology. Modifications to pedestrian control devices from the *2003 Manual on Uniform Traffic Control Devices* (MUTCD) are also included.

Crosswalk Improvements

- Use a ladder or cross-hatched pattern that is more visible to motorists;
- Use "Pedestrian Crossing" warning signs with pedestrian-actuated flashing beacons, which alert oncoming traffic to pedestrians in the crosswalk;
- Move the vehicle STOP line farther back from crosswalk AND add STOP HERE FOR PEDESTRIANS sign;
- Install raised crosswalks;
- Sign and mark crosswalks. For greatest effectiveness, include curb ramps or curb extensions;
- Use in-pavement lights to alert motorists to the presence of a pedestrian crossing or when someone is preparing to cross the street. Transportation professionals should review the new Chapter 4L of the 2003 MUTCD that provides guidance on the use of in-pavement lights at crosswalks;
- Consider using MUTCD Sign R1-6: STOP FOR PEDESTRIANS or YIELD TO PEDESTRIANS signs can be placed at crosswalks without signals in central business districts and other areas of high pedestrian activity to reinforce and remind drivers of the laws regarding the right-of-way of pedestrians; and
- MUTCD Sign R1-5(a): YIELD HERE TO PEDESTRIANS signs are for use in advance of unsignalized marked mid-block crosswalks.

R1-5(a)

R1-6

Safety Effects Of Marked Vs. Unmarked Crosswalks At Uncontrolled Locations [6]

- On two-lane roads, the presence of a marked crosswalk alone at an uncontrolled location was associated with no difference in pedestrian crash rate, compared to an unmarked crosswalk.
- On multi-lane roads with traffic volumes of more than 12,000 vehicles per day, having a marked crosswalk was associated with a higher pedestrian crash rate compared to an unmarked crosswalk.
- Raised medians provided significantly lower pedestrian crash rates on multi-lane roads, compared to roads with no raised median.

Intersection Design/ Physical Improvements

- Install barriers such as fences or shrubs to discourage pedestrians from crossing at unsafe locations;
- Install bulb-outs at intersections to reduce pedestrian crossing distance;
- Provide wide refuge islands and medians;
- Construct pedestrian overpasses/underpasses;
- Install raised medians; and
- Reduce corner radii.

Intersection Operations

- Reassess traffic signal operations, including consideration of pedestrian walking speeds/pedestrian signal timing and pedestrian-only phasing Consider restricting right-turn-on-red (RTOR);
- Illumination;
- Mid-block traffic signal; and
- Far-side bus stops.

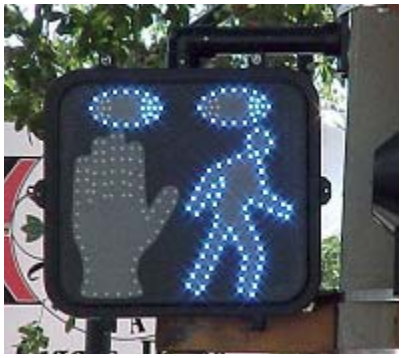
Signal Hardware/ Technology

Consider installation of Pedestrian Countdown Signals

2003 MUTCD Section 4E.07 Countdown Pedestrian Signals
A pedestrian interval countdown display may be added to a pedestrian signal head in order to inform pedestrians of the number of seconds remaining in the pedestrian change interval.

Consider installation of Animated Eye Pedestrian Signal

Animated eyes are intended for use at pedestrian crosswalks as an alternative to conventional pedestrian signals. Animated eye displays may encourage pedestrians to look for turning vehicles traveling on an intersecting path by including a prompt as part of the pedestrian signal. The prompt is a pair of animated eyes that scan from side to side at the start of the WALK indication.



Accessible Pedestrian Signals

2003 MUTCD: Section 4E.06 Accessible Pedestrian Signals (APS)
The installation of APS at signalized locations should be based on an engineering study, which should consider the following factors: **(1)** potential demand for accessible pedestrian signals; **(2)** a request for accessible pedestrian signals; **(3)** traffic volumes during times when pedestrians might be present, including periods of low-traffic volumes or high turn-on-red volumes; **(4)** complexity of traffic signal phasing; and **(5)** complexity of intersection geometry. When using APS, the pedestrian signal must be visible and any push-buttons must be accessible with audible locator tones for people with visual disabilities.

Pedestrian Intervals and Signal Phases

2003 MUTCD Section 4E.10
The pedestrian clearance time should be sufficient enough to allow a crossing pedestrian, who left the curb or shoulder during the WALKING PERSON signal indication, to travel at a walking speed of 4 ft. per second to make it **to at least the far side of the traveled way or to a median of sufficient width for pedestrians to wait.** Where pedestrians, who walk slower than 4 ft. per second or use wheelchairs, routinely use the crosswalk, a walking speed of less than 4 ft. per second should be considered in determining the pedestrian clearance time.

The Three E-Approach: Engineering Alone is Not Sufficient

Improved pedestrian safety at intersections requires coordination among public authorities, professional engineers, media, education experts and vehicle designers to reduce both the number and severity of pedestrian collisions. Pedestrian safety cannot be improved by traffic engineering alone; it is a partnership between the driver, pedestrians, parents of young children, schools, police departments and others.

From an enforcement perspective, we need to ensure motorist compliance with traffic control devices, posted speeds and pedestrian safety laws. Pedestrians need to understand and obey intersection traffic control. Pedestrians need to make themselves more visible during evening and nighttime hours. One way to do this is to wear reflective clothing and accessories. All partners need to develop a sustained and comprehensive intersection safety public awareness campaign that reaches both motorists and pedestrians.

Sample Pedestrian Safety Programs/Tools

Federal Highway Administration's Pedestrian Safety Campaign Planner

This toolkit contains outreach materials that states and local jurisdictions and communities can customize and

use locally. The threefold purpose of the campaign is to **(1)** sensitize drivers to the fact that pedestrians are legitimate road users and should always be expected on or near the roadway, **(2)** educate pedestrians about minimizing risks to their safety and **(3)** develop program materials to explain or enhance the operation of pedestrian facilities, such as crosswalks and pedestrian signals.
http://safety.fhwa.dot.gov/pedcampaign/index.htm

Federal Highway Administration's Crash Group/General Countermeasure Matrix

This tool identifies potential solutions for use by safety practitioners. This matrix is particularly helpful as a resource of potential engineering countermeasures, which may be implemented at a location to address a particular pedestrian crash type.
http://safety.fhwa.dot.gov/saferjourney/Library/matrix.htm

Federal Highway Administration's Pedestrian and Bicycle Crash Analysis Tool (PBCAT)

The Pedestrian and Bicycle Crash Analysis Tool is a crash-typing software intended to assist state and local pedestrian/bicycle coordinators, planners and engineers with improving walking and bicycling safety through the development and analysis of a database containing details associated with crashes between motor vehicles and pedestrians or bicyclists. The software allows a person to:

- Determine the *crash type* through a series of on-screen questions about the crash, crash location and maneuvers of the parties involved;
- Customize the database in terms of units of measurement, variables and location referencing, as well as import/export data from/to other databases;
- Produce a series of tables and graphs defining the various crash types and other factors associated with the crashes, such as age, gender and light conditions; and
- Recommend countermeasures linked to specific bicycle and pedestrian crash types and related resource and reference information.

This tool can be ordered free of charge through the following Web site. http://www.walkinginfo.org/pc/order.htm.

ITE/Partnership for A Walkable America

Pedestrian Project Awards

ITE, in cooperation with the Partnership for a Walkable America and a grant from the Robert Wood Johnson Foundation, conducted a Pedestrian Project Award Program in 2003. More than 106 submittals were received in six categories: safety, facilities, education, policy, partnerships and elderly and mobility impaired. Each submission, including the program description for both the winners and all nominees, has been digitized and is included on ITE's Transportation and Active Living Web Site as follows:
http://www.ite.org/activeliving/index.asp.

The 2003 Pedestrian Awards were given to the following organizations:

- **Safety.** City of Boulder Colorado and Short Elliott Hendrickson
- **Facilities.** New York Department of Transportation and Vollmer Associates LLP.
- **Education.** Utah Department of Health and the Utah Highway Safety Office for the Green Ribbon Month project.
- **Policies.** The Wisconsin Department of Transportation for the Wisconsin Pedestrian Policy Plan 2020.
- **Partnership.** City Council Member Richard Conlin and Feet First for Seattle's Pedestrian Summer project.
- **Elderly and Mobility Impaired.** City of Portland, et. al.

References

1. NHTSA, FARS, 2002.
2. Insurance Institute for Highway Safety, Status Report 35 (5), May 13, 2000.
3. Fatality Facts, Pedestrians 2002, Insurance Institute for Highway Safety.
4. NHTSA, FARS, 2000.
5. Insurance Institute for Highway Safety, Q&A: Pedestrians, December 2000.
6. Zegeer, Charles V. et. al. *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations. Executive Summary and Recommended Guidelines. FHWA RD-01-075*, February 2002. http://www.walkinginfo.org/pdf/r&d/crosswalk_021302.pdf

Additional Resources

FHWA. The Effects of Innovative Pedestrian Signs at Unsignalized Locations: A Tale of Three Treatments. REPORT NO. FHWA-RD-00-098 August 2000. http://www.walkinginfo.org/task_orders/to_11/3signs00.pdf

Florida Department of Transportation Pedestrian and Bicycle Research. http://www11.myflorida.com/safety/ped_bike/ ped_bike_reports.htm

Institute of Transportation Engineers. *Alternative Treatments for At-Grade Pedestrian Crossings*, Item LP-629. 2001, 200 pp., ISBN No: 0-935403-61-2.

Institute of Transportation Engineers. *Design and Safety of Pedestrian Facilities*, Item RP-026A. 1998, 115 pp.

National Center for Statistics and Analysis Advanced Research and Analysis. DOT HS 809 456 Technical Report: Pedestrian Roadway Fatalities, April 2003. http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/ Rpts/2003/809-456.pdf

Pedestrian and Bicycle Information Center. http://www.walkinginfo.org/

U.S. Access Board. http://www.access-board.gov/

Walkinginfo.org Accessible Pedestrian Signals Home Page. http://www.walkinginfo.org/aps/home.cfm