Chapter 1

The Big Picture

Photo by Michael Ronkin

Land Use

Assume That People Will Walk

Transit

Streets: The Arteries of Life

**How Pedestrians Are Affected by Traffic:
Traffic Volume and Speed**

ADA Design Guidelines

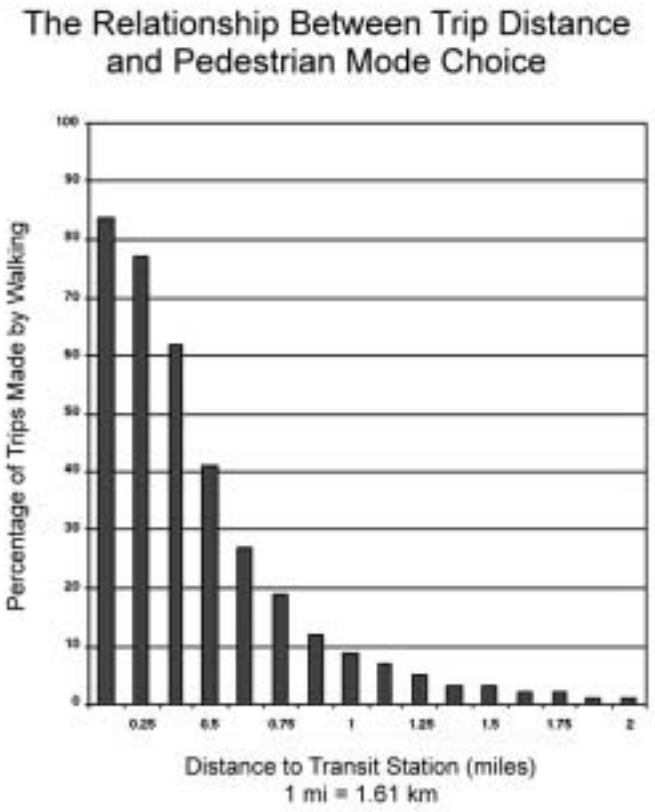
Land Use

Creating a walkable community starts with the very nature of the built environment: having destinations close to each other; siting schools, parks, and public spaces appropriately; allowing mixed-use developments; having sufficient densities to support transit; creating commercial districts that people can access by foot and wheelchair; and so on. Most walking trips are less than 0.8 km (0.5 mi).[1] While mixed-use developments with sufficient density to support transit and neighborhood commercial businesses can make walking a viable option for residents, single-use, low-density residential land-use patterns discourage walking. When residents are segregated from sites such as parks, offices, and stores, there will be fewer pedestrian trips because destinations are not close enough for walking. The connection between land-use planning and transportation planning is critical, but all too often ignored.

Integrating land-use and transportation planning allows new developments to implement these strategies from the onset. Communities that support balanced transportation make walking and public transit attractive options.

Photo by Cara Seiderman

Design streets for people to use them. Assume people will walk.



Source: Federal Transit Administration, Transit Cooperative Research Program, Transit and Urban Form, TCRP Report 16, 1996. Chart adapted from Figure 19.

In established communities, many of these goals can be met with "infill development" to increase density and community viability. Changes in zoning laws and sidewalk warrants to allow mixed-use development and pedestrian connections, such as sidewalks, easy-to-access crosswalks, and shared-use paths, can also increase pedestrian safety and mobility.

Photo by Cara Seiderman

A busy commercial street in Ann Arbor, Michigan emphasizes pedestrian use and provides attractive areas for people to sit, stroll, and meet.

Assume That People Will Walk

Whether building new infrastructure or renovating existing places, it should always be assumed that people will walk and plans should be made to accomodate pedestrians. People will want to walk everywhere they can, and a comfortable, inviting, and safe environment should be provided for them. There are many reasons that people walk: to run errands, to visit neighbors, to go to local stores, to take their children to the local park, for exercise, or even for the sheer enjoyment of being a pedestrian. Children should be able to walk to school or to their friends' houses. All of these activities constitute a significant number of trips. About four-fifths of all trips are non-work-related.(1)

If people aren't walking, it is probably because they are prevented from doing so. Either the infrastructure is insufficient or has serious gaps. Are there continuous walkways? Are there physical barriers such as rivers, drainage ways, walls, or freeways that prevent convenient walking access in a community? Do bridges for automobiles also provide a safe walking area for pedestrians? Does the lack of curb ramps or the existence of steep grades or steps prevent access for the elderly or people in wheelchairs? Are there information barriers preventing people with visual disabilities from crossing the street? Is there a major road that separates the residential neighborhood from the commercial district? Are there places for people to cross roads safely?

Walking rates in different neighborhoods within the same city are directly related to the quality of the system. In other words, in high-quality pedestrian environments, lots of people walk. Where the system fails — missing sidewalks, major barriers, no safe crossings — people walk less, and those who do are at greater risk.

People also want to walk in an environment where they can feel safe, not only safe from motor vehicle traffic, but safe from crime or other concerns that can affect personal security. Areas need to be well lit to encourage walking during evening hours. If the pedestrian system is not accessible, it is often not safe. For example, lack of access may cause wheelchair users to use the street rather than a poorly maintained sidewalk. Some populations may be at a higher risk of pedestrian crashes. Children under age 15 are the most overrepresented group in pedestrian crashes and people over age 65 have the most pedestrian fatalities. Therefore, it is especially important to provide adequate facilities in the vicinity of land uses such as retirement homes and school zones.

The walking environment should be open and inviting, but not sterile and vacant. Pedestrians need more than sidewalks and crosswalks. In addition to protecting pedestrians from motor vehicle traffic, it is important to have a secure, pleasant, and interesting walking environment to encourage people to walk.

Traditionally, safety problems have been addressed by analyzing police crash reports and improvements have been made only after they are warranted by crash numbers. However, planners and engineers should consider problem-identification methods such as interactive public workshops, surveying pedestrians and drivers, and talking with police to identify safety problems in an area before crashes occur. This may help proactively identify locations for pedestrian safety improvements and will involve citizens in the process of improving safety and mobility in their own communities.

Transit

Walking and transit are complementary. Good walking conditions for pedestrians are important inducements to using public transportation, since most public transit trips include a pedestrian trip at one or both ends. People should be able to walk to a bus stop or a train station from their homes and to jobs, shopping, and other activities. Conversely, good public transportation, with buses, subways, and paratransit vehicles that run frequently and are reliable, is essential to achieving a walkable city. The trip should be as seamless as possible and transit stops should be friendly, comfortable places. When development occurs around a transit stop, more transit can be supported, and people will have more options for how to travel there. Special attention should be paid to how people will get from the transit stop to their destinations. No matter how convenient the trip is otherwise, if pedestrians don't feel safe for even a short distance, they will choose not to go, or to go by another mode (usually driving — and the more people who drive, the less pedestrian-friendly a place becomes).

Streets: The Arteries of Life

Streets serve many functions, including:

- **Linkage**. They connect parts of cities to each other, one town to another, and activities and places.
- **Transportation**. They provide the surface and structure for a variety of modes. All modes and users should be provided for: pedestrians, bicyclists, transit, motor vehicles, emergency services, maintenance services, etc.
- **Access**. They provide public access to destinations.

Pedestrian injuries are less severe on lower speed roadways. The street pictured above is a heavily traveled arterial in one of Seattle, Washington's thriving residential neighborhoods. High speed and concerns about pedestrian safety resulted in the redesign shown in the "after" picture. Bike lanes and a median strip have encouraged slower traffic speeds. Speeds were reduced by about 4.8 km/h (3 mi/h), while average daily traffic remained about the same.

- **Public right-of-way**. Space for utilities and other underground infrastructure is usually a hidden function of the street.
- **Sense of place**. The street is a definable place, a place for people to interact, the heart of a community. A street can serve this role by being a venue for parties, fairs, parades, and community celebrations, or by simply being a place where neighbors stop to chat.

Streets are often designed to emphasize some functions over others. At one extreme is a limited-access highway that serves as a corridor for motor vehicle travel. At the other extreme is a private cul-de-sac, which has no linkage and has limited access. Many streets are designed so that certain desirable functions are not provided. Examples include commercial streets where access to destinations is difficult, and strip development along high-speed roads where no sidewalks or pedestrian crossings exist.

When streets and roads are evaluated for improvements, it is helpful to consider whether the design effectively meets all the desired functions of the roadway. If not, the street should be redesigned to adequately meet those functions.

How Pedestrians Are Affected by Traffic: Traffic Volume and Speed

High volumes of traffic can inhibit a person's feeling of safety and comfort and create a "fence effect" where the street is almost an impenetrable barrier. The effect of traffic volumes on community life has been measured. In his seminal 1980 study, Donald Appleyard looked at how traffic volumes on comparable streets in San Francisco affected community life. People living on a street with light traffic (2,000 vehicles per day) had three times as many friends and twice as many acquaintances on the street as did people living on a street with heavy traffic (16,000 vehicles a day).[2]

Traffic speed is usually the more critical aspect to walkability and safety. Though pedestrians may feel comfortable on streets that carry a significant amount of traffic at low speeds, faster speeds increase the likelihood of pedestrians being hit. At higher speeds, motorists are less likely to see a pedestrian, and even less likely to actually stop in time to avoid a crash. At a mere 49.9 km/h (31 mi/h), a driver will need about 61.0 m (200 ft) to stop, which may exceed available sight distance; that number is halved at 30.6 km/h (19 mi/h).[3]

Unfortunately, most of our streets are designed to encourage higher traffic speeds. Fortunately, we do have tools that can change this, primarily by redesigning streets through traffic calming or by designing new streets with lower design speeds. Speed reductions can increase pedestrian safety considerably. The safety benefits of reduced speeds

extend to motorists and cyclists as well, although the advantage to pedestrians is the most substantial.

Photo by Dan Burden

This roadway may act as a barrier to pedestrians. Those who are walking along the waterfront may find it difficult to cross to the commercial establishments and those on the commercial side may be reluctant to cross to the waterfront.

ADA Design Guidelines

The Americans with Disabilities Act (ADA) was passed to ensure that all people, including those with disabilities, have equal access to transportation. People with disabilities may have limited visual and cognitive ability, or a combination of disabilities, which is more common as a person grows older. A person may experience a disability on a permanent or temporary basis. Without accessible pedestrian facilities, people with disabilities will have less opportunities to engage in employment, school, shopping, recreation, and other everyday activities. New or altered facilities must provide access for all pedestrians. This also needs to occur when implementing all the tools and treatments that are presented in this guide.

While improvements for persons with disabilities were mandated by the Federal Government to ensure access and mobility for physically-challenged pedestrians, most of these improvements benefit all pedestrians. Some of the items that will be presented in this guide, such as adequate time to cross streets, well-designed curb ramps, limited driveways, and sidewalks that are wide and clear of obstructions and have minimal cross-slope, are examples of design features that will accommodate pedestrians with disabilities, persons using strollers, and indeed, all pedestrians.[4]

Photo by Kristen P. Oguntoyinbo

Street designs that accommodate people with disabilities create a better walking environment for all pedestrians.

All new construction or retrofit projects must include curb ramps that comply with ADA requirements. Agencies should review their street system to identify other barriers to accessibility and prioritize the needed improvements. Examples of barriers that are often overlooked include poles and signs in the middle of a sidewalk, steeply sloped driveways, and interruptions such as broken or missing sidewalk sections. An adequate level of surveillance and maintenance can also be important to providing accessibility, especially in winter months in areas where snow accumulates. While all streets should be upgraded to be accessible, public agencies should set priorities for high-use areas, such as commercial districts, schools, parks, transit facilities, etc., and retrofit as rapidly as possible.

Chapter 2

Pedestrian Crash Factors

Photo by Dan Burden

Pedestrian Crash Statistics

Pedestrians Most at Risk

Alcohol Impairment

Speeding

Times of Occurrence

Area Type

Location Type

Crash Types and Countermeasures

Typing Pedestrian Crashes

Chapter 1 provided an overview of the need to provide a more pedestrian-friendly environment along and near streets and highways. Chapter 2 addresses the pedestrian crash problem and related factors that must be understood to select appropriate facilities to improve pedestrian safety and mobility. A brief discussion of the pedestrian crash problem in the United States is given below and is also reported by Zegeer and Seiderman in a related publication.(1)

Pedestrian Crash Statistics

Pedestrian/motor vehicle crashes are a serious problem throughout the world and the United States has a particular problem with pedestrian deaths and injuries.

Specifically, 4,906 pedestrians were reported to have been killed in motor vehicle crashes in the United States in 1999.(2) These deaths accounted for 11.8 percent of the 41,611 motor vehicle deaths nationwide that year. An estimated 85,000 pedestrians were injured or killed in motor vehicle collisions, which represents 2.6 percent of the 3.2 million total persons injured in traffic crashes.(2) A drop in pedestrian fatalities in recent years may reflect the fact that people are walking less, as evidenced by the U.S. Census and the Nationwide Personal Transportation Survey (NPTS). The need to reduce pedestrian deaths and injuries while promoting increased walking continues to be an important goal for the engineering profession.

Pedestrians Most at Risk

Crash involvement rates (crashes per 100,000 people) are the highest for 5- to 9-year-old males, who tend to dart out into the street. This problem may be compounded by the fact that speeds are frequently a problem in areas where children are walking and playing.

In general, males are more likely to be involved in a crash than females; in 1999, more than 70 percent of pedestrian fatalities were male and the male pedestrian injury rate was a third higher than for females.(2)

Rates for older persons (age 65 and over) are lower than for most age groups, which may reflect greater caution by older pedestrians (e.g., less walking at night, fewer dart-outs) and a reduced amount of walking near traffic. However, older adult pedestrians are much more vulnerable to serious injury or death when struck by a motor vehicle than younger pedestrians. For example, the percentage of pedestrian crashes resulting in death exceeds 20 percent for pedestrians over age 75, compared to less than 8 percent for pedestrians under age 14.(3-4)

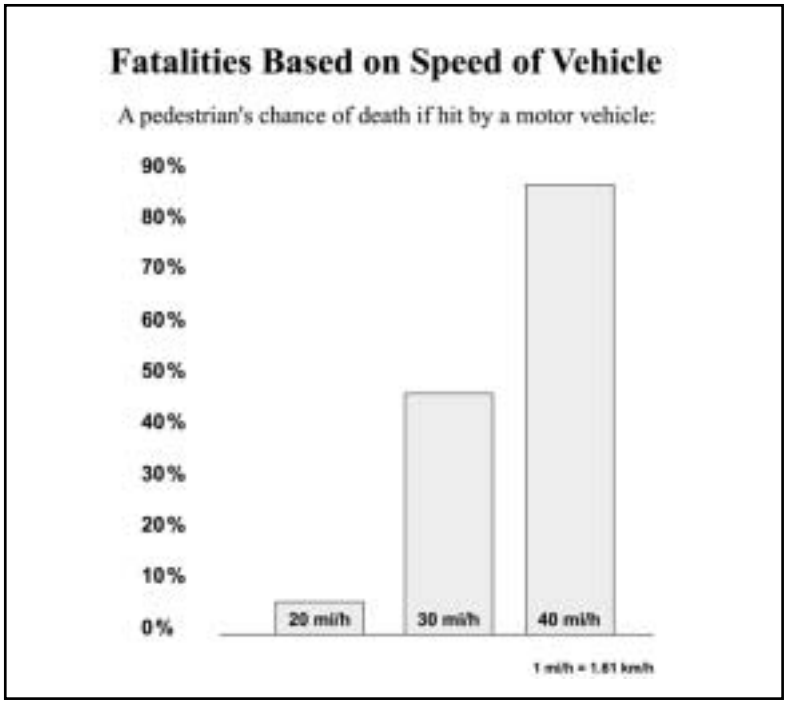
Photos by Dan Burden

Alcohol Impairment

Alcohol impairment is a serious problem for pedestrians as well as drivers of motor vehicles, although there is evidence that the picture is improving. From 1980 through 1989, 37 percent to 44 percent of fatally injured pedestrians had a blood alcohol concentration (BAC) of .10 or greater. In 1997, that figure was 29.5 percent and the intoxication rate for drivers was 12.5 percent. In 1989, of all adult pedestrians killed in nighttime collisions with motor vehicles, 59 percent had a BAC of .10 or greater, while only 31 percent had no alcohol in their blood.[4-5] From 1987 to 1997, the intoxication rates for pedestrian fatalities in all age groups decreased, with the highest decrease, 19 percent, for those 55 to 64 years old and the least decrease, 3 percent, for those 35 to 44 years old.[2,6]

Speeding

Speeding is a major contributing factor in crashes of all types. In 1997, speeding was a contributing factor in 30 percent of all fatal crashes.[2] Speeding has serious consequences when a pedestrian is involved. A pedestrian hit at 64.4 km/h (40 mi/h) has an 85 percent chance of being killed; at 48.3 km/h (30 mi/h), the likelihood goes down to 45 percent, while at 32.2 km/h (20 mi/h), the fatality rate is only 5 percent.[7] Faster speeds increase the likelihood of a pedestrian being hit. At higher speeds, motorists are less likely to see a pedestrian, and are even less likely to be able to stop in time to avoid hitting one.



Photos by Dan Burden

Times of Occurrence

Photo by Dan Burden

Pedestrian crashes are most prevalent during morning and afternoon peak periods, when the traffic levels are highest. Fatal pedestrian crashes typically peak later in the day, between 5 and 11 p.m., where darkness and alcohol use are factors.[6] In 1997, nearly one-half of all pedestrian fatalities occurred on Friday, Saturday, or Sunday (17 percent, 18 percent, and 13 percent, respectively).[2,9] Crashes where older pedestrians are hit are more evenly distributed throughout the days of the week than those for younger pedestrians. Older pedestrians are more likely to be struck during daylight hours, when they are most likely to be exposed to traffic.[3] September through January have the highest number of nationwide pedestrian fatalities, with typically fewer daylight hours and more inclement weather.[4,8] Child pedestrian fatalities are greatest in May, June, and July, perhaps due to an increase in outside activity.[8]

Area Type

Pedestrian crashes occur most frequently in urban areas where pedestrian activity and traffic volumes are greater compared to rural areas. The National Safety Council estimates that 85.7 percent of all nonfatal pedestrian crashes in the United States occur in urban areas and 14.3 percent occur in rural areas. However, 25 percent of pedestrian fatalities occur in rural areas, where vehicle speeds are higher than on city streets.[8,10] In addition, many rural areas have no sidewalks, paths, or shoulders to serve as separated pedestrian facilities.

Location Type

In terms of crash location, 65 percent of crashes involving pedestrians occur at non-intersections. This is particularly true for pedestrians under age 9, primarily because of dart-outs into the street. For ages 45 to 65, pedestrian crashes are approximately equal for intersections and non-intersections. Pedestrians age 65 and older are more likely to be struck at intersections (60 percent) compared to non-intersections (40 percent), since older pedestrians tend to cross at intersections more often than younger ones.[9] Moreover, some older pedestrians have physical and vision disabilities that place greater demand on intersection design.[8-9] Studies have shown that older pedestrians are particularly overrepresented in crashes at intersections involving left-turning and right-turning vehicles.[3]

Crash Types and Countermeasures

Close examination of pedestrian crashes can suggest corrective measures to lessen the likelihood of some of these crashes. In the 1970s, methods for typing pedestrian and bicycle crashes were developed by the National Highway Traffic Safety Administration (NHTSA) to better define the sequence of events and precipitating actions leading to pedestrian/motor vehicle crashes.[11-13] These methodologies were applied by Hunter in a 1996 study to more than 8,000 pedestrian and bicycle crashes from 6 States.[14] The results provided a representative summary of the distribution of crash types experienced by pedestrians and bicyclists. Some of the most frequently occurring types, include dart-out first half (i.e., the pedestrian is struck in the first half of the street being crossed) (24 percent), intersection dash (13 percent), dart-out second half (10 percent), midblock dart (8 percent), and turning-vehicle crashes (5 percent).[11-13]

Typing Pedestrian Crashes

The development of effective roadway design and operation, education, and enforcement measures to accommodate pedestrians and prevent crashes is hindered by insufficient detail in computerized State and local crash files. Analysis of these databases can provide information on where pedestrian crashes occur (city, street, intersection, two-lane road, etc.), when they occur (time of day, day of week, etc.), and characteristics of the victims involved (age, gender, injury severity, etc.). Current crash files cannot provide a sufficient level of detail regarding the sequence of events leading to the crash.

The crash-typing methodology described above has evolved over time and has been refined as part of a software package known as the Pedestrian and Bicycle Crash Analysis Tool (PBCAT). The development of PBCAT was sponsored by the Federal Highway Administration (FHWA) and NHTSA through the University of North Carolina Highway Safety Research Center.

PBCAT is a software product intended to assist State and local pedestrian and bicycle coordinators, planners, and engineers with the problem of lack of data regarding the sequence of events leading to a crash. PBCAT accomplishes this goal through the development and analysis of a database containing details associated with crashes between motor vehicles and pedestrians or bicyclists. One of these details is the crash type, which describes the pre-crash actions of the parties involved. Of the more than 60 specific pedestrian crash types used for PBCAT, there are 13 general classifications useful for grouping pedestrian crashes. They are defined in Chapter 3. With the database developed, the software can then be used to produce reports and select countermeasures to address the problems identified. Those interested may reg-

ister for the PBCAT software and user's manual from the Pedestrian and Bicycle Information Center website at: www.walkinginfo.org/pbcat.

Chapter 3

Selecting Pedestrian Safety Improvements

Photo by Dan Burden

Methods to Identify High-Crash/High-Risk Locations

Methods to Improve Pedestrian Safety

Crash-Related Countermeasures

Definitions of Pedestrian Crash Types

This chapter is divided into three sections. The first section discusses the process of identifying locations for safety treatments where pedestrian crashes have occurred in the past and may occur in the future. The second section of this chapter is a general discussion of methods to improve pedestrian safety. The chapter concludes by providing a matrix of pedestrian engineering and operational improvements that might be used to address 13 pedestrian crash groups.

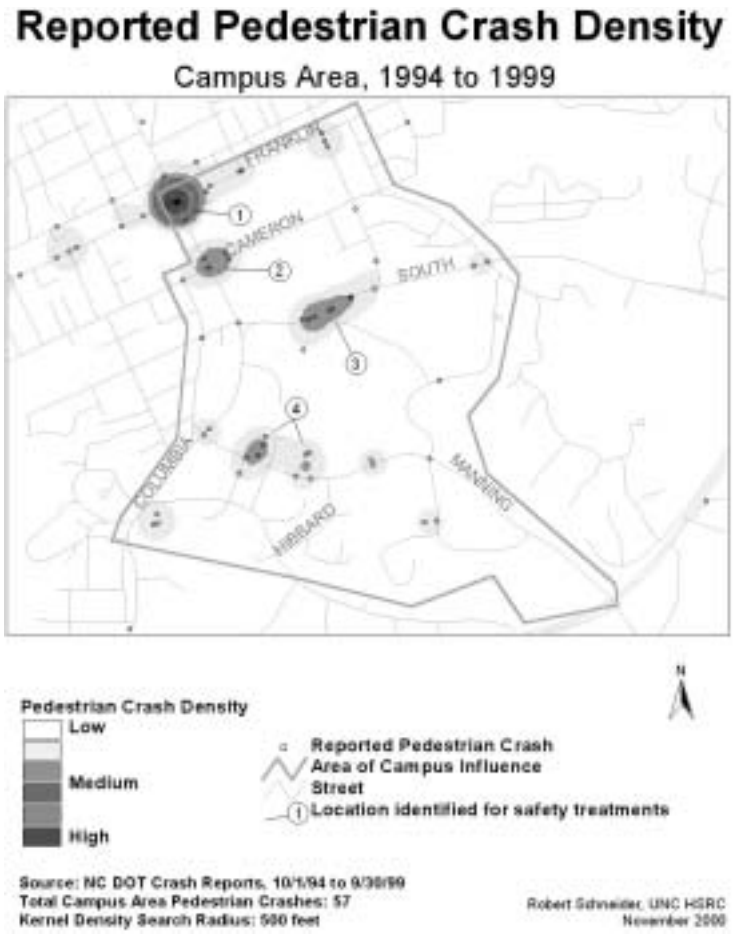
Photo by Robert Schneider

Methods to Identify High-Crash/High-Risk Locations

A first step in the process of improving pedestrian safety is to identify locations or areas where pedestrian crash problems exist and where engineering, education, and enforcement measures will be most beneficial. Mapping the locations of reported pedestrian crashes in a neighborhood, campus, or city is a simple method of identifying sites for improving walking safety. One method of analyzing crash locations includes using computerized Geographic Information Systems (GIS) software, as shown by the density map of reported pedestrian crashes on a college campus pictured on the next page.

This type of map can help transportation engineers and planners focus safety improvements on intersections, street sections, or neighborhoods where pedestrian crashes have occurred.

Several issues should be considered when creating GIS maps of reported crash locations. First, the total number of pedestrians and vehicles that use each location will affect reported crash density.



Second, pedestrian crashes may not be reported frequently enough to establish a pattern of unsafe walking locations. In either case, performing a conflict analysis, noting pedestrian and driver behavior or examining roadway and walkway characteristics at specific sites, or mapping locations known to have a high potential for pedestrian crashes in an area may improve the identification of unsafe locations for walking. Other methods for identifying locations with pedestrian problems include using walkability checklists and calculating a pedestrian level of service.

Methods to Improve Pedestrian Safety

Some pedestrian crashes are associated with deficient roadway designs. Pedestrians and motorists often contribute to pedestrian crashes through a disregard or lack of understanding of laws and safe driving or walking behavior.(1) Because most crashes are a result of human error, crashes will not be completely eliminated as long as pedestrians and vehicles share the same space. Yet, the consequences of these crashes are exacerbated by speeding, failing to yield, or failing to check both directions for traffic, so new education, enforcement,

and engineering tools are needed to manage the conflict between pedestrians and drivers.

A complete program of pedestrian safety improvements includes:[1-2]

- Provision of pedestrian facilities, such as sidewalks and crosswalks.
- Roadway and engineering measures, such as traffic control devices, lighting, and roadway design strategies implemented on streets and highways for both pedestrian and vehicular movements.
- Programs to enforce existing traffic laws and ordinances for motorists (e.g., obeying speed limits, yielding to pedestrians when turning, traffic signal compliance, obeying drunk-driving laws) and pedestrians (e.g., crossing the street at legal crossings, obeying traffic and pedestrian signals).
- Forgiving vehicle designs that minimize pedestrian injury from vehicle impact.
- Wearing of reflective clothing and materials by pedestrians, and/or using a flashlight when walking at night.
- Education programs provided to motorists and pedestrians.

Roadway improvements can often reduce the likelihood of a pedestrian crash. Physical improvements are most effective when tailored to an individual location and traffic problem. Factors to consider when choosing an improvement include: location characteristics, pedestrian and vehicle volume and types, vehicle speed, design of a given location, city laws and ordinances, and financial constraints.[1,3]

It is important to remember that overuse or unjustified use of any traffic control measure is not recommended, since this may breed disrespect for such devices.[4] Although facilities for pedestrians can, in many cases, reduce the risk of pedestrian collisions, crash reduction is not the only reason for providing such facilities. Other benefits of pedestrian facilities include improved access to destinations by walking, better air quality due to less dependence on driving, and improved personal health. Traffic and transportation engineers have the responsibility for providing facilities for all modes of travel, including walking.[1]

Crash-Related Countermeasures

A total of 47 different pedestrian measures are presented in this guide that address various types of roadway situations. However, engineers and planners may want further guidance on which pedestrian measures are appropriate to address certain types of pedestrian crashes.

Pages 22-25 contain a matrix of 12 pedestrian crash groupings, with a list of 49 possible countermeasures. The final two countermeasures, education and enforcement, are essential complements to each of the 47 engineering treatments. Although they are not discussed in detail in this guide, they are addressed in several education and enforcement references. The dots in the matrix suggest the countermeasures that

may be primary candidates to address a given crash type, which takes into account whether the crash type occurs at an intersection or midblock location. The secondary benefits are not included in the matrix. For example, the primary purpose of a pedestrian street is to address midblock crash types (e.g., dartout, dash). Although a pedestrian may have the secondary benefit of eliminating a "through vehicle at intersection" crash type, it is not a suggested treatment for this crash type. Instead, such countermeasures as mini-circles, intersection diverters, etc., are suggested in the matrix to address "through vehicle at intersection" crashes.

To illustrate how to use the table, consider the second crash type on the table ("Multiple Threat"). This is a crash involving an unsignalized crossing on a multi-lane road, where one vehicle stops to let a pedestrian cross the street. The pedestrian steps into the street in front of the stopped vehicle and then continues into the adjacent lane in front of an oncoming vehicle and is struck. The driver of the second vehicle may not see the pedestrian, since the sight distance is typically blocked by the first (stopped) vehicle.

The chart shows that there are 20 potential countermeasures that may reduce the probability of this type of crash, depending on the site conditions. These countermeasures include curb extensions (which improve sight distance between pedestrians and motorists), pedestrian crossing islands (which provide places of refuge in the middle of the street), crosswalk enhancements, and other possible countermeasures.

After the four-page countermeasure matrix, a more detailed listing is given for each crash type that shows potential countermeasures for various possible causes or problems. For example, for Crash Group 2 (Multiple Threat), three possible causes or problems contributing to this crash type include:

- Motorist's view of pedestrian is blocked so motorist fails to yield.
- Pedestrian tries to cross high-speed and/or high-volume arterial street.
- Pedestrian does not have adequate time to cross multi-lane road way.

A different list of countermeasures is given for each of these three possible contributing factors.

These charts are intended to give general information on candidate measures that should be considered when trying to reduce a pattern of pedestrian crashes at a location or roadway section. Many pedestrian crashes are the direct result of careless or illegal driver behavior and/or unsafe pedestrian behavior. Many of these crashes cannot necessarily be prevented by roadway improvements alone. In such cases, pedestrian and/or motorist education and enforcement activities may be helpful.

The next chapter provides details on the 47 engineering improvements to enhance pedestrian safety and mobility.

CRASH GROUP	Midblock Dart/Dash	Multiple Threat	Midblock Mailbox Etc.	Failure to Yield (Unsignalized)	Bus-Related
COUNTERMEASURES					
1. Sidewalk/Walkway					•
2. Curb Ramp				•	•
3. Crosswalk Enhancements	•	•		•	•
4. Transit Stop Treatments	•	•		•	•
5. Roadway Lighting	•	•	•	•	•
6. Overpass/Underpass	•	•		•	
7. Street Furniture	•				•
8. Bike Lane/Shoulder	•	•	•	•	•
9. Road/Lane Narrowing	•	•	•	•	
10. Fewer Lanes		•		•	•
11. Driveway Improvement					
12. Raised Median	•	•	•	•	
13. One-Way Street					
14. Smaller Curb Radius				•	
15. Right-Turn Slip Lane					
16. Modern Roundabout					
17. Modified T-Intersection					
18. Intersection Median Barrier		•		•	
19. Curb Extension	•	•		•	•
20. Choker	•			•	
21. Pedestrian Crossing Island	•	•		•	•
22. Chicane	•		•	•	
23. Mini-Circle					
24. Speed Humps	•		•	•	
25. Speed Table	•	•	•	•	
26. Raised Intersection				•	

Turning Vehicle At Intersection	Through Vehicle At Intersection	Walking Along Roadway	Working/ Playing in Road	Not in Road	Backing Vehicle	Crossing Expressway
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CRASH GROUP	Midblock Dart/Dash	Multiple Threat	Midblock Mailbox Etc.	Failure to Yield (Unsignalized)	Bus-Related
COUNTERMEASURES					
27. Raised Ped. Crossing	•	•		•	•
28. Gateway	•		•	•	
29. Landscape Options				•	
30. Paving Treatments				•	
31. Driveway Link/Serpentine	•			•	
32. Woonerf	•				
33. Diverter	•				
34. Full Street Closure	•				
35. Partial Street Closure	•				
36. Pedestrian Street	•			•	
37. Traffic Signal	•	•		•	•
38. Pedestrian Signal	•	•		•	•
39. Pedestrian Signal Timing					
40. Signal Enhancement	•				
41. RTOR Restriction					
42. Advanced Stop Lines		•			•
43. Sign Improvement	•	•	•	•	•
44. School Zone Improvement	•	•		•	•
45. Identify Neighborhood	•		•	•	
46. Speed-Monitoring Trailer	•		•	•	
47. Parking Enhancement	•		•	•	•
48. Ped./Driver Education	•	•	•	•	•
49. Police Enforcement	•	•	•	•	•

Turning Vehicle At Intersection	Through Vehicle At Intersection	Walking Along Roadway	Working/ Playing in Road	Not in Road	Backing Vehicle	Crossing Expressway
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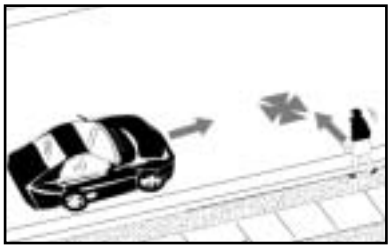
Of the more than 60 specific pedestrian crash types, there are 13 crash groupings (12 specific types and 1 miscellaneous type) that are most useful for identifying safety problems and corresponding countermeasures. They are defined below:

Definitions of Pedestrian Crash Types

1. Midblock: Dart/Dash



The pedestrian walked or ran into the roadway and was struck by a vehicle. The motorist's view of the pedestrian may have been blocked until an instant before the impact, and/or the motorist may have been speeding.

Possible Cause/Problem #1

Child runs into neighborhood/collector street.

General Countermeasures

a. Implement traffic-calming measures such as speed humps, speed tables, or chicanes.
b. Remove or restrict on-street parking.
c. Provide adequate nighttime lighting.
d. Provide curb extensions.
e. Install spot street narrowing at high midblock-crossing locations.
f. Narrow travel lanes.
g. Install street closure/diagonal diverter at selected intersection(s).
h. Provide adult crossing guard (in school zone).
i. Educate children about safe crossing behavior and adults about speeding.
j. Add on-street bike lanes.
k. Convert street to woonerf, pedestrian street, or driveway link/serpentine.
l. Design gateway to alert motorists that they are entering neighborhood with high level of pedestrian activity.
m. Provide a raised pedestrian crossing.

Possible Cause/Problem #2

Pedestrian tries to cross high-speed and/or high-volume arterial street.

General Countermeasures

a. Install medians or pedestrian crossing islands.
b. Provide staggered crosswalk through the median (forcing pedestrians to walk and look to the right for oncoming traffic in the second half of street).
c. Provide curb extensions at intersections or midblock to improve direct line of sight between vehicle and pedestrian.
d. Improve/add nighttime lighting.
e. Install midblock traffic signal with pedestrian signals, if warranted.
f. Install standard warning sign (see *Manual on Uniform Traffic Control Devices* (MUTCD)) or yellow or fluorescent yellow/green signs to alert drivers to pedestrian crossing area.
g. Install overpass or underpass.

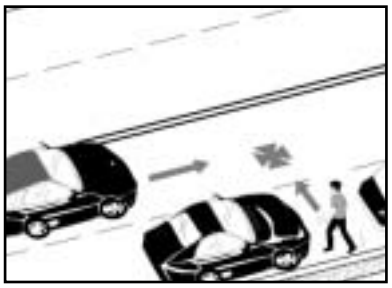
h. Enforce speed limits, pedestrian ordinances.
i. Add traffic-calming measures.
j. Bus young children across busy streets or adjust school district boundaries.
k. Relocate bus stop.
l. Use speed-monitoring trailer.

2. Multiple Threat

The pedestrian entered the traffic lane in front of stopped traffic and was struck by a vehicle traveling in the same direction as the stopped vehicle. The stopped vehicle may have blocked the visibility between the pedestrian and the striking vehicle, and/or the motorist may have been speeding.

Possible Cause/Problem #1

Motorist's view of pedestrian is blocked and motorist fails to yield.



General Countermeasures

a. Recess stop lines 9.1 m (30 ft) in advance of crosswalk.
b. Install traffic signals with pedestrian Hand/Man or WALK/DON'T WALK signals, if warranted.
c. Provide midblock or intersection curb extensions.
d. Install traffic-calming devices such as speed tables or raised pedestrian crossings on local or other neighborhood streets.
e. Install barriers or signs to prohibit crossings and direct pedestrians to safer crossing locations nearby.
f. Provide raised crosswalks to improve pedestrian visibility.
g. Install advance warning signs or flashers.
h. Relocate bus stop to far side of crossing area.
i. Improve roadway lighting.
j. Enforce crosswalk laws.

Possible Cause/Problem #2

Pedestrian tries to cross high-speed and/or high-volume arterial street.

General Countermeasures

a. Narrow travel lanes (e.g., add bike lanes) to slow vehicle speeds and reduce crossing distance.
b. Reduce roadway width. For example, modify four-lane undivided roadways to two through lanes with sidewalks and bike lanes, plus a center two-way left-turn lane (or raised median).
c. Increase police enforcement of speed limit.
d. Construct overpass or underpass.
e. Install raised median or pedestrian crossing island.

Possible Cause/Problem #3

Pedestrian does not have adequate time to cross multi-lane roadway.

General Countermeasures

a. Install traffic signals with pedestrian WALK/DON'T WALK signals, if warranted.

b. Adjust pedestrian signal timing.
c. Provide raised crosswalk to improve pedestrian visibility.
d. Provide midblock or intersection curb extensions.
e. Install raised pedestrian crossing island.
f. Enforce crosswalk laws.
g. Reduce roadway width.

3. Mailbox or Other Midblock

The pedestrian was struck while getting into or out of a stopped vehicle or while crossing the road to/from a mailbox, newspaper box, ice-cream truck, etc.

Possible Cause/Problem #1

Pedestrian struck while going to/from a private residence mailbox/newspaper box.

General Countermeasures

a. Relocate mailboxes to safer crossing area or provide safer crossings at existing location.
b. Improve lighting.
c. Provide traffic-calming measures (e.g., chicanes or raised devices on residential streets).
d. Add bike lanes and reduce total roadway and lane width.
e. Install pedestrian warning signs (see MUTCD).
f. Implement driver education program.
g. Implement pedestrian education program.
h. Provide raised median on multi-lane arterial street.
i. Construct gateway or provide signs that identify neighborhood as an area with high levels of pedestrian activity.

Possible Cause/Problem #2

Pedestrian struck while going to/from an ice-cream vendor or similiar destination.

General Countermeasures

a. Reduce lane or roadway width.
b. Add pedestrian crossing islands to roadway.
c. Provide traffic-calming measures on local streets.
d. Create Public Service Announcements (PSAs) to educate parents, children, and drivers.
e. Adopt an Ice-Cream Truck Ordinance. This ordinance would prohibit motorists from passing a stopped ice-cream truck. Trucks would be equipped with flashing lights and a "stop" arm that would extend when the truck stopped to serve children.

Possible Cause/Problem #3

Pedestrian struck while getting into/out of parked vehicle or by an emergency or speeding vehicle.

General Countermeasures

a. Implement speed-reduction measures such as chicanes or speed tables.
b. Implement traffic-calming measures on local/collector streets.
c. Restrict on-street parking.
d. Increase police enforcement of speed limit.

4. Failure to Yield at Unsignalized Location

At an unsignalized intersection or midblock location, a pedestrian stepped into the roadway and was struck by a vehicle. The motorist failed to yield to the pedestrian and/or the pedestrian stepped directly into the path of the oncoming vehicle.

Possible Cause/Problem #1

Motorist fails to yield to pedestrian at two-lane, low-speed road crosswalk (or unmarked crossing).

General Countermeasures

a. Install raised intersection, raised crosswalk, speed table, or speed humps with truncated domes at both ends.
b. Install overhead CROSSWALK, school zone, or other warning signs.
c. Install curb extensions or choker.
d. Construct raised pedestrian crossing island.
e. Install traffic signal with pedestrian signals, if warranted.
f. Add chicane, use serpentine design or use special paving treatments along street to slow traffic.
g. Use landscaping that slows vehicle speeds without impeding sightlines.
h. Reduce curb radius to slow vehicle speeds.

Possible Cause/Problem #2

Pedestrian has difficulty crossing multi-lane road.

General Countermeasures

a. Install raised medians or pedestrian crossing islands.
b. Install traffic signal with pedestrian signals, if warranted.
c. Modify four-lane, undivided street to two lanes plus a two-way, left-turn lane (TWLTL) or median with turning pockets and bike lanes.
d. Install nighttime lighting.
e. Use police speed enforcement.
f. Use far-side bus stops.
g. Narrow lanes, reduce number of lanes, and/or install bike lanes.
h. Construct overpass or underpass.
i. Ensure that curb ramps are provided to make crossing easier for all pedestrians.

Possible Cause/Problem #3

Motorist unwilling to yield due to high motorist speeds or high traffic volumes.

General Countermeasures

a. Implement traffic-calming measures.
b. Narrow roadway by reducing number of lanes, reducing lane widths, and/or adding bicycle lanes.
c. Provide gateway, identify neighborhood with signs, and/or create a pedestrian street.
d. Increase police enforcement of speed limit.
e. Construct pedestrian crossing islands.
f. Install traffic signal with pedestrian signals, if necessary.
g. Install signs or sidewalk barriers to guide pedestrians to safer crossing locations.
h. Use speed-monitoring trailer.

5. Bus-Related

The pedestrian was struck by a vehicle either: (1) by crossing in front of a commercial bus stopped at a bus stop; (2) going to or from a school bus stop; or (3) going to or from, or waiting near, a commercial bus stop.

Possible Cause/Problem #1

Motorist fails to yield to pedestrian or pedestrian crosses during inadequate gap in traffic due to limited sight distance at intersection.

General Countermeasures

a. Move bus stop to far side of intersection or crosswalk.
b. Install curb extension.
c. Consider an alternative bus stop location.
d. Install pedestrian crossing islands or raised crosswalk.
e. Install or improve roadway lighting.
f. Install crosswalk markings to encourage pedestrians to cross in the crosswalk behind the bus.
g. Mark bus stop area with pedestrian warning signs.
h. Remove parking in areas that obstruct the vision of motorists and pedestrians.

Possible Cause/Problem #2

Pedestrian has difficulty walking along roadway and crossing at midblock location with high vehicle speeds and/or high volumes.

General Countermeasures

a. Provide bus pull-off area.
b. Consider an alternative bus stop location.
c. Install midblock curb extensions.
d. Provide curb ramps and an accessible sidewalk.
e. Install sidewalk and/or sidewalk barriers to direct pedestrians to a nearby crossing location.
f. Provide pedestrian education/training.
g. Add bike lanes or painted shoulder.
h. Add recessed stop lines.

i. Increase police speed enforcement.
j. Install or improve roadway lighting.
k. Reduce number of roadway lanes.
l. Install traffic and pedestrian signals, if warranted.

Possible Cause/Problem #3

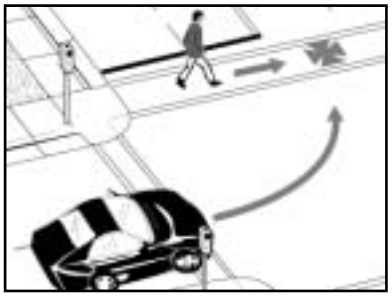
Pedestrian has difficult time crossing, waiting, or walking in the vicinity of school bus stop.

General Countermeasures

a. Select safer location for school bus stop.
b. Implement pedestrian/driver education programs.
c. Involve school, neighborhood groups, and PTA in promoting enforcement and education.
d. Provide sidewalks.
e. Provide street furniture or other amenities at bus stop.
f. Install or improve roadway lighting.
g. Enforce regulations against passing stopped school bus.
h. Educate pedestrians to cross behind the bus.

6. Turning Vehicle at Intersection

The pedestrian was attempting to cross at an intersection and was struck by a vehicle that was turning right or left.

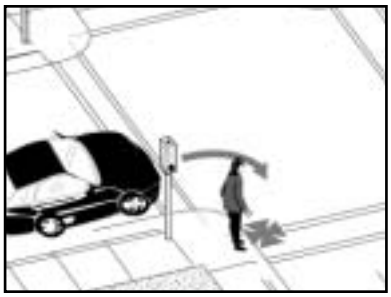


Possible Cause/Problem #1

Conflict between pedestrian and left-turning vehicle.

General Countermeasures

a. Prohibit left turns.
b. Provide separate left-turn and WALK/DON'T WALK signals.
c. Add special pedestrian signal phasing (e.g., exclusive protected pedestrian signal or leading pedestrian interval).
d. Convert to one-way street network (if justified by surrounding areawide pedestrian and traffic volume study).
e. Install warning signs for pedestrians and/or motorists (see MUTCD).
f. Develop/provide Public Safety Announcement (PSA) safety messages.
g. Add curb extensions or curb ramps.
h. Convert intersection to modern roundabout or mini-circle where all motorists turn right.
i. Consider closing street or using modified T-intersection, diverter, or intersection median barrier.
j. Construct overpass or underpass.
k. Install pedestrian crossing island and raised median.
l. Use traffic-calming devices, such as a raised intersection or raised pedestrian crossing, to reduce vehicle speeds.



Possible Cause/Problem #2
Conflict between pedestrian and right-turning vehicle.

General Countermeasures
a. Prohibit Right Turn on Red (RTOR).
b. Reduce right-turn radii.
c. Add curb extensions or curb ramps.
d. Improve right-turn slip-lane design.
e. Install warning signs for pedestrians and/or motorists.
f. Provide leading pedestrian interval.
g. Remove intersection snow/clutter at the corner to improve visibility and give pedestrian space to stand outside of roadway.
h. Improve intersection lighting to improve visibility.
i. Provide advanced stop lines and marked crosswalks.
j. Consider street closure.
k. Move bus stop to far side of intersection.
l. Construct overpass or underpass.
m. Install pedestrian crossing island and raised median.
n. Use a traffic-calming device, such as a raised intersection or raised pedestrian crossing, to reduce vehicle speeds.
o. Remove on-street parking from the approaches to crosswalks.

Possible Cause/Problem #3
Substantial number of school children crossing and large turning vehicle movement.

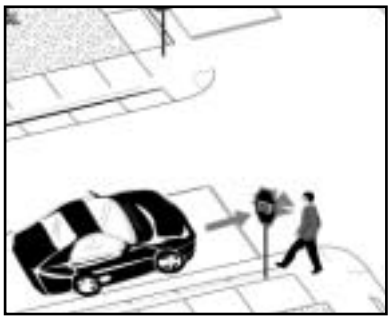
General Countermeasures
a. Provide adult crossing guards during school crossing periods, or two guards for wide streets.
b. Provide police enforcement at the intersection.
c. Educate children about safe crossing behavior.
d. Install pedestrian crossing islands for wide two-way streets.
e. Prohibit left turns.
f. Add exclusive pedestrian phase or leading pedestrian interval.
g. Improve intersection lighting.
h. Consider closing street or using modified T-intersection, diverter, or intersection median barrier.

Possible Cause/Problem #4
Inadequate sight distance and/or intersection geometrics.

General Countermeasures
a. Remove sight obstructions and/or roadside obstacles (e.g., trees/shrubs, mailboxes, poles, newsstands, trash cans).
b. Provide special pedestrian signal phasing (e.g., exclusive protected pedestrian signal interval).
c. Install pedestrian warning signs and/or motorist regulatory signs (see MUTCD).
d. Prohibit left turns.

e. Reduce turn radii.
f. Install right-turn slip lane with pedestrian safety islands.
g. Improve intersection lighting.
h. Add paving treatments that improve visibility of pedestrian crossing areas.
i. Prohibit Right Turn on Red (RTOR).

7. Through Vehicle at Intersection



The pedestrian was struck at a signalized or unsignalized intersection by a vehicle that was traveling straight ahead.

Possible Cause/Problem #1
Pedestrian could not see traffic signal.

General Countermeasures
a. Install new or larger pedestrian WALK/DON'T WALK or automated pedestrian signals.
b. Move bus stop to far side of intersection.

Possible Cause/Problem #2
Children crossing in school zones.

General Countermeasures
a. Provide adult crossing guards, or two guards for wide streets.
b. Install pedestrian overpass or underpass.
c. Install pedestrian signals.
d. Install school regulatory flashers (e.g., SPEED LIMIT 25 MPH WHEN FLASHING).
e. Provide school zone signs and pavement markings.
f. Provide pedestrian education to students and motorists.
g. Increase police enforcement.
h. Use traffic-calming devices such as raised intersection or mini-circle to reduce vehicle speeds.
i. Consider closing street or using diverter or intersection median barrier.
j. Provide advanced stop lines.
k. Provide curb extensions to reduce crossing distance.
l. Provide curb ramps to make crossing easier for all pedestrians.
m. Provide a raised pedestrian crossing.
n. Convert to one-way street network (if justified by surrounding areawide pedestrian and traffic volume study).

Possible Cause/Problem #3
Excessive delay to pedestrians prior to getting the WALK interval.

General Countermeasures
a. Re-time signal to be more responsive to pedestrian needs (e.g., shorter cycle lengths or convert to fixed-time operation).
b. Provide quick-response pedestrian push-buttons or automatic (e.g., microwave or infrared) detectors.

c. Install pedestrian overpass or underpass (if justified based on high pedestrian volumes with high traffic speeds or volumes).
d. Provide pedestrian crossing islands.

Possible Cause/Problem #4
Lack of pedestrian compliance with WALK phase due to other causes.

General Countermeasures
a. Re-time signal to be more responsive to pedestrian needs (e.g., shorter cycle length).
b. Provide adequate WALK and clearance intervals.
c. Provide leading pedestrian interval.
d. Provide pedestrian education to students and motorists.
e. Provide adult crossing guard at school crossings.

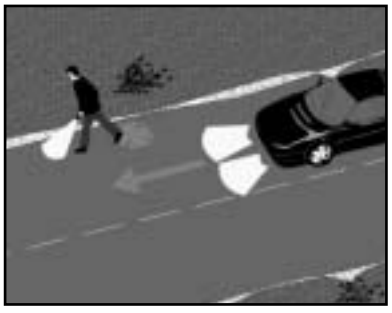
Possible Cause/Problem #5
Motorist did not see pedestrian in time to stop.

General Countermeasures
a. Remove sight obstructions such as mailboxes or parked vehicles.
b. Add pedestrian crossing islands or raised crosswalk.
c. Remove on-street parking near intersection (e.g., up to 30.5 m [100 ft]).
d. Use traffic-calming devices, such as speed tables or a speed-monitoring trailer, on streets approaching the intersection if speed is an issue.
e. Add curb extensions.
f. Construct raised intersection.
g. Improve nighttime lighting.
h. Move bus stop to far side of intersection.
i. Add paving treatments that improve visibility of pedestrian crossing areas.

Possible Cause/Problem #6
Motorist ran red light at signalized intersection.

General Countermeasures
a. Increase police enforcement.
b. Install camera enforcement.
c. Add short all-red interval at signal.

8. Walking Along Roadway



The pedestrian was walking or running along the roadway and was struck from the front or from behind by a vehicle.

Possible Cause/Problem #1
Inadequate walking area.

General Countermeasures
a. Provide a sidewalk on both sides of road.

b. Provide an asphalt path or paved shoulder.
c. Reduce number of lanes (e.g., four lanes to three lanes) and add sidewalk, planting strip, bike lanes, or painted shoulder.
d. Construct and maintain sidewalks and curb ramps to be usable by people with disabilities.

Possible Cause/Problem #2
High vehicle speeds and/or volume.

General Countermeasures
a. Add sidewalk or walkway.
b. Provide nighttime lighting.
c. Install "Walk on Left Facing Traffic" signs.
d. Increase lateral separation between pedestrians and motor vehicles (e.g., bike lanes or landscape buffers).
e. Increase police enforcement of speed limit.
f. Construct and maintain sidewalks and curb ramps to be usable by people with disabilities.
g. Use speed-monitoring trailers.
h. Construct gateway or install signs to identify neighborhood as area with high pedestrian activity.

Possible Cause/Problem #3
Indequate route to school.

General Countermeasures
a. Provide sidewalks.
b. Involve school groups and PTA in evaluating safe routes to school and promoting education and enforcement.
c. Provide adult crossing guards.
d. Implement traffic-calming methods at selected sites.
e. Construct and maintain sidewalks and curb ramps to be usable by people with disabilities.

Possible Cause/Problem #4
Sidewalks are not accessible to all pedestrians.

General Countermeasures
a. Construct curb ramps.
b. Remove obstacles in sidewalk.
c. Build missing sidewalk segments.
d. Relocate poles and street furniture to provide continuous passage in sidewalk area.
e. Enforce parking laws to prevent cars from blocking sidewalks.

9. Working/Playing in Road

A vehicle struck a pedestrian who was: (1) standing or walking near a disabled vehicle, (2) riding a play vehicle that was not a bicycle (e.g., wagon, sled, tricycle, skates), (3) playing in the road, or (4) working in the road.

Possible Cause/Problem #1
Worker, policeman, etc. struck in roadway (arterial street).

General Countermeasures
a. Provide better physical separation/protection from motor vehicles.
b. Improve nighttime lighting and retroreflective materials on workers.
c. Improve traffic control measures (e.g., signs, markings, cones, barricades, and flashers) warning motorists of workers' presence.
d. Increase police enforcement of speed limits in work zones.
e. Increase worker safety training.

Possible Cause/Problem #2
Pedestrian was struck playing on foot or on play vehicle (e.g., skateboard, wagon, sled, in-line skates) on local/collector street.

General Countermeasures
a. Provide accessible sidewalks or walkways on both sides of street.
b. Introduce traffic-calming measures (e.g., speed humps, street narrowing).
c. Improve nighttime lighting.
d. Implement pedestrian and motorist education programs.
e. Provide community park/playground.
f. Convert streets to a woonerf or use signs to identify neighborhood as area with high levels of pedestrian activity.
g. Consider street closures (full or partial) or using diverters.

Possible Cause/Problem #3
Vehicle speeds are excessive on local street.

General Countermeasures
a. Narrow streets and/or travel lanes.
b. Install traffic-calming devices such as speed humps, speed tables, mini-circles, and/or chicanes.
c. Convert to driveway link/serpentine street.
d. Use speed-monitoring trailers in conjunction with police enforcement.

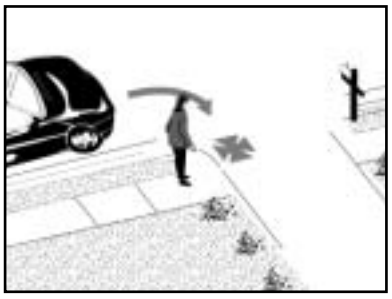
Possible Cause/Problem #4
Disabled vehicle-related (walking to/from disabled vehicle).

General Countermeasures
a. Provide sidewalks, walkways, or paved shoulders.
b. Implement pedestrian/driver education program.
c. Provide adequate nighttime lighting.
d. Provide motorist assistance program.

Possible Cause/Problem #5
Working on or standing by a disabled vehicle.

General Countermeasures
a. Provide paved shoulders.
b. Provide adequate nighttime lighting.
c. Educate drivers about what to do if a vehicle becomes disabled.
d. Provide a motorist assistance program.

10. Not in Road (Sidewalk, Driveway, Parking Lot, or Other)



The pedestrian was standing or walking near the roadway edge, on the sidewalk, in a driveway or alley, or in a parking lot, when struck by a vehicle.

Possible Cause/Problem #1
Pedestrian was struck while waiting to cross roadway, standing at or near curb.

General Countermeasures
a. Provide accessible sidewalks/walkways and crosswalks.
b. Install curb extensions for better line of sight between pedestrians and motor vehicles.
c. Reduce curb radii to slow turning cars.
d. Implement driver education program.
e. Install sidewalk barriers.
f. Improve nighttime lighting.
g. Increase speed enforcement.
h. Provide sidewalk buffer (landscape strip or bike lane).
i. Use adult crossing guard.

Possible Cause/Problem #2
Pedestrian was struck in parking lot, driveway, private road, gas station, alley, etc.

General Countermeasures
a. Redesign or re-stripe parking lot to provide pedestrian access.
b. Maintain level sidewalk across driveway area.
c. Implement pedestrian and motorist education programs.
d. Move sidewalk farther back so that driver will have more time to stop for a pedestrian crossing a driveway.
e. Improve nighttime lighting.
f. Build/improve local parks for child activities.
g. Provide clear pedestrian path across parking lot.
h. Remove landscaping or other visual obstructions near driveways.

Possible Cause/Problem #3
Vehicle entered or exited a driveway or alley and struck pedestrian.

General Countermeasures
a. Provide sidewalk or walkway.
b. Add adequate planting strip or sidewalk separation.
c. Remove sight obstructions (e.g., trim hedges or lower fencing).
d. Maintain level sidewalks across driveways or alleys.
e. Narrow driveways and reduce turning radii.
f. Provide clear walking path across driveway.
g. Remove unneeded driveways and alleys.
h. Provide advance warning signs for drivers.

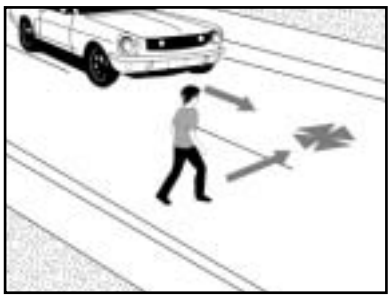
11. Backing Vehicle

The pedestrian was struck by a backing vehicle on a street, in a driveway, on a sidewalk, in a parking lot, or at another location.

Possible Cause/Problem #1
Pedestrian struck by backing vehicle.

General Countermeasures
a. Enhance pedestrian education.
b. Enhance motorist education.
c. Provide auditory backing alert on vehicle.
d. Eliminate, modify, or relocate parking if feasible.
e. Remove unneeded driveways and alleys.
f. Remove landscaping or other sight obstruction near driveways.
g. Provide clearly delineated walkways for pedestrians in parking lots.
h. Relocate pedestrian walkways.
i. Improve nightime lighting.
j. Provide raised pedestrian crossings or curb extensions to improve the visibility of pedestrians to backing motorists.

12. Crossing on Expressway



The pedestrian was struck while crossing a limited-access expressway or expressway ramp.

Possible Cause/Problem #1
Disabled vehicle (pedestrian crosses expressway to seek help).

General Countermeasures
a. Install/upgrade roadway lighting.
b. Increase police surveillance.
c. Provide motorist assistance program.
d. Educate drivers on what to do if a vehicle is disabled.

Possible Cause/Problem #2
Pedestrians routinely cross section of expressway.

General Countermeasures
a. Install large, visible pedestrian warning signs.
b. Install/upgrade nighttime lighting.
c. Provide pedestrian overpass/underpass.
d. Install pedestrian fencing or barriers along roadway right-of-way
e. Increase police surveillance.

13. Miscellaneous

This category includes all other pedestrian crash types, such as: intentional crashes, driverless vehicle, a secondary crash after a vehicle/vehicle collision, a pedestrian struck by falling cargo, emergency vehicle striking a pedestrian, a pedestrian standing or lying in the road, or other/unknown circumstances.

The information described above on pedestrian crash groups is referenced in the next chapter for selecting corresponding pedestrian safety improvements.

Possible Cause/Problem #1
Pedestrian lying in road.

General Countermeasures
a. Install or upgrade nighttime lighting.
b. Increase police enforcement and surveillance.
c. Provide taxi rides home from bars.

Possible Cause/Problem #2
Emergency vehicle-related.

General Countermeasures
a. Increase police surveillance.
b. Install/upgrade lighting.
c. Provide public education.

Possible Cause/Problem #3
Pedestrian falls from vehicle.

General Countermeasures
a. Increase police enforcement of teens "vehicle surfing."
b. Pass/enforce laws and provide education programs against riding in back of pickup trucks.

Possible Cause/Problem #4
Pedestrian standing in road prior to crash — action unknown.

General Countermeasures
a. Provide accessible sidewalks/walkways and crosswalks.
b. Install/upgrade roadway lighting.
c. Provide raised median (multi-lane roads).
d. Add pedestrian crossing islands.

e. Enforce speed limit.
f. Provide safe pedestrian crossings (e.g., traffic signal, if warranted).

Possible Cause/Problem #5
Pedestrian struck by driverless vehicle.

General Countermeasures
a. Require mandatory statewide vehicle inspection.
b. Address through State driver education program.