Pedestrians

Type of Problem Being Addressed

General Description of the Problem

While the number of annual pedestrian fatalities due to traffic accidents had generally decreased across the United States over the latter part of the 1990s (about 13 percent overall from 1992 to 2002, per NHTSA Web site), that trend seems to have changed somewhat over the early years of the new millennium (see Exhibit III-1). There were 71,000 pedestrians injured in traffic crashes in 2002 (per NHTSA Web site).

The number of conflicts and fatalities remains high in many urban areas and for specific segments of the population. In addition, results of travel surveys suggest that the observed drop in pedestrian fatalities in recent years may simply reflect reduced exposure rather than any gains in pedestrian safety.

The need to reduce pedestrian deaths and injuries (see Exhibit III-2), even in the face of ongoing efforts to increase levels of walking, continues to be an important goal for the engineering profession. Specific groups that do not or cannot drive primarily depend on walking for transportation, including children, the elderly, and low-income populations. These individuals comprise up to 30 percent of the population in many communities and are particularly in need of a safe walking environment to help lower their risk of injury and death.

The U.S. Census is the most complete information on the percent of journey-to-work trips made by walking. For the 2000 U.S. Census, the percentage of journeys to work by foot was 2.9 percent, or 3.8 million workers 16 years and over (Reschovsky, 2004). This estimate is lower than the 1990 Census data, which showed 3.90 percent of workers 16 years and over, or 4.5 million people, walking to work. About 1 in 5 trips involve travel to or from work.

EXHIBIT III-1

Pedestrians Killed in Crashes with Vehicles, 1994-2002 (Source: NHTSA Web site)

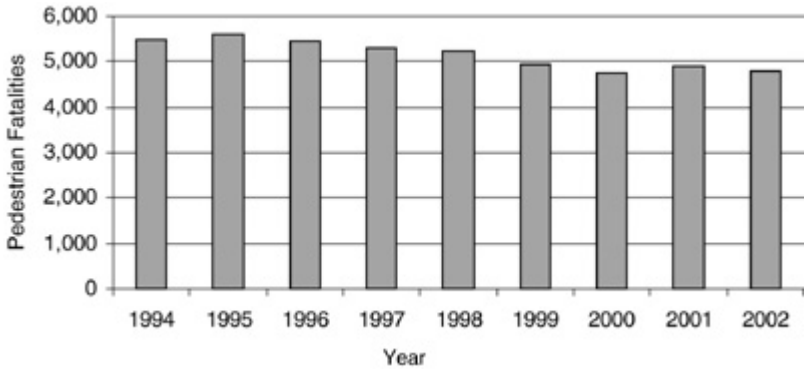
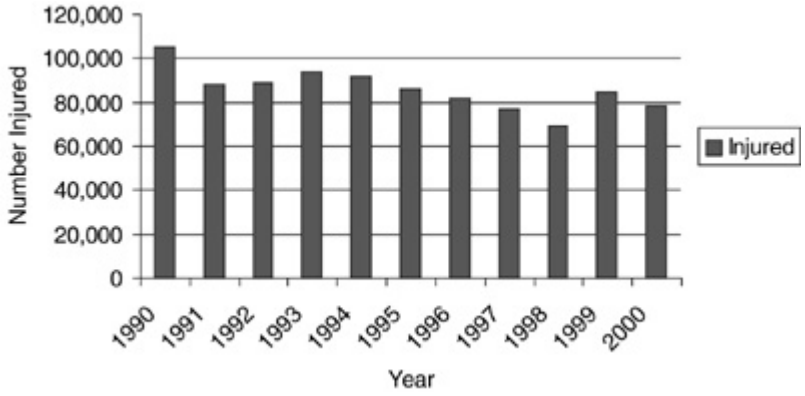


EXHIBIT III-2

Pedestrians Injured or Killed in Crashes with Vehicles, 1990-2000 (Source: NHTSA Web site)

Note: A significant number of pedestrian injury crashes requiring emergency room treatment but not reported to police agencies are not included in these reported fatalities and injuries.



The Nationwide Personal Transportation Survey, which measures travel of all kinds at the national level, also indicates there has been a decrease in the percent of trips made by walking. In 1995, approximately 20 billion trips, or 5.4 percent of all trips, were made by walking. These numbers compare to 18 billion walking trips, or 7.2 percent of all trips, in 1990.[1] While the absolute number of walking trips increased by about 11 percent between the 1990 and 1995 NPTS surveys (Hu and Young, 1992,1993; U.S. Department of Transportation, 1995), it was far less than the increase in trips by private auto, creating a reduction in the percentage of total trips by walking. If walking trips had increased at the same rate as private auto trips, the observed reduction in pedestrian fatalities would likely have been much smaller. During the 5-year time period covered by the two NPTS surveys, pedestrian fatalities decreased by 13.9 percent (from 6,482 to 5,584). Engineering improvements coupled with enhanced safe behavior by pedestrians and motorists are needed to further reduce pedestrian fatalities.

States and Local Areas with the Highest Numbers of Crashes

Crash statistics differ significantly by State and local jurisdictions. States with the highest number of pedestrian crashes per 100,000 population in 2000 included Florida, Arizona, Delaware, and New Mexico; the District of Columbia also has a high rate. State pedestrian traffic fatality counts and fatality rates are presented in Exhibit III-3.

EXHIBIT III-3

Pedestrian Traffic Fatalities and Fatality Rates by State, 2000

State	Total Traffic Fatalities	Resident Population (thousands)	Pedestrian Fatalities	Percent of Total	Pedestrian Fatalities per 100,000 Population
Alabama	995	4,451	61	6.1	1.4
Alaska	103	653	8	7.8	1.2
Arizona	1,036	4,798	130	12.5	2.7
Arkansas	652	2,631	38	5.8	1.4
California	3,753	32,521	670	17.9	2.1
Colorado	681	4,168	80	11.7	1.9
Connecticut	342	3,284	49	14.3	1.5
Delaware	123	768	22	17.9	2.9
District of Columbia	49	523	18	36.7	3.4
Florida	2,999	15,233	492	16.4	3.2
Georgia	1,541	7,875	137	8.9	1.7
Hawaii	131	1,257	29	22.1	2.3
Idaho	276	1,347	6	2.2	0.4
Illinois	1,418	12,051	187	13.2	1.6
Indiana	875	6,045	51	5.8	0.8
Iowa	445	2,900	25	5.6	0.9
Kansas	461	2,668	19	4.1	0.7
Kentucky	820	3,995	53	6.5	1.3
Louisiana	937	4,425	100	10.7	2.3
Maine	169	1,259	15	8.9	1.2
Maryland	588	5,275	91	15.5	1.7
Massachusetts	433	6,199	82	18.9	1.3
Michigan	1,382	9,679	170	12.3	1.8
Minnesota	625	4,830	38	6.1	0.8
Mississippi	949	2,816	64	6.7	2.3
Missouri	1,157	5,540	88	7.6	1.6
Montana	237	950	11	4.6	1.2
Nebraska	276	1,705	20	7.2	1.2
Nevada	323	1,871	43	13.3	2.3
New Hampshire	126	1,224	7	5.6	0.6
New Jersey	731	8,178	145	19.8	1.8
New Mexico	430	1,860	47	10.9	2.5
New York	1,458	18,146	335	23.0	1.8
North Carolina	1,472	7,777	144	9.8	1.9
North Dakota	86	662	5	5.8	0.8
Ohio	1,351	11,319	96	7.1	0.8
Oklahoma	652	3,373	43	6.6	1.3
Oregon	451	3,397	50	11.1	1.5
Pennsylvania	1,520	12,202	170	11.2	1.4
Rhode Island	80	998	6	7.5	0.6
South Carolina	1,065	3,858	84	7.9	2.2
South Dakota	173	777	13	7.5	1.7
Tennessee	1,306	5,657	99	7.6	1.7
Texas	3,769	20,119	412	10.9	2.0
Utah	373	2,207	33	8.8	1.5
Vermont	79	617	7	8.9	1.1
Virginia	930	6,997	92	9.9	1.3
Washington	632	5,858	66	10.4	1.1
West Virginia	410	1,841	25	6.1	1.4
Wisconsin	799	5,326	51	6.4	1.0
Wyoming	152	525	12	7.9	2.3
U.S. Total	**41,821**	**274,634**	**4,739**	**11.3**	**1.7**
Puerto Rico	566	3,809	181	32.0	4.8

Note: Totals may not equal sum of components due to independent rounding.
Sources: Fatalities — Fatality Analysis Reporting System, NHTSA. Population — Bureau of the Census.

Factors Affecting the Number and Severity of Crashes

Alcohol Impairment

Alcohol impairment may be as serious a problem for pedestrians as it is for motor-vehicle drivers, although there is evidence the problem may be lessening, based upon fatal crash data for the year 2000. From 1980 through 1987, 37 percent to 44

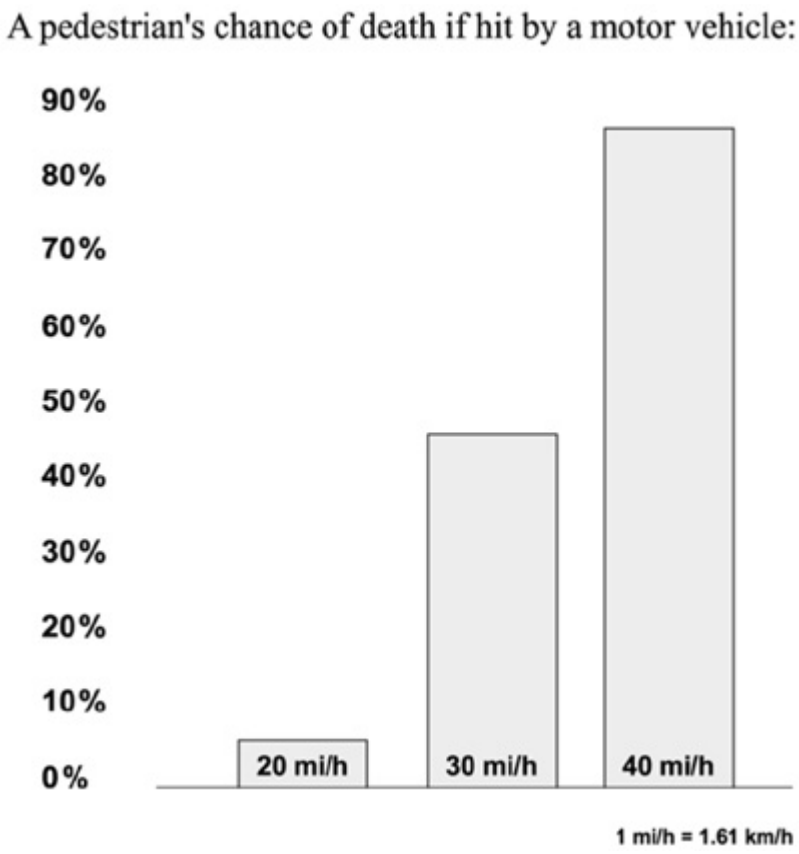
percent of fatally injured pedestrians had a reported blood-alcohol concentration (BAC) of 0.10 or greater (Federal Highway Administration, 2002). In 1997, that figure was 29.5 percent, and in 2002 it decreased to 21 percent (NHTSA Web site). Alcohol involvement in pedestrian crashes continues to be a concern, however, due to the continued high percentage of either drivers or pedestrians who have some level of BAC. Alcohol involvement—either for the driver or the pedestrian or both—was reported in nearly one-half of all pedestrian fatalities (NHTSA Web site). However, care should be taken in using these results, as NHTSA cautions that BAC results reported to the Fatality Analysis Reporting System (FARS) are from state measurements and many are untested. Also, it is not clear whether the drop in pedestrian fatalities involving alcohol-impaired pedestrians may be partly the result of less reporting of alcohol involvement due to changes in police practices in 2000.

Speed

Speed is a major contributing factor in crashes of all types (see Exhibit III-4). In 2000, high vehicle speed was a contributing factor in 29 percent of all fatal crashes, a number slightly lower than in previous years—30 percent in 1994, 1996, 1997, 1998, and 1999 and 31 percent in 1995 (NHTSA Web site). Speed has serious consequences when a pedestrian is involved (see Exhibit III-4). A pedestrian hit at 64.4 km/h (40 mph) has an 85-percent chance of being killed; at 48.3 km/h (30 mph), the likelihood goes down to 45 percent, while at 32.2 km/h (20 mph), the fatality rate is only 5 percent (U.K. Department of Transport). Faster speeds

EXHIBIT III-4

Fatalities Based on Speed of Vehicle (Source: U.K. Department of Transport)



also increase the likelihood of a pedestrian being hit. At higher speeds, motorists are less likely to see and react to a pedestrian, and are even less likely to be able to stop in time to avoid hitting one (Federal Highway Administration, 2000). Speed, however, is always a factor in crashes, regardless of whether it is illegal (i.e., above the posted speed limit) or not. *Speed limits that are set inappropriately high* can also contribute to pedestrian crashes and injuries.

Types of Pedestrian Crashes

In order for engineers and planners to address specific pedestrian hazards and high-crash locations, information is needed on *where* the pedestrian crashes occur (city, street, intersection, two-lane road, etc.), *when* they occur (time of day, day of week, etc.), *characteristics* of the victims involved (age, gender, injury severity, etc.), and the *events* that precipitated the crash (child chasing ball onto road, motorist swerving around a parked car, etc.).

Where Crashes Occur

Area Type

Pedestrian crashes occur most frequently in urban areas where both pedestrian activity and traffic volumes are greater than in 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 (Zegeer et al., 1992, 1993). In addition, many rural areas have no sidewalks, paths, or shoulders to serve as separated pedestrian facilities, and no lighting to increase the visibility of pedestrians at nighttime.

Location Type

According to the NHTSA, "most pedestrian fatalities in 2000 occurred in urban areas (71 percent), at nonintersection locations (78 percent), in good weather conditions (91 percent), and at night (64 percent)." Additionally, "more than two-thirds (68 percent) of the 2000 pedestrian fatalities were males." While all age groups are more likely to be killed at nonintersection locations, the numbers are higher for children primarily because of dartouts into the street. Likewise, the oldest age groups are more likely to be struck at intersections since older pedestrians tend to cross at intersections more often than younger ones. Moreover, some older pedestrians have physical, visual, and/or hearing impairments that place greater demand on intersection design (Zegeer et al., 1992). Studies have shown that older pedestrians are particularly over-represented in crashes at intersections involving vehicles turning left and right (National Highway Traffic Safety Administration, 1990b) (see Exhibit III-5 and Exhibit III-6).

When Crashes Occur

Exhibit III-7 and Exhibit III-8 show the time of day for when crashes occur.

- Pedestrian crashes are most prevalent during morning and afternoon peak periods, when traffic as well as pedestrian volumes are highest (National Highway Traffic Safety Administration, 1990). III-5
- Fatal pedestrian crashes occur most often late in the day, between 5 and 11 p.m., when peak periods, darkness, and alcohol use are factors (National Highway Traffic Safety Administration, 1990a).
- Child pedestrian fatalities are greatest in May, June, and July, perhaps due to an increase in outside activity (Zegeer et al., 1992).
- Older pedestrians are more likely to be struck during daylight hours, when they are also most likely to be exposed to traffic (Zegeer et al., 1993).

EXHIBIT III-5

Percent of Pedestrian Crash Fatalities at Intersections (Approximately 22 Percent of All Fatalities) by Age, 2000 (Source: Zegeer et al., 1993)

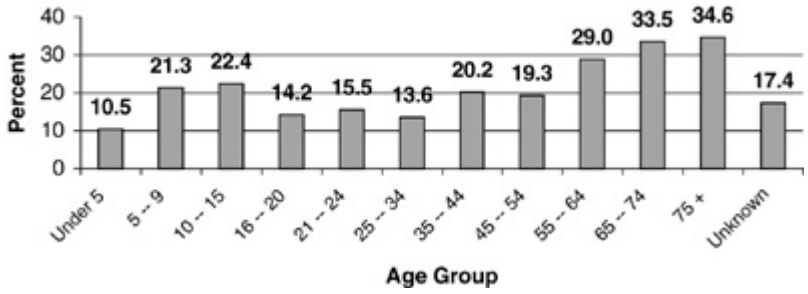
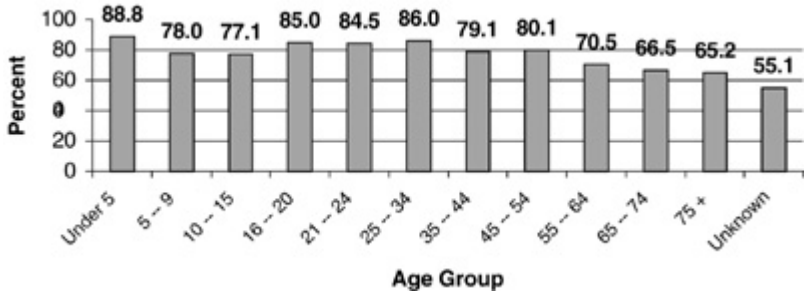


EXHIBIT III-6

Percent of Pedestrian Crash Fatalities at Nonintersection Locations (Approximately 77 Percent of All Fatalities) by Age, 2000 (Source: Zegeer et al., 1993)



Characteristics of the Victims

Specific populations that are heavily represented in crash injury and fatality statistics are children under the age of 16 and older pedestrians. Both of these groups deserve special attention because for many of them driving is not an option and, in the case of older pedestrians that no longer drive, their numbers will increase dramatically as a result of the "graying of the population." "Older pedestrians (ages 70+) accounted for 17 percent of all pedestrian fatalities and 6 percent of all pedestrians injured. The death rate for this group, both males and females, was 3.18 per 100,000 population—higher than any other age group" (NHTSA Web site). The pedestrian age group that is most likely to be involved in a crash is 5- to 9-year-old males, who tend to dart out into the street, a problem that can be aggravated by higher vehicle speeds in areas where children are walking and playing (U.S. Department of Transportation, 2001).

EXHIBIT III-7

Percent of Fatal Pedestrian Crashes by Time of Day, Weekday (Source: National Highway Traffic Safety Administration, 1990)

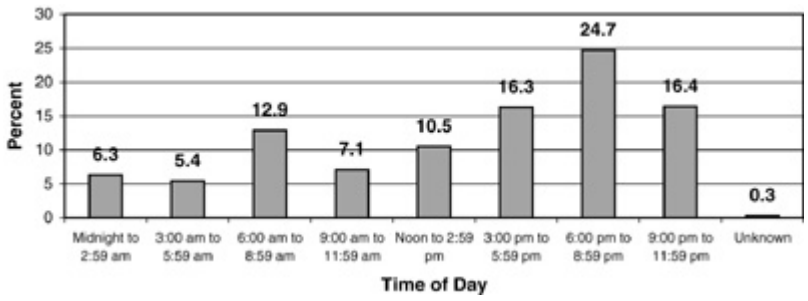
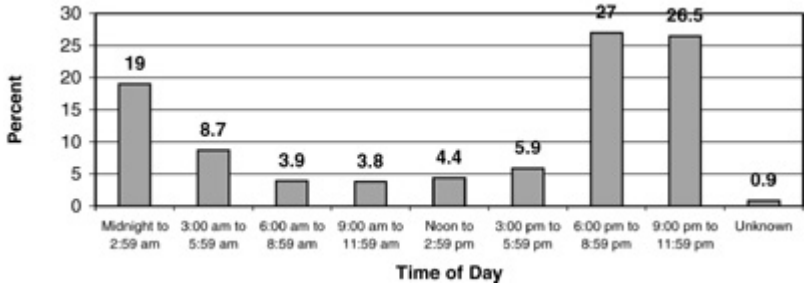


EXHIBIT III-8

Percent of Fatal Pedestrian Crashes by Time of Day, Weekend (Source: National Highway Traffic Safety Administration, 1990)



Precipitating Events

To address pedestrian motor-vehicle safety problems, agencies must have information on factors precipitating a crash. Exhibit III-9 below contains information on factors related to fatal collisions involving a pedestrian and a single motor vehicle. The percentages in the graph total more than 100 percent because in some instances more than one related factor was identified. Most frequently cited were improper crossing of a roadway or intersection and walking, playing, or working in the roadway.

The National Highway Traffic Safety Administration developed a methodology for typing pedestrian crashes in the 1970s (National Highway Traffic Safety Administration, 1971). The method was refined in the early 1990s and used to determine the crash types for more than 5,000 pedestrian crashes in the States of California, Florida, Maryland, Minnesota, North Carolina, and Utah (Hunter et al., 1995; National Highway Traffic Safety Administration, 1971) (see Exhibit III-10).

EXHIBIT III-9

Related Factors in Single Vehicle Fatal Pedestrian Crashes, 1998-2000 (Shankar, 2003)

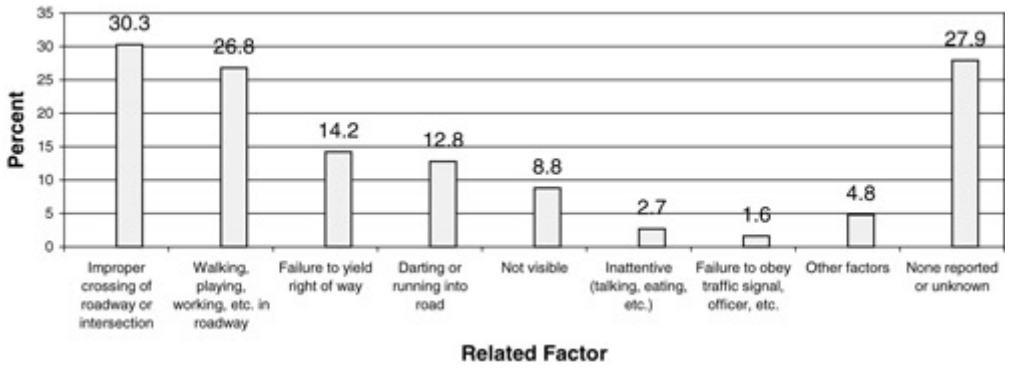
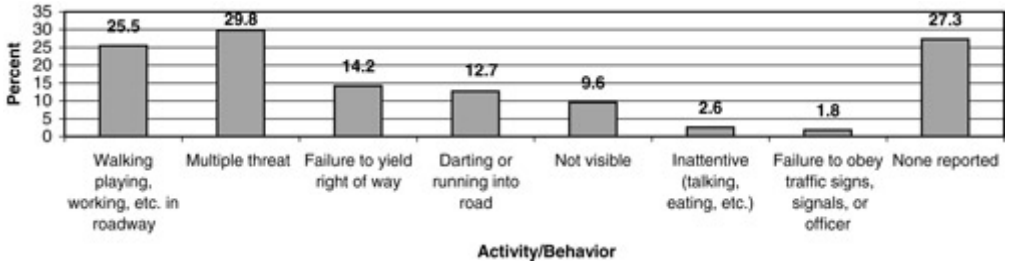


EXHIBIT III-10

Pedestrian Activity/Behavior That Preceded Fatal Crashes, 2000



Key findings of this study, which pertained to both fatal and nonfatal crashes, included the following:

- 41 percent of pedestrian crashes occurred at roadway intersections and an additional 8 percent at driveway or alley intersections
- Most frequent intersection crash types included vehicle turning at intersection (10 percent), intersection dash (7 percent), and driver violation at intersection (5 percent)
- Half of all midblock crashes involved a pedestrian either darting into the intersection with the motorist view blocked or running into the intersection when the motorist's view was not blocked
- 8 percent involved a pedestrian walking along the roadway, and in two-thirds of these crashes the pedestrian was walking with traffic when struck from behind
- Two-thirds (66 percent) of pedestrians were coded for at least one contributing factor to their crash. Most frequently noted were running into the roadway (15 percent), failure to yield (12 percent), alcohol impairment (10 percent), stepping from between parked vehicles (7 percent), and walking or running in the wrong direction, with traffic (5 percent)
- 55 percent of motorists were coded for at least one contributing factor to the crash; most frequently cited were hit-and-run (16 percent), failure to yield to pedestrian (15 percent), and improper backing (6 percent)

Crash types that were the most severe as measured by the percentage of pedestrians seriously injured or killed were

- Midblock, other (46.8 percent serious and fatal injury)
- Disabled vehicle related (41.7 percent serious and fatal injury)
- Walking along roadway (40.4 percent serious and fatal injury)
- Driverless vehicle (37.8 percent serious and fatal injury)

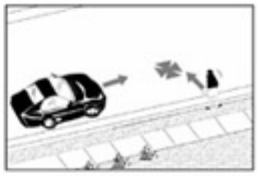
Least severe crashes included

- Vehicle turning at intersection (18.4 percent serious and fatal injury)
- Backing vehicle (22.5 percent serious and fatal injury)
- Bus-related (22.7 percent serious and fatal injury)
- Driver violation at intersection (27.8 percent serious and fatal injury)

Based upon these findings and additional research, 13 crash type groupings (12 specific types and 1 miscellaneous type) have been identified for use with crash data to identify safety problems and corresponding countermeasures (see Exhibit III-11 for the 12 specific types). They can also be used to help educate safety professionals, as well as the general public, about the types of situations that pose dangers to pedestrians. These crash types form the basis for the Pedestrian and Bicycle Crash Analysis Tool software known as PBCAT (Harkey et al., 2000).

Appendix 1 presents a matrix of these 12 major crash types showing which strategies might be considered to help mitigate each crash type.

EXHIBIT III-11
Twelve Crash-Type Groupings

Definitions of Pedestrian Crash Types	Example
1. Midblock: Dart/Dash Definition: 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.	
2. Multiple Threat Definition: 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 sight distance between the pedestrian and the striking vehicle, and/or the motorist may have been speeding.	
3. Mailbox or Other Midblock Definition: 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.	
4. Failure to Yield at Unsignalized Location Definition: 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.	
5. Bus-Related Definition: 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.	
6. Turning Vehicle at Intersection Definition: The pedestrian was attempting to cross at an intersection and was struck by a vehicle that was turning right or left.	

Definitions of Pedestrian Crash Types	Example
7. Through Vehicle at Intersection Definition: The pedestrian was struck at a signalized or unsignalized intersection by a vehicle that was traveling straight ahead.	
8. Walking Along Roadway Definition: The pedestrian was walking or running along the roadway and was struck from the front or from behind by a vehicle.	
9. Working/Playing in Road Definition: 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.	
10. Not in Road (Driveway, Parking Lot, Sidewalk or Other) Definition: 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.	
11. Backing Vehicle Definition: 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.	
12. Crossing an Expressway Definition: The pedestrian was struck while crossing a limited-access expressway or expressway ramp.