Alternative Treatments for At–Grade Pedestrian Crossings
© 2001 Institute of Transportation Engineers
ISBN No: 0-935403-61-2; LP–629

Posted: 7/9/03

The following index pages were added to the original 2001 printing when reprinted in 2002.
Index

A
Abbreviations, 109
Abdulsattar, H.N., et al., 91
Access Design for the Blind, 20
Accessible pedestrian signals (APSs) for the visually impaired
advance limit lines at signalized intersections, 81
automated pedestrian detection, 85–86
defined, 105
diagonal crossings, 83
driveway signal and pedestrian crossing, 96
flashing beacons at uncontrolled crossings, 45, 46
Hawk crossings, 78
intersection pedestrian signals, 72
lagging pedestrian signal intervals, 80
leading pedestrian signal intervals, 79
midblock signal-controlled crossings, 69, 70
Pelican crossings, 73
porkchop islands, 91
Puffin crossings, 75
push buttons as signalized intersections, 84
signalized intersections, 86–87
Toucan crossings, 76
uncontrolled crossings, 20
Accident statistics. See Statistics
Acronyms, 109
ADAAG. See Americans with Disabilities Act Accessibility Guidelines
Adelaide, Australia, detectable warning on curb ramp, 56
ADT. See Average daily traffic
Advance signs
flashing amber lights on, 45
STOP and YIELD limit lines at uncontrolled crossings, 34
STOP limit lines at signalized intersections, 81–82, 96
Alternative treatments of pedestrian crossings, 2
sources of information, 27–28
Amber lights. See specific types of lighting
Ambient lighting for drivers, 44
Americans with Disabilities Act Accessibility Guidelines (ADAAG), 54, 84, 86, 106
Animated eye signal displays at intersections, 88–89
Anti-skid pavement surfacing, 41, 73
Approach, defined, 105
APSs. See Accessible pedestrian signals (APSs) for the visually impaired
Arcadia, California, orange barrels at school crossing, 102
Areas for further study, 10
Arizona. See also specific cities
school crossing signs, 99
Arlington, Virginia, right turn on red prohibition sign, 94
Austin, Texas
flashing beacons, 46
fluorescent yellow-green signs, 37, 38
refuge island, 40
sign for push button use, 45
YIELD sign, 30
Australia. See also specific cities
curb extensions, 48
flashing beacons, 45
installation guidelines, 24–26
major traffic control items (MTCIs), 24–25
minor traffic control items, 25
pedestrian crossings without flashing lights, 25–26
pedestrian operated signals, 26
Pelican crossings, 26, 72, 73
Puffin crossings, 26, 74, 75
push buttons, 84
refuge island, 40
Index

school crossing flags, 102
slip lane, 107
Toucan crossings, 76
Zebra-style crossings, 92
Automated Road Research Board, 73, 75
Automated detection of pedestrians
activating amber strobe lighting, 42–43
infrared and microwave, 85–86
Puffin crossings, 74
signalized intersections, 85–86
uncontrolled crossings, 51–52
wheelchair detection, 86
Average daily traffic (ADT), 65
defined, 105
and pedestrian-related collisions, 3, 6–8

B
Bacque, P., et al., 54
Bandwidth, defined, 105
Barlow, J., and B.L. Bentzen, 55
Barnes dance. See Scramble pattern
Barrier curb, defined, 105
Beaverton, Oregon, raised crosswalks, 62
Belisha beacon, defined, 105
Bentzen, B.L., and L.S. Tabor, 84, 87
Bentzen, B.L., et al., 87
Bicycle crossings. See also Toucan crossings
fluorescent yellow-green signs, 37
in-pavement markers and, 43
Bicycle lanes, 48, 59
Bicycle/pedestrian shared crossings. See Toucan crossings
Blind pedestrians. See Visually impaired pedestrians
Blinking yellow signal. See Flashing beacons
Blood alcohol levels in fatally injured pedestrians, 5
Boulder, Colorado
textured paving in crosswalk, 50
YIELD portable/pole-mounted signs, 30
Bozeman, Montana, curb extensions, 48
Braking distance and anti-skid pavement surfacing, 41
Bulb out, defined, 105
Burden, D., and P. Lagerway, 48
Buses
nearsides signals and, 97
speed cushions at residential crossings and, 60
flashing markers, 44
state highway study of markings and pedestrian collisions, 8–9
Cambridge, Massachusetts
chicanes with islands, 61
curb radius reduced, 53
raised intersections, 63
Canada. See also specific cities or provinces
advance YIELD sign and limit line, 34
flashing beacons, 45, 46, 47
installation guidelines, 20–23
pedestrian crossovers (PXOs), 45
push buttons, 84
right turn on red (RTOR), 82
signal-controlled pedestrian crossings, 4
split pedestrian crossovers (SPXOs), 54, 55
zigzag markings, 35
Capacity, defined, 105
Channelization, defined, 105
Chicanes with islands on residential streets, 60–61
Children. See also School crossings
area for further study, 10
Canada, determination of pedestrian volumes, 21
flag applications and, 37, 93
refuge islands and, 38
Christchurch, Australia, 24
Clearwater, Florida
animated eyes in pedestrian signal displays, 88, 89
roundabouts and automated pedestrian detection, 85
Cobblestone treatment and railings, 42
Coffin, A., and J. Morrall, 66
Collector street, defined, 105
Collisions. See Pedestrian collisions
Color treatment of speed cushions at residential crossings, 60
Construction zones and double-fine warning signs, 100
Countdown signals at intersections, 87–88
Critical volume (CV), defined, 105
Crossing opportunities, calculation of, 21–22
Crosswalks. See also Marked crosswalks; Raised crosswalks; Removal of crosswalks
defined, 105
Curb extensions, 103
defined, 105
signalized intersections, 89
uncontrolled crossings, 46–47
Curb radii reduced at uncontrolled crossings, 52–53
Curb ramp, defined, 105
Curbed islands to restrict left-turns, 56
Cycle time, defined, 105

C
Calabasas, California, chicanes with islands, 61
California. See also specific cities
fluorescent yellow-green signs, 37, 38
marked crosswalks, 7–8
microwave detectors to activate in-pavement

126
D
De Robertis, M., and M. Ridgway, 5, 6, 19
Delay, defined, 105
Denver, Colorado
diagonal crossings, 84
double-fine zone warning sign, 100
lane reductions, 48, 49
overhead signs at signalized intersections, 90
overhead signs warning of school-age pedestrians, 100, 101
Department of Environment, Transport, and the Regions (UK), 60, 61, 73, 87
Department of Transport (UK), 51
Design hour volume (DHV), defined, 105
Design speed (DS), defined, 105
Design width (DW), defined, 105
Detectable warning, defined, 105–106
Detectable warnings at uncontrolled crossings, 54–56
Detection of pedestrians. See Automated detection of pedestrians
Detours for part-time street closures, 102
Diagonal pedestrian crossings, 83–84
Disabled persons. See also Visually impaired pedestrians; Wheelchairs
area for further study, 10
Canada, determination of pedestrian volumes, 21
flag applications and, 37, 93
raised crosswalks and, 61–62
raised intersections and, 63
refuge islands and, 38, 39, 90
right turns on red and, 94
Divided highway, defined, 106
DON'T WALK
blinking yellow signal indications, 95
driversway signal and pedestrian crossing and, 96
flashing signal, 69
steady red signal, 70
Double-fine zones, school-related crossings, 100
Double-posted pedestrian signs at uncontrolled crossings, 32–33
Downtowns
curb extensions, 46
curb radius reduced, 53
diagonal crossings, 83
lighting at uncontrolled crossings, 44
midblock signal-controlled crossings with flashing red, 69
right turn on red prohibitions, 93
speed in, 103
textured surfaces in crosswalks, 50
Drainage
curb extensions and, 46, 47, 89
raised intersections and, 63
DRIVE Initiative, 74
Driveway signals at signalized intersections, 96
Dual wheelchair ramps at signalized intersections, 94–95
Dublin, Eire, pork chop island, 91

E
Edinburgh, Scotland, setback crosswalks, 57
Educational signs for pedestrian push-button signals, 80–81
Elderly. See Older pedestrians
Emergency vehicles and speed cushions, 60
England. See United Kingdom
Entry treatments at residential crossings, 62–63
Equivalent adult units, 21, 23
Europe. See also specific countries
accessible pedestrian signals, 87
nearside signals at signalized intersections, 96
pedestrian collision statistics, 5–6
Ewing, R., 47, 50, 53, 62, 63, 89
Exclusive pedestrian phase, defined, 106
Eyes animated in pedestrian signal displays, 88

F
Federal Highway Administration (FHWA)
research, 1, 95, 103
Ferrara, Italy, nearside signals at signalized intersection, 97
Fillmore, California, street lighting, 45
Fines, double-fine warning sign, 100
Fitzpatrick, K., and H.A. Parham, 59
Flags
Australia school crossings, 102
signalized intersections, 93
uncontrolled crossings, 36–37
Flashing beacons
Australia, 25–26, 45
Hawk crossings, 77–78
school crosswalks, 101
uncontrolled crossings, 45–46, 121
yellow signal for pedestrians, 95–96
Fleck, J., 79
Florida. See also specific cities
countdown pedestrian signal, 88
Fluorescent yellow-green signs
with flashing beacons at school crosswalks, 101
school-related crossings, 100–101
uncontrolled crossings, 37
France, advisory device, 31
Index

G
Geometric design, defined, 106
Germany
marked crosswalks at uncontrolled locations, 65
pedestrian fatalities, 6
uncontrolled locations and marked crosswalks, 3
Glock, J.W., et al., 71, 77, 78
Glossary, 105–107
Grade, defined, 106
Great Britain. See United Kingdom
Greater London Council Road Safety Unit, 35
Green time, defined, 106

H
Habib, P., 36
Half signals, 45, 71, 77
Hannan, T.J., 79, 83
Hauger, J.S., et al., 55
Hawk crossings, 77–78
High-intensity activated crosswalk (Hawk) crossings, 77–78
High-visibility markings
left-turn lanes at signalized intersections, 92
uncontrolled crossings, 32
Zebra crossings, 32, 92
Hourly volume, defined, 106
Huang, H., et al., 43, 51
Hughes, R.G., 55
Hughes, R.G., et al., 86

I
In-pavement raised markers at uncontrolled crossings, 42–43
Infrared detection of pedestrians at intersections, 85–86. See also Automated detection of pedestrians
Installation guidelines, 19–26
accessible pedestrian signals for the visually impaired, 20
Australia, 24–26
Canada, 20–23
Ontario, 23
crossing traffic information, 24
drawbacks of minimal treatment, 19
Great Britain, 23–24
midblock crosswalks, 19
New Zealand, 24
pedestrian flows, 24
pedestrian volume determination, 21
road collisions, 24
site characteristics, 24
traffic control signals, 19–20, 23
United States, 19–20
vehicle flows, 24
vehicle traffic information, 24
Insurance Institute for Highway Safety; 94
Intelligent Transportation Systems (ITS), 104
Intersection, defined, 106
Intersection pedestrian signals (IPSSs), 45–46, 71–72
Islands. See also Raised islands; Refuge islands
defined, 106
pork chop islands, 90–91
Italy, nearside signals at signalized intersection, 97
ITE Pedestrian and Bicycle Task Force, xv, 1, 27
ITE Traffic Engineering Council Technical
Committee report, 43

J
Japan, tactile surfaces for visually impaired, 51

K
Katz, Okitsu, & Associates, 43
Kirkland, Washington
flags at pedestrian crossings, 37, 93
in-pavement raised markers, 43
Kittle, C., 37

L
Lagging pedestrian signal intervals, 80
Lalani, N., 39, 42, 44, 73, 75, 82, 97
Lalani, N., and R. Kochevar, 66
Lalani, N., and R.M. Elizer, 102
Lalani, N., and W. Baranowski, 81
Landscaping
curb extensions and, 46
lane reductions and, 48
Lane reductions at uncontrolled crossings, 48–49
Las Vegas, Nevada, staggered refuge islands, 54
Leading pedestrian signal intervals, 79
LEDs
animated eyes in pedestrian signal displays, 88
strobe lighting, 42
Left-turning vehicles
leading pedestrian signal intervals, 79
restrictions at uncontrolled intersections, 56
setback crosswalks, 82
widening turn lanes, 59
Zebra crossings, 92
Legal considerations
countdown pedestrian signals, 88
double fines, 100
Leonard, J., et al., 88
Level of service, defined, 106
Lighting for pedestrians, 44
Limit lines at uncontrolled crossings, 34
Locator tone, defined, 106
London, UK
pavement legends and other pedestrian aids, 36
railing at crossing, 41, 42
refuge island, 40
turning vehicle warnings, 91
London Research Centre, London Accident Analysis Unit, 41
Long Beach, California
pedestrian collisions studies, 67
removal of crosswalks, 67
uncontrolled locations and marked crosswalks, 3
Longitudinal pavement markings on residential streets, 59
Los Angeles, California
automated detection at signalized intersections, 85, 86
double-posted signs at uncontrolled crossings, 32–33
driveway signal and pedestrian crossing, 96
flashing beacons, 45, 46, 121
midblock signal-controlled crossings, 69, 70
pedestrian collision studies, 10, 65–66
removal of crosswalks, 65–66
uncontrolled locations and marked crosswalks, 3, 120

M
Madison, Wisconsin, YIELD in-street signs, 29
Major street, defined, 106
Major street crossings
“half signals,” 71–72
with residential streets, 62–63
uncontrolled locations, 29–57
Major traffic control items (MTCIs), 24–25
Marked crosswalks
California, 3, 20, 117–119
drawbacks of, 19
Germany, 3
removal of, 65–67
studies, 6–10, 65, 103
uncontrolled locations. See Uncontrolled locations
United States, 19–20
Massachusetts. See specific cities
Median, defined, 106
Medians, 25, 70
Melbourne, Australia, sidewalk extension entry treatment, 62
Microwave detection of pedestrians at intersections, 85–86. See also Automated detection of pedestrians
Midblock crosswalks, 19–20, 104
defined, 106
flashing red signal, 69–70
non-flashing red signal, 70–71
Pelican crossings, 24, 72–73
Puffin crossings, 24, 73–75
staggered islands, 89
Midblock pedestrian signals in Ontario, Canada, 23
Miller, R., and R. Davis, 6
Minimum clearing width, defined, 106
Montana. See specific cities
Multilingual population and signage, 81
“Multiple threat” collisions, 19

N
Narrow travel lanes on residential streets, 59, 60–61
Nearside signals at signalized intersections, 96–97
Netherlands, 95–96
blinking yellow signal indications, 95
pedestrian collisions and fatalities, 6
sidewalk extension entry treatment, 62
New Jersey school crossing with fluorescent yellow-green sign and flashing beacon, 101
New York, YIELD in-street signs, 31
New Zealand installation guidelines, 24
flashing beacons, 45
high-visibility markings, 33
Nighttime
accessible pedestrian signals and, 87
chicanes with islands, 61
curb extensions and, 47, 89
motor vehicle-related collisions, 5, 54
push buttons and, 84
NO PASSING signs, 36
Norfolk, Virginia, diagonal crossings and visually impaired pedestrians, 83

O
Obstacle, defined, 106
Older pedestrians
area for further study, 10
Canada, determination of pedestrian volumes, 21
fatality rate and, 5
refuge islands and, 38
right turns on red and, 94
Ontario, Canada
double-fine warning sign, 100
lagging pedestrian signal intervals, 80
midblock pedestrian signals, 23
midblock signal-controlled crosswalks, 70, 71
perpendicular crossing, 97
PXOs, 45
school crossing sign with flashing beacon, 101
Orange barrels at school crossings, 102
Oregon. See specific cities
Orlando, Florida
in-pavement raised markers, 43
right turn on red prohibition sign, 94
Overhead flashing beacons, 45
Overhead signs
flashing amber lights on, 45
fluorescent yellow-green at school crosswalks, 100–101
signalized intersections, 90
uncontrolled crossings, 37–38
Overpass, pedestrian, 25

P
Palm Springs, California
curb extensions, 89
lane reductions, 48, 49
patterned paving in crosswalk, 50
Parking lanes
reductions, 48
widening of, 59
Parking restrictions
advance limit lines at signalized intersections and, 82
curb extensions and, 47, 89
zigzag markings and, 35
Part-time street closures at school crossings, 101–102
Pasadena, California, scramble pattern at signalized intersections, 83
Passing sight distance, defined, 106
Passive detectors activating amber strobe lighting, 42–43
Pavement legends
signalized intersections, 91
uncontrolled crossings, 36
Peak hour trip (PHT), defined, 106
Peak hour turning movements (PHTM), defined, 106
Pedestrian, defined, 106
Pedestrian and bicycle shared crossings. See Toucan crossings
Pedestrian and Bicycle Task Force, xv, 1, 27
Pedestrian collisions
Los Angeles, California, 65–66
marked crosswalks alone, 65
statistical data, 1, 5–6
studies at marked crosswalks, USA, 6–10
Ventura, California, 66–67
Zebra crossings, 65
Pedestrian crossing installation guidelines. See Installation guidelines
Pedestrian crossovers (PXOs), 45
Pedestrian-deterrent paving, 42–43
Pedestrian flows, 24
Pedestrian light controlled (Pelican) crossings, 72–73. See also Pelican crossings
Pedestrian-operated signals. See also Push-button signals at intersections
Australia, 26
Pedestrian user friendly intelligent (Puffin) crossings, 73–75. See also Puffin crossings
Pedestrian volume determination, 21
Pelican crossings, 3, 24, 25, 26, 72–73
automated detection and, 85
railings used with, 42, 73, 82
Perpendicular crossings, 97
Petaluma, California
automated detection at signalized intersections, 85
overhead sign and flashing beacon, 47
Phoenix, Arizona
automated detection at signalized intersections, 85, 86
school crossings and portable signs, 99
Pork chop islands at signalized intersections, 90–91
Portable signs
school crosswalks, 99
YIELD in-street signs, 29
Portland, Oregon
automated detection at signalized intersections, 85, 86
flashing beacons at school crossings, 101
intersection pedestrian signals, 72
Puffin crossings, 3, 24, 25, 26, 73–75
automated detection and, 85
Push-button signals at intersections
educational signs for, 80–81
LED strobe lighting, 42
for overhead signs, 38
Puffin crossings, 74
signalized intersections, 84
PXOs (pedestrian crossovers), 45

R
Railings
porkchop islands and, 91
setback crosswalks and, 57, 82
signalized intersections and, 73, 82–83
uncontrolled crossings and, 41–42
Railroad crossings, 93
Raised crosswalks on residential streets, 61–62
Raised intersections on residential streets, 63
Raised islands. See also Refuge islands
chicanes with, 60–61
pork chop, for right turn movements, 90–91
pork chop islands, 90–91
staggered at signalized intersections, 89–90
staggered islands, 89–90
uncontrolled crossings, 38–40, 53–54, 56
Raised pavement markers at uncontrolled crossings, 42–43
Ramps
defined, 105
wheelchair. See Wheelchairs
Reduced curb radii at uncontrolled crossings, 52–53
Refuge islands, 25, 103
lane reduction and, 48
pork chop islands, 90–91
signalized intersections, 89–90
staggered islands, 53–54, 89–90
uncontrolled crossings, 38–40, 53–54
Removal of crosswalks, 65–67
uncontrolled locations, 3–4, 103
Residential street crossings, 3, 13, 59–63
chicanes with islands, 60–61
longitudinal pavement markings, 59
raised crosswalks, 61–62
raised intersections, 63
sidewalk extension entry treatments, 62–63
speed cushions at crossings, 59–60
Retting, R., and R. Van Houten, 82
Retting, R., et al., 79, 91
Right turn on red (RTOR), 82
nearside signals and, 97
prohibitions, 93–94
Right-turning vehicles
pork chop islands at signalized intersections, 90–91
prohibitions at signalized intersections, 93–94
setback crosswalks and, 82
warnings at signalized intersections, 90–91
Roadside, defined, 106
Roadside, defined, 106
Roadway, defined, 106
Roadway signing at uncontrolled crossings, 29–31
Roseville, California, detectable warning on parallel
curb ramp, 55, 56
RTOR. See Right turn on red

S
Safety zones, 25
double fines in, 100
Salem, Oregon, dual wheelchair ramps, 95
Salt Lake City, Utah, flags at pedestrian crossings, 93
San Diego, California
Crosswalk Study (1970), 9
study of pedestrian fatalities (1998–1999), 9–10
San Francisco, California
leading pedestrian signal intervals, 79, 80
talking signs at signalized intersections, 87
San Jose, California
flashing beacons, 46
in-pavement raised markers and flashing amber
LEDs, 44
San Luis Obispo, California
in-pavement raised markers, 43
policy on marked pedestrian crossings, 20,
117–119
staggered refuge islands, 54
Santa Ana, California
advance STOP limit line, 34
study of marked crosswalks, 7–8
Santa Rosa, California, overhead signs, 39
Savil, T., et al., 51
Sawai, H., et al., 51
School crossings, 4, 18, 99–102, 122, 123
flag treatments, 102
flashing beacons, 101
fluorescent yellow-green signs, 37, 100–101
orange barrels, 102
overhead signs, 100–101
part-time street closures, 101–102
portable signs, 99
right turns on red and, 94
Ventura, California, Route to School Program,
67
Scramble pattern
defined, 106
signalized intersections, 83–84
Seattle, Washington
chicanes with islands, 61
intersection pedestrian signals, 72
Separate turn lane, defined, 106
Setback crosswalks
signalized intersections, 82
uncontrolled intersections, 56–57
Shoulder, defined, 106
Sidewalk, defined, 106
Sidewalk extensions. See also Curb extensions
to edge of travel lanes, 46–47, 89
residential street entry, 62–63
Sierra Madre, California, YIELD in-street signs, 31
Sight distance (SD), defined, 106
Signal-controlled pedestrian crossings, 4, 14, 69–78
flashing red signal for drivers, 69–70
Hawk crossings, 77–78
intersection pedestrian signals, 71–72
Pelican crossings, 72–73
Puffin crossings, 73–75
solid red signal for drivers, 70–71
Toucan crossings, 75–77
Signal progression, defined, 106
Signaled intersection crossings, 4, 15–18, 79–97
  accessible pedestrian signals, 86–87
  advance limit lines, 81–82
  animated eye signal displays, 88–89
  automated detection of pedestrians, 85–86
  blinking yellow signal indications, 95–96
  countdown signals, 87–88
  curb extensions, 89
  driveway signals, 96
  educational signs, 80–81
  flag applications, 93
  lagging pedestrian signal intervals, 80
  leading pedestrian signal intervals, 79
  nearside signals, 96–97
  overhead signs, 90
  pork chop islands, 90–91
  push-button signals, 84
  railings, 82–83
  scramble pattern, 83–84
  setback crosswalks, 82
  staggered pedestrian refuge islands, 89–90
  turn prohibitions, 93–94
  warnings of turning vehicles, 91–92
  wheelchair detection, 86
  wheelchair ramps, 94–95
  Zebra crossings, 92
Signs. See also Portable signs
  educational signs for pedestrian push-button signals, 80–81
  fluorescent yellow-green signs, 37
  overhead signs, 37–38, 90
  traffic sign, defined, 107
  turning vehicle warnings, 91
  uncontrolled crossings, 29–31
Skewed intersections and perpendicular crossings, 97
Skid-resistant pavement surfacing, 41, 73
Slip lane, defined, 107
Snow removal
  curb extensions and, 47, 89
  in-pavement raised markers and, 43
  refuge islands and, 39
Speech messages and signals. See Accessible pedestrian signals (APSs) for the visually impaired
Speed cushions at pedestrian crossings, 59–60
Split pedestrian crossovers (SPXOs), 54
Split speed bumps, 59–60
Square meter, defined, 107
Staggered pedestrian refuge islands signaled intersections, 89–90
uncontrolled crossings, 53–54
Statistics
  part-time street closure for school and traffic volume, 102
  pedestrian collisions, 1, 5–6, 9–10, 66, 67
  split pedestrian crossovers (SPXOs), 54
STOP limit lines. See Advance signs
Stopping sight distance, defined, 107
Street lighting for pedestrians, 44
Strobe lighting, 42
Summary of studies on pedestrian collisions, 6–10
  areas for further study, 10
Surface warning features for the visually-impaired, 
  50–51, 54–56
Sweden
  advance YIELD limit line, 34
  pedestrian-activated warning sign, 31
  pedestrian collisions and fatalities, 6
  push buttons as signaled intersections, 85
  Zebra crossings, 3, 65
T
Tactile directions with push buttons at signaled intersections, 84–85
Tactile ground surface indicators (TGSI)  
  perpendicular crossings and, 97
  raised crosswalks and, 62
  raised intersections and, 63
  raised islands and, 90
  uncontrolled crossings, 39, 50–51
Talking signs. See Accessible pedestrian signals (APSs) for the visually impaired
Theft of flags, 37, 93, 102
Thousand Oaks, California, in-pavement raised markers and flashing amber LEDs, 44
Tomcheck, P., 65
Toronto, Canada
  NO PASSING sign, 36
  raised crosswalks, 62
  raised intersections, 63
  split pedestrian crossovers (SPXOs), 54, 55
  Toucan crossings, 3, 24, 75–77
  automated detection and, 85
  Traffic-calming techniques on residential streets, 
    59–63
Traffic control signals, 19–20, 23
Traffic Engineering Council Technical Committee report, 43
Traffic islands. See Islands; Refuge islands
Traffic markings, defined, 107
Traffic sign, defined, 107
Transport and Road Research Laboratory (Great Britain), 35
Transportation Association of Canada, 20–23
Transportation Research Board (TRB) study of pedestrian-related collisions, 8, 103
Travel lanes on residential streets, 59
Triangular pork chop islands, 90–91
Tucson, Arizona
   Hawk crossings, 77–78
   midblock signal-controlled crosswalks, 70, 71
   overhead signs, 39
   Toucan crossings, 75–77
Turn lanes, 48, 97
Turning vehicles. See also Left-turning vehicles;
   Right-turning vehicles
   advance limit lines and, 81
   animated eyes in pedestrian signal displays for, 88
   curb extensions and, 47, 89
   curb radius reduced and, 53
   diagonal crossings and, 83
   prohibitions at signalized intersections, 93–94
   setback crosswalks and, 82
   warnings at signalized intersections and, 91–92
Two can cross (Toucan) crossings, 75–77. See also
   Toucan crossings

U
Uncontrolled locations, 2–3, 11–12, 29–57, 103, 124
   advance STOP and YIELD limit lines, 34
   automated detection of pedestrians, 51–52
   curb extensions, 46–47
   curb radii reduced, 52–53
   detectable warnings, 54–56
   double-posted signs, 32–33
   flags, 36–37
   flashing beacons, 45–46
   fluorescent yellow-green signs, 37
   high-visibility markings, 32
   in-pavement raised markers, 42–43
   lane reductions, 48–49
   left-turn restrictions, 56
   lighting, 44
   overhead signs, 37–38
   parking restrictions, 35
   pavement legends, 36
   refuge islands, 38–40
   removal of marked crosswalks, 3–4, 103
   setback crosswalks, 56–57
   signs, 29–31
   staggered refuge islands, 53–54
   tactile ground surface indicators, 50–51
   textured surfaces, 50
   zigzag markings, 35
United Kingdom. See also specific cities
accessible pedestrian signals, 87
anti-skid pavement surfacing, 41
automated detection at signalized intersections, 85
chicanes with islands, 61
flashing beacons, 45, 47
installation guidelines, 23–24
lane reductions, 48, 49
Pelican crossings, 72, 73
publications availability, 28
push buttons, 84
railings at signalized intersections, 82–83
refuge islands, 38, 39, 90
setback crosswalks at signalized intersections, 82
speed cushions, 60
staggered refuge islands, 90
tactile ground surfaces, 51
Toucan crossings, 76–77
Zebra crossings, 3, 23
zigzag markings, 35

United States. See also specific cities and states
accessible pedestrian signals, 86–87
advance limit lines at signalized intersections, 81
educational signs near pedestrian push buttons, 80
installation guidelines, 19–20
marked crosswalks, 19–20
pedestrian collision statistics, 5
push buttons as signalized intersections, 85
right turn on red (RTOR), 82, 93–94
University of North Carolina study
   Hawk crossings, 78
   pedestrian markings at uncontrolled locations, 6–7
U.S. Access Board, 55, 84
Utah. See specific cities

V
Van Houten, R., 34, 46
Van Houten, R., et al., 88, 92
Vancouver, British Columbia
   double-posted signs at uncontrolled crossings, 33
   intersection pedestrian signals (IPS), 71, 72
   refuge island, 40
Vandalism, 81
Vehicle flows, 24
Ventura, California
   curb radius reduced, 53
   marked crosswalks at uncontrolled locations, 3, 32, 124
   parking restrictions, 36
   part-time street closure for school, 101, 102
   pedestrian collisions studies, 66–67
removal of crosswalks, 66–67
school crossings, 122, 123
street lighting, 45
striped narrow travel lanes, 59
Victoria, Australia
  curb extensions, 48
  flags at school crossings, 102
  Pelican crossings, 73
  Puffin crossings, 75
  Zebra crossings, 92
Virginia. See specific cities
Visually impaired pedestrians
  accessible pedestrian signals. See Accessible pedestrian signals (APSs) for the visually impaired
curb extensions and, 46
detectable warnings for, 54–56
detection of at uncontrolled crossings, 52
diagonal crossings and, 83
dual wheelchair ramps, 95
educational signs and, 81
flag applications not useful for, 37, 93
nearside signals and, 97
overhead signs and audible signals, 38
railings at signalized intersections, 82
raised crosswalks and, 62
raised intersections and, 63
refuge islands and, 39, 90
right turns on red and, 94
setback crosswalks and, 57, 82
signal information cues, 86–87
tactile surface warnings for, 39, 50–51
textured surfaces in crosswalks, 50
Volume, defined, 107
Volume/capacity ratio (V/C), defined, 107

W
Wales, UK, raised crosswalks, 62
WALK interval
  flashing signs, 69
  lagging pedestrian signal intervals, 80
Pelican crossings, 72
signalized intersection crossings, 79
steady red signal, 70
Warnings
  detectable warnings. See Detectable warnings at uncontrolled crossings
turning vehicles at signalized intersections, 91–92
Warrants, defined, 107
Washington (state). See also specific cities
  flags at pedestrian crossings, 37
  high-visibility markings, 32
  overhead signs, 39
  porkchop islands, 91
Watkins, K., 62
Web sites for additional information, 27–28
Wet pavement and anti-skid surfacing, 41
Wheelchairs. See also Disabled persons
curbed islands to restrict left-turns and, 56
detectable warnings and, 55
detection at signalized intersections, 86
overhead signs warning of, 90
ramps, 90, 91, 94–95
staggered refuge islands and, 53, 54
textured surfaces in crosswalks and, 50
 Widening turn lanes, 59
Wisconsin. See specific cities
Wording
  language difficulties, 81
  legends on pavement, 36, 91–92

Y
YIELD signs, 29–31
YIELD WHEN FLASHING signs, 46

Z
Zebra crossings, 3, 23, 32
  Australia Zebra-style crossings, 92
  Great Britain, 32, 35, 65
Zegeer, C., and M.J. Cynecki, 93, 94
Zegeer, C., et al., 3, 65
Zigzag markings at uncontrolled crossings, 35