

CHAPTER 3

**Planning For Pedestrians
In Large Urban Centers**

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1. INTRODUCTION

Since the onset of the automobile revolution people, jobs and commerce have gradually migrated away from the urban core. As the exodus progressed many of our cities were retrofitted to accommodate the automobile with little consideration for the effects of those changes on the original mode of travel – walking. Now that attention has refocused on our nation’s large cities, we want people to come back. But cities face the same limitations they have in any age – space for maneuverability and storage is at a premium. They also face new limitations – those on the amount of pollution they can allow vehicles to pour into the air. Because automobile congestion and parking demands already threaten to overwhelm city streets, it would be best for cities if people traveled by transit - and on foot.

A pedestrian-friendly environment means better access to transit and bus stops, modes that help ease automobile congestion. Busy sidewalks provide customers for shops, groceries, restaurants, art galleries and visitor attractions. A “walking city” beckons tourists and conventioners who contribute to urban economic development. An active street (and sidewalk) life affirms that cities are attractive and interesting.

Because of design and land use choices made by the generations that preceded the automobile, people *can* walk from place to place in cities. But many choose not to, and scant literature addresses how urban centers can best encourage more walking and accommodate those who do venture out on unsafe or overcrowded streets. Research and how-to guides tend to focus on residential areas where traffic calming measures slow traffic, reduce noise, and promise a more “livable” neighborhood, while high speeds and fatality rates draw attention to large suburban arterials. The landmark Americans with Disabilities Act required cities to retrofit their streets to meet the needs of pedestrians that travel by wheelchair or are otherwise challenged, and a lot of recent literature aims to help engineers meet those challenges. A surprising volume of literature is dedicated to the needs of the elderly, children, or the alcohol-impaired who are most at risk for collisions and most vulnerable to serious injuries.

That material is extremely helpful to engineers and other city officials responsible for transportation planning, but does not address ways to generate more and safer walking activity by the general population in our large cities.

This guide focuses specifically on strategies applicable in urban centers with a high concentration of pedestrians (and potential pedestrians). The goal is to integrate the needs of all users into an organic, urban whole rather than recommending piecemeal solutions to conflicts between users.

Pedestrian Activity and the Vitality of the Urban Core

Many cities have experienced the benefits of a more pedestrian-friendly urban environment and the increased walking activity that comes with it. Baltimore’s Inner Harbor is a testament to “build it and they will come.” The festival-marketplace atmosphere draws enough people to support multi-level Harbor Place, featuring upscale

retail, food stands and smaller shops. The pedestrian-oriented design creates a bustling, indoor-outdoor tourist center at the harbor's edge, with ample open space for strolling and street performers. When San Francisco dismantled its Embarcadero Expressway and replaced it with an urban waterfront boulevard, the pedestrian-scaled improvements sparked a revitalization that included renovation of a historic ferry building, a new light rail line and views of the water and the Bay Bridge that hadn't been seen in 40 years.

Smaller cities have had similar success. West Palm Beach was determined to generate pedestrian activity in the depressed Climatis Street area, and recognized that high speeds on the wide multi-lane road and unfriendly streetscape were key barriers. The city removed traffic lights, installed roundabouts, widened sidewalks and put in landscaping. Pedestrians promptly reappeared and the city's initial investment of \$10 million was parlayed into \$300 million in private investments.

The Right Mix of Ingredients for a Healthy Pedestrian Environment

The good news for cities is that urban cores generally enjoy a compact layout and a street grid that is conducive to walking and other non-motorized transportation modes. In some cities, motorists are already the minority users of the street network. According to the 1990 Census, in New York City over 64% of the city's eight million residents do not drive to work, and only 44% of its households own or have access to an automobile. A survey completed in the New York & northern New Jersey metropolitan area found that walking accounts for 18% of social/recreational trips and 10% of work trips. In dense urban neighborhoods like Manhattan, one-third of all residents' trips are by transit; cars are used for fewer than 20% of trips; and walking accounts for 40% of all trips.¹

So what makes a city *walkable*? Safety is a primary issue. People avoid walking where they fear getting hurt. In most examples of successful streetscape redesigns, the elimination of safety hazards and other discomforts brought pedestrians back.

The statistics in Table 3 highlight an important relationship between speed and safety across communities. According to the report's ranking of metropolitan areas, the older compact communities around Boston have a very high percentage of people who walk. They also have the lowest score among large cities on the pedestrian fatality index. Since Boston's narrow streets and high traffic volume keep vehicle speeds low, we observe a correlation between vehicle speeds and the incidence of fatalities. Reading upward in the ranking, the most dangerous metropolitan areas tend to be newer, sprawling, southern and western communities, whose wide roadways have been designed to accommodate automobiles traveling at high speeds.

But continuing with the Boston example, while fatality rates in Boston proper are low at only 22 per year, the injury rate among pedestrians is quite high. Each year over 1,100

¹ *Travel in the New York-New Jersey Metropolitan Area: A Summary of Results from the 1997/98 Regional Travel-Household Interview Survey*, April 2000. New York Metropolitan Transportation Council and the North Jersey Transportation Planning Authority.

pedestrians are injured seriously enough to require ambulance transport to the hospital. The mayor's press office in November 1999 blamed the high rate on "poor pedestrian habits, such as jaywalking, crossing outside of the crosswalk and crossing with the DON'T WALK signal". Also blamed were "driver behaviors such as speeding, running red lights and stop signs, failure to yield to pedestrians and alcohol-impaired driving".

High average speed then is not the only threat on city streets. This handbook identifies elements that discourage poor habits among road users to create safer and more attractive city streets.

Organization of this Guide

Based on an extensive literature review and interviews with transportation engineers, city officials, pedestrian advocacy groups and transportation consultants, this guide covers techniques that facilitate high-pedestrian activity in urban environments.

The following section outlines four primary strategies for creating a safer and more inviting pedestrian environment. Section II introduces the common challenges and constraints faced by transportation engineers and planners who try to implement those strategies. Section III outlines a guide to funding sources that are available for pedestrian-related projects. Section IV is a reference guide to forty-five applied measures along with positive and/or negative feedback from cities in the form of case studies.

Table 3. Pedestrian Walking Rates Compared to Fatality Rates in Metropolitan Areas

Rank	Metro Area	Total Pedestrian Deaths* (1997-1998)	Percentage of Commuters Walking to Work**	Pedestrian Danger Index***	1995-1996 Ranking
1	Tampa-St. Petersburg-Clearwater, FL	192	2.27%	91	1
2	Atlanta, GA	185	1.45%	83	4
3	Miami-Fort Lauderdale, FL	274	2.25%	81	2
4	Orlando, FL	139	3.46%	65	7
5	Jacksonville, FL	71	2.57%	64	11
6	Phoenix, AZ	190	2.65%	60	5
7	West Palm Beach-Boca Raton, FL	49	1.99%	58	3
8	Memphis, TN-AR-MS	70	2.96%	52	15
9	Dallas-Fort Worth, TX	192	1.86%	52	8
10	New Orleans, LA	88	3.09%	52	12
11	Houston-Galveston-Brazoria, TX	205	2.26%	50	9
12	Salt Lake City-Ogden, UT	60	2.32%	49	17
13	Charlotte-Gastonia-Rock Hill, NC-SC	56	2.07%	48	18
14	Greensboro-Winston-Salem, NC	51	2.29%	46	13
15	Nashville, TN	42	1.94%	45	14
16	Las Vegas, NV	86	3.67%	44	6
17	St. Louis, MO-IL	98	2.15%	43	25
18	Oklahoma City, OK	36	2.11%	40	10
19	Los Angeles-Riverside-Orange Co., CA	737	2.94%	39	16
20	Kansas City, MO-KS	52	1.89%	38	19
21	Detroit-Ann Arbor-Flint, MI	209	2.41%	38	20
22	Sacramento-Yolo, CA	71	2.68%	38	21
23	Raleigh-Durham-Chapel Hill, NC	52	3.12%	38	28
24	San Antonio, TX	81	3.58%	36	26
25	Austin-San Marcos, TX	46	2.86%	36	23
26	Denver-Boulder-Greeley, CO	94	3.28%	29	29
27	Portland-Salem, OR-WA	79	3.27%	27	24
28	San Francisco-Oakland-San Jose, CA	268	3.63%	26	31
29	San Diego, CA	134	4.53%	26	35

30	Indianapolis, IN	35	2.17%	26	22
31	Washington-Balt., DC-MD-VA-WV	279	3.87%	24	30
32	Grand Rapids-Muskegon-Holland, MI	28	2.76%	24	27
33	Chicago-Gary-Kenosha, IL-IN-WI	333	4.01%	23	33
34	Hartford, CT	34	3.40%	22	34
35	Seattle-Tacoma-Bremerton, WA	104	3.53%	21	36
36	Norfolk-Virginia Beach-Newport News, VA	46	3.67%	20	37
37	Cincinnati-Hamilton, OH-KY-IN	47	2.99%	19	45
38	Minneapolis-St. Paul, MN-WI	70	3.22%	19	40
39	Columbus, OH	34	3.25%	17	42
40	New-York-No. New Jersey-Long Island, NY-NJ-CT-PA	869	6.31%	17	41
41	Cleveland-Akron, OH	8	2.98%	16	43
42	Buffalo-Niagara Falls, NY	2	4.38%	15	32
43	Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	197	5.26%	15	38
44	Milwaukee-Racine, WI	38	3.95%	14	39
45	Rochester, NY	24	4.34%	12	44
46	Boston, MA-NH	147	5.12%	12	47
47	Pittsburgh, PA	52	5.08%	10	46

From *Mean Streets 2000*, Environmental Working Group/The Tides Center and the Surface Transportation Policy Project, June 2000.

* From the Fatal Accident Reporting System (FARS), maintained by the National Highway Traffic Safety Administration, contains approximately 2.5 million records or every fatal traffic-related accident in the United States since 1986.

* 1990 U.S. census data.

*** The pedestrian fatality index was calculated by dividing the overall fatality rate (per 100,000 people) by the percentage of people walking to work. The results were then normalized on a scale of 1 to 100, with 1 being the safest and 100 the most dangerous.

2. STRATEGIES

Strategy 1: Reduce vehicle speeds

Lower speeds on urban roadways enhance pedestrian safety and comfort. Persons who drive at or below 20 mph are better able to see pedestrians in time to stop at intersections. At impact speeds of less than 30mph, injuries can more likely be survived.

Transportation officials report that motorist compliance with posted speed limits below 30 mph is so poor that trying to enforce it does not work. Therefore reducing the posted limit must be done in conjunction with calming devices that physically slow motorists. New York State passed legislation in 1999 to allow speeds to be reduced from 30 to as low as 15 mph when done in conjunction with physical calming measures.²

Vehicle Speed	Risk of Pedestrian Fatality in Collision
20 mph	5%
30 mph	45%
40 mph	85%

Source: U.K. Department of Transportation.

Measures that reduce vehicle speeds:

- Narrow roadways to keep vehicles in more compact formation, increasing predictability of movement and encouraging slower speeds. Of particular danger are streets whose widths fluctuate from point to point – usually where part of a roadway was widened during reconstruction. This creates a series of choke points and speedways.
- Time traffic signals to reward compliant motorists with sequential green lights.
- Enforce slow turning speeds with neck downs, which create tighter turning radii.

Strategy 2: Shorten & Simplify Crossings

Crossings should be short in both time and distance to minimize pedestrian exposure to vehicular traffic. Reduce pedestrian delay to reduce the pedestrians' motive to cross against the light and therefore improve compliance with pedestrian controls. Unclear controls confuse pedestrians who then behave unpredictably at crossings. Signs, signals and markings should be readily understood and simple to obey.

Measures that shorten crossings:

- Break a wide roadway into shorter crossing segments with landscaped pedestrian islands.
- Extend the curb to shorten total crossing distances.

² Former N.Y.C. DOT Director of Traffic Calming Michael King points out that most fatal injuries in New York City occur at high-speed, wide crossings like those along Coney Island Avenue in Brooklyn. The Mayor's Office and the Streets Department in Philadelphia reached the same conclusion in a 1997 report. Wide streets with high pedestrian and auto volumes such as Broad Street accounted for the greatest number of accidents.

- Mark crosswalks along paths that pedestrians naturally prefer since they are very sensitive to out-of-the-way travel and seek the shortest route rather than the one provided for them.
- Use stop signs and concurrently-timed signals for more frequent periods of pedestrian right-of-way.
- Program pushbuttons to respond in no more than 30 seconds.
- Provide a WALK/DON'T WALK signal head at complex intersections and where traffic signals are not visible or don't provide adequate information.
- Tell pedestrians how much time remains before cross-traffic is released with the countdown walk signal.
- Encourage looking behavior among pedestrians with signage.
- Eliminate the permissive right-turn-on-red in urban centers.

Strategy 3: Communicate Pedestrian Presence

Motorists on the roadway tend to watch for other motorists – because automobiles pose a threat to them while pedestrians do not receive equal attention. To make matters worse pedestrians are hard for motorists to see, often obscured by other cars, streetlights, trash receptacles, and mailboxes.

Measures that improve visibility:

- Make sure motorists and pedestrians see each other by moving stop lines back from the crosswalk
- Restrict parking at corners.
- Build curb extensions that project pedestrians into the roadway where motorists will see them.
- Integrate a leading pedestrian interval into the WALK signal phase to allow pedestrians to get off the curb and be seen by motorists before they begin turning into the pedestrian path.
- Encourage motorists to scan for pedestrians with stop signs in place of traffic signals.
- Provide sufficient lighting so pedestrians are visible to motorists.
- To maximize the visibility of YIELD TO PEDESTRIAN IN CROSSWALK signage, place the signs on stationary traffic cones in the middle of crosswalks.
- Install pedestrian sensors to automatically activate a warning signal when a pedestrian enters the crosswalk.

Strategy 4: Expand and Enhance the Pedestrian Domain

Safe and convenient walking paths reduce the disincentives to walking. Enhancements to a street provide the incentives that really draw pedestrians. Wide, clear sidewalks suggest that people are not only permitted but encouraged to walk. So does informational and directional signage oriented to sidewalk users. Urban plazas and parks draw people with a place to sit and enjoy a bubbling fountain or contemplate public art. These amenities are what define good cities as well as good pedestrian spaces.

Measures that enhance streetscapes:

- Most importantly, increase sidewalk space.
- Remove or consolidate parking meters, news boxes, etc. that act as obstacles to safe walking (and block motorists' view of pedestrians).
- Provide amenities and art. City transportation departments and departments of public works can work jointly with parks departments or private organizations to landscape, create seating, and install public art.
- Work with the city to reduce horn honking and vehicle exhaust, which are especially noxious to pedestrians. These and other nuisances, like construction sites that force pedestrians off their path, can reduce a traveler's incentive to walk.

3. CHALLENGES

A few key issues were repeatedly cited by transportation officials as barriers to effective implementation of plans to benefit pedestrian activity.

FEDERAL AND STATE STANDARDS INAPPROPRIATE TO CITIES

There is constant conflict perceived by local officials between smart pedestrian planning and the guidelines in the American Association of State and Highway Transportation Officials (AASHTO) Green Book and the Manual of Uniform Traffic Control Devices (MUTCD) for such things as road widths and signage. The departments fear legal liability over non-compliant measures which often inhibits the best designs.

An Atlanta Department of Traffic official notes that American Association of State Highway and Transportation Officials (AASHTO) guidelines are based on criteria developed in the 1930s. For example, stopping distances and horizontal and vertical curves are based on outdated automotive technology. The ability of cars to corner and stop has come a long way in half a century. Deceleration lanes, he points out, are unnecessary in cities. They encourage high speeds and increase the distance pedestrians must cross. A 90-degree angled intersection is more appropriate in most instances. Atlanta officials report that Georgia DOT has recognized that and no longer requires acceleration lanes after five years of urging from the city.

Another problem in Atlanta is the freeway-style ramps that exit into urban areas. Despite limits on road expansions, in air quality non-attainment areas many road projects are getting pushed through as *safety improvements*, and are aimed at reducing the incidence of rear-end collisions. Pedestrian advocates feel that the resulting ramps amount to road expansion and don't take pedestrians into account at all. The state continues to push through projects such as new turn lanes and deceleration lanes in the name of safety.

Philadelphia faces a different problem with respect to inappropriate safety guidelines. Pennsylvania DOT does not recognize non-reportable accidents when defining traffic signal warrants. Reportable accidents are limited to those after which a vehicle can't move and must be towed, or an injury or death has occurred. Police officers at the scene record many collisions that can't be considered in decision-making. Meanwhile federal and state funding is based on meeting specific criteria defined by those warrants.

USE OF FEDERAL FUNDS

Federal and state funding guidelines provide one more example of insensitivity to city needs. Funding for new or improved roads is based on both minimum lane width and the demonstrated consideration of a bike lane during reconstruction, yet there are no pedestrian requirements. In order to achieve narrower lanes and wider sidewalks, a waiver is required.

Similarly, officials in Boston note that federal and state money is available for arterials, not residential streets, so traffic calming is implemented on arterials. Because narrow

arterials in older cities are ill suited to further calming efforts, the result is a tendency among frustrated motorists to choose other routes. Traffic is therefore diverted onto residential streets.

CONSISTENCY, PREDICTABILITY, AND MAKING CHANGES

Many officials point out the dangers inherent in making changes to the street network. Localized changes affect the predictability of the network for regular users, creating inconsistency from street to street or intersection to intersection.

The planning division of the Boston Transportation Department reports a history of ad hoc intersection planning. For example, pushbuttons are not required to activate the walk phase during peak hours. They *are* required at other times yet no information alerts the pedestrian that they must push the button in off-peak hours. Perhaps that is why pedestrians there have made Boston the “jaywalking capital.”

Engineering and signal changes along a pedestrian’s usual routes can be problematic. Officials find that implementing changes “in a bunch” is the best approach. Otherwise the changes create more hazards than they fix, and may be undone by protests and resulting concerns over liability.

In the spirit of “better safe than sorry,” New York City DOT officials say they have placed pedestrian crossing signals at 85% of signalized intersections, regardless of warranted demand. Therefore there are numerous pedestrian WALK/DON’T WALK indications even in simple intersections where the vehicular threat comes from only one direction. This is done primarily due to liability concerns. Yet one result of this approach is an increase in calls for maintenance when cities are already overwhelmed by daily demands.

The key to a successful strategy may be the manner of a plan’s implementation. The best way to avoid inconsistent application of treatments is to attempt area-wide implementation rather than spot-fixes. It is important that the area of focus be easily defined and readily identifiable to the community. People should be kept informed about the plans and therefore expect them. If the community expects the changes they are less likely to resist them for being unfamiliar. Ideally, the treatment should be integrated with a larger plan – in conjunction with a general traffic calming effort, or with a larger municipal project as in the case of Houston’s new Enron Field.

Pedestrian advocates at Walk Boston feel that changes (e.g. from exclusive to concurrent signal phasing) should be accompanied by a public relations campaign and additional signage. Slow turning movements should be enforced through physical adjustments to street design, through signage like “Vehicles Turning” aimed at pedestrians and “Yield to Pedestrians” aimed at drivers. Radio advertising along with press releases would ideally accompany the change, says the group.

In New York City, the Downtown Brooklyn Traffic Calming Project has involved a series of newsletters that kept the community informed from the outset of the project.

Newsletters included definitions of traffic calming, information on open houses, and a reply card for specific community feedback.

“HIGHWAY MENTALITY”

“Traffic engineer’s mentality” has become a derogatory label now that many in the field recognize that traffic engineering has been focused primarily on the movement of automobiles for the last fifty years to the detriment of other modes.

The formal education of engineers does not yet reflect the new interest in a balanced transportation system – not based on the observations of some longtime transportation professionals. Most of the officials consulted for this guide expressed a willingness to be sensitive to the pedestrian. But most admitted that single-mindedness was still entrenched at many levels within city departments. Efforts have been made to educate engineers through conferences and workshops. Response is mixed regarding the effort to educate transportation engineers. One official doesn’t feel that the effects are lasting – much like enforcement efforts on jaywalking.

The City of West Palm Beach, Florida has taken a proactive stance to combat the old-school thinking. In November 1996 the City released its *Transportation Language Policy*, a guide to removing auto-biased language from the planners’ and engineers’ lexicon. All department directors and division heads were instructed to adopt the new, objective language and use it in all correspondences, resolutions, ordinances, plans, and in meetings. Terms like “improvement” or “increase in capacity” are stricken in favor of terms clearly stipulating WHO benefits from a proposal and how other modes will be affected by it.³

PLANNING FOR VEHICLE AND PEDESTRIAN NEEDS

Other barriers to implementation include contradicting views on what constitutes “traffic delay.” Who should be given priority within limited space and time constraints—motorized vehicles or pedestrians? How long should either user have to wait to cross an intersection? Of course the goal should be to minimize delay for all users. Some pedestrian advocates suggest using person-delay, rather than vehicle delay, where signal timing can be adjusted to reflect changing volumes of vehicles and pedestrians.

A level of service measures for pedestrian traffic is also recommended.

GAINING POLITICAL SUPPORT

The interests of public and elected officials clearly lie in being immediately responsive to their voting constituency on a case-by-case basis across scattered areas. A healthy transportation network, in contrast, is better achieved by area-wide planning. But an

³The 7pp document is available from the Rudin Center. For more information, please contact the West Palm Beach Transportation Division at (561) 659-8031. Ian Lockwood, Principal Engineer.

area-wide perspective is hard to maintain. After a pedestrian fatality, for example, the community and elected officials may insist on a quick fix such as the installation of a traffic signal to “solve” the problem.

On the other hand, the burden of proof is rightly on planners to defend their solutions. Their explanations should reflect long-term observations by city agencies. But because planning departments seldom have dedicated pedestrian staffers, little data has been compiled about pedestrian traffic. With few before-and-after studies of implemented devices, planners can’t back up a campaign of good ideas that would get people and politicians on board. Not surprisingly, transportation officials feel that long-term planning is a luxury with their limited resources. Most of the staff, they report, is kept busy with crisis management – for instance fielding complaints from citizens who call to report a signal malfunction or to request a change in signal timing.

Furthermore, transportation departments are constantly barraged with problems and “ideas” coming down the pike from various sectors like the city council, grass roots community groups, the mayor’s office, and utility companies. “Maybe 5 out of 100 ideas are good,” reported one official, but all must be given consideration by departments with limited resources. It is difficult to be proactive in this environment. In some cases though, transportation officials report having established a relationship with elected officials by being truthful with them, and felt they had gained their trust and respect. While they couldn’t win every battle and had to grant favors now and again, they felt that they were listened to.

DEFINING DEPARTMENTAL RESPONSIBILITY FOR PEDESTRIAN PLANNING

Most transportation departments do not have a dedicated pedestrian or bicycle planner. The U.S.DOT *Bicycling and Walking Study (Final Report)* recommends a full-time local pedestrian/bicycle coordinator to carry out program planning, policy development, facility design, accident analysis, coordination among agencies, etc. The study also recommends that the staffers develop coalitions with local advocacy groups. As of 1991, almost half of all local program coordinators were positioned within planning departments and a quarter were located in engineering or public works departments.

Currently, the Boston Transportation Department incorporates input from advocacy groups like “Walk Boston.” They would like to have a budget and time for a staffer to dedicate part-time to planning rather than to full-time crisis management (e.g. answering complaints regarding signal timing). Currently, pedestrian studies and planning only arise at the time a road is undergoing reconstruction. The exception is problem areas where an incident or a high number of complaints draw attention.

Some officials do not feel that the U.S.DOT recommendation for dedicated coordinators is a good idea. A better solution, they say, is to have senior engineering staff “on board with pedestrian concerns.”

4. FINANCING

In recent years, the Federal Highway Administration (FHWA) has been developing a new, expanded statement of policy regarding the non-motorized modes of transportation – walking and bicycling. Most significantly, in the congressionally mandated *National Bicycling and Walking Study*, the FHWA has taken the position that bicycling and walking for transportation have too long been the "forgotten modes" and that this should change. The report laid out an action plan to achieve the report's goals of doubling the current percentage (from 7.9% to 15.8%) of total trips made by bicycling and walking and to simultaneously reduce by ten percent the number of bicyclists and pedestrians killed or injured in traffic crashes⁴.

Federal resources available for pedestrian and bike facilities increased significantly in 1991, when Congress passed the Intermodal Surface Transportation Efficiency Act (ISTEA), and continue to be made available through the Transportation Equity Act (TEA-21). Among other programs, TEA-21 explicitly allocates funds to promote transportation safety, a program known as the Surface Transportation Program safety set-aside, or "STP safety funds." About \$300 million is available each year for this program and pedestrian safety is an eligible activity.

Yet with pedestrians making up 14% of annual traffic fatalities, the states use less than one percent (0.6%) of all federal transportation dollars to provide pedestrians with better facilities (1997-1998). Local application of federal funds for pedestrian safety has been similarly disproportionate. (See Table 4.)

States have spent other money – over \$1 billion – on pedestrians and bicycles through a program known as the Enhancements program. While the program supports development of bike paths and separate pedestrian spaces, it is not rightly considered a safety program.

As outlined below, bicycle and pedestrian projects are broadly eligible for funding from almost all the major Federal-aid highway, transit, safety, and other programs. The following list is taken from the web site for the U.S.DOT/Federal Highway Administration Bicycle and Pedestrian Program, Bicycle and Pedestrian Provisions of the Federal-Aid Program: www.fhwa.dot.gov/environment/bikeped/BP-Broch.htm.

Federal-aid Highway Program

National Highway System funds may be used to construct bicycle transportation facilities and pedestrian walkways on land adjacent to any highway on the National Highway System, including Interstate highways.

⁴ Final Report, The National Bicycling and Walking Study: Transportation Choices for a Changing America, FHWA-PD-94-023, 1994.

Table 4: Federal Safety Funding that Goes to Local Pedestrian Safety Projects

Metropolitan Area	Average Annual # of Auto-Related Fatalities	Average Annual # of Auto-related fatalities that are pedestrians	Percentage of Auto-related fatalities that are pedestrians	% of Federal Safety Spending Devoted to Pedestrian Safety (since 1992)*
New York, NY	677	310	46%	0%
San Francisco, CA	136	43	31%	0%
Los Angeles-Long Beach, CA	1099	299	27%	1.2%
Chicago, IL	585	158	27%	0%
Boston, MA	235	58	25%	0%

Source: Environmental Working Group/Surface Transportation Policy Project report, Mean Streets, 1997.

* The Financial Management Information System (FMIS) maintained by the Federal Highway Administration, contains over 550,000 records of every federal highway project since 1992. This database was analyzed in a number of different ways, including analyzing total spending, safety spending under the STP safety set-aside programs, and projects that were designed for pedestrian safety. STP safety projects were identified using codes obtained from FHWA. Pedestrian safety projects were identified in two different ways. All projects that were identified by work-type codes as being pedestrian projects were included. However, a 1996 GAO report found that bicycle and pedestrian projects were frequently miscoded in the database (GAO 1996). Thus, in addition to using codes in the database to identify pedestrian projects, researchers included any project whose description identified it as being pedestrian related.

Surface Transportation Program (STP) funds may be used for either the construction of bicycle transportation facilities and pedestrian walkways, or non-construction projects (such as maps, brochures, and public service announcements) related to safe bicycle use and walking. TEA-21 adds "the modification of public sidewalks to comply with the Americans with Disabilities Act" as an activity that is specifically eligible for the use of these funds.

Ten percent of each State's annual STP funds are set aside for **Transportation Enhancement Activities (TEAs)**. The law provides a specific list of activities that are eligible TEAs and this includes "provision of facilities for pedestrians and bicycles, provision of safety and educational activities for pedestrians and bicyclists," and the "preservation of abandoned railway corridors (including the conversion and use thereof for pedestrian and bicycle trails)."

Another 10 percent of each State's STP funds is set-aside for the **Hazard Elimination and Railway-Highway Crossing programs**, which address bicycle and pedestrian safety issues. Each State is required to implement a Hazard Elimination Program to identify and correct locations that may constitute a danger to motorists, bicyclists, and pedestrians. Funds may be used for activities including a survey of hazardous locations and for projects on any publicly owned bicycle or pedestrian pathway or trail, or any safety-related traffic calming measure. Improvements to railway-highway crossings "shall take into account bicycle safety."

Congestion Mitigation and Air Quality Improvement Program funds may be used for either the construction of bicycle transportation facilities and pedestrian walkways, or non-construction projects (such as maps, brochures, and public service announcements) related to safe bicycle use.

Recreational Trails Program funds may be used for all kinds of trail projects. Of the funds apportioned to a State, 30 percent must be used for motorized trail uses, 30 percent for non-motorized trail uses, and 40 percent for diverse trail uses (any combination).

Provisions for pedestrians and bicyclists are eligible under the various categories of the **Federal Lands Highway Program** in conjunction with roads, highways, and parkways. Priority for funding projects is determined by the appropriate Federal Land Agency or Tribal government.

National Scenic Byways Program funds may be used for "construction along a scenic byway of a facility for pedestrians and bicyclists."

Job Access and Reverse Commute Grants are available to support projects, including bicycle-related services, designed to transport welfare recipients and eligible low-income individuals to and from employment.

High Priority Projects and **Designated Transportation Enhancement Activities** identified by TEA-21 include numerous bicycle, pedestrian, trail, and traffic calming projects in communities throughout the country.

Federal Transit Program

Title 49 U.S.C. (as amended by TEA-21) allows the **Urbanized Area Formula Grants, Capital Investment Grants and Loans, and Formula Program for Other than Urbanized Area Transit Funds** to be used for improving bicycle and pedestrian access to transit facilities and vehicles. Eligible activities include investments in "pedestrian and bicycle access to a mass transportation facility" that establishes or enhances coordination between mass transportation and other transportation.

TEA-21 also created a **Transit Enhancement Activity program** with a one percent set-aside of Urbanized Area Formula Grant funds designated for, among other things, pedestrian access and walkways, and "bicycle access, including bicycle storage facilities and installing equipment for transporting bicycles on mass transportation vehicles."

Highway Safety Programs

Pedestrian and bicyclist safety remain priority areas for **State and Community Highway Safety Grants** funded by the Section 402 formula grant program. A State is eligible for these grants by submitting a Performance plan (establishing goals and performance measures for improving highway safety) and a Highway Safety Plan (describing activities to achieve those goals).

Research, development, demonstrations and training to improve highway safety

(including bicycle and pedestrian safety) is carried out under the Highway Safety Research and Development (Section 403) program.

Federal/State Matching Requirements

In general, the Federal share of the costs of transportation projects is 80 percent with a 20 percent State or local match. However, there are a number of exceptions to this rule.

- Federal Lands Highway projects and Section 402 Highway Safety funds are 100 percent federally funded.
- Bicycle-related Transit Enhancement Activities are 95 percent Federally funded.
- Hazard elimination projects are 90 percent Federally funded. Bicycle-related transit projects (other than Transit Enhancement Activities) may be up to 90 percent Federally funded.
- Individual Transportation Enhancement Activity projects under the STP can have a match higher or lower than 80 percent. However, the overall Federal share of each State's Transportation Enhancement Program must be 80 percent.
- States with higher percentages of Federal Lands have higher Federal shares calculated in proportion to their percentage of Federal lands.
- The State and/or local funds used to match Federal-aid highway projects may include in-kind contributions (such as donations). Funds from other Federal programs may also be used to match Transportation Enhancement, Scenic Byways, and Recreational Trails program funds. A Federal agency project sponsor may provide matching funds to Recreational Trails funds provided the Federal share does not exceed 95 percent.

5. DEVICES – TRAFFIC SIGNAL CONTROL

STOP SIGNS IN PLACE OF TRAFFIC SIGNALS

Where volumes are sufficient traffic signals are required to create gaps in vehicular traffic so waiting pedestrians can cross. However, signals should only be installed after a case-by-case review because in certain circumstances stop signs are the better alternative.

Traffic signals help reduce pedestrian accidents where there is both high-volume pedestrian (3,500+ daily) and high-volume motor traffic (27,500+ daily) (Zegeer et al, 1985). However, removal of traffic signals and replacement with multi-way stop signs has been shown to reduce pedestrian accidents under certain low volume traffic conditions.

Philadelphia Beginning in 1978, the Department of Streets undertook a signal removal program in strict adherence to the Pennsylvania DOT's traffic signal guidelines.⁵ There was no publicity about the change at the time and no reported resistance from the community.

A study of the converted sites has found a reduction in all crash types of 24%, scaling for levels of severity, light conditions, and impact types. Collisions resulting in pedestrian injuries declined by 18%. Furthermore, the conversion resulted in less severe crashes when they did occur – 54% for pedestrians and 62% for motorists (Hauer et al).

By the early 1990s, with the city in a recession and looking for cost-cutting measures, the city's motives for conversion came under scrutiny. Streets Department engineers attended city council meetings to argue the merits of continuing the conversion program by asking the council to consider the “dynamics of the driver” by visualizing their own behavior behind the wheel. A motorist who approaches a green signal tends to focus attention on the signal, accelerating in order to “make the green.” In contrast, a motorist approaching a stop sign removes his foot from the accelerator and scans for other motorists and pedestrians to determine whether he may roll through the intersection. Statistics support the argument that this cautious behavior is actually safer for the pedestrian, with fewer collisions and less severe injuries when collisions do occur.

New York City The buildings that make up New York University are spread out across a 40-block area of the Greenwich Village neighborhood, set on a pre-existing urban grid of primarily one-way streets. The institution sought in the 1960s to create a more campus-like setting, despite its non-traditional location. Appeals to the N.Y.C. DOT resulted in the installation of multi-way stop signs at many intersections. Additionally, large painted

⁵ Guidelines meant that signals at intersections with annual average daily traffic (ADT) of less than 9,000 on the major street or less than 2,500 on the minor street were superfluous. Often, the signal was placed in flashing mode for 1 month prior to removal. Site inspection indicated that removals were typically at low volume intersections of one-way non-arterial streets, where signals tended to be pre-timed and on short cycle lengths of the order of 60 seconds. Typically, the approaches had parking on both sides and one lane.

lettering in the road before crosswalks read STOP. Rudin Center staff observed that eye contact is frequent between waiting pedestrians and motorists, each nodding to indicate the other may proceed.

EXCLUSIVE VERSUS CONCURRENTLY TIMED PEDESTRIAN INTERVAL

The exclusive pedestrian interval (sometimes called “all red” or “scramble”) stops vehicular traffic in all directions while pedestrians cross without conflict. Exclusive phasing offers maximum protection for the pedestrian, but also maximum delay. Concurrent timing reduces delay for all users because there are fewer phases to each cycle.

Zegeer (1985) conducted studies of various signal alternatives in 15 cities. Exclusive timing was associated with a fifty-percent reduction in pedestrian accidents for downtown locations with heavy pedestrian volumes and low vehicle speeds and volumes compared to signalized intersections with concurrent signal timing or with no pedestrian signals. However, at intersections with fewer than 1,200 pedestrians per day, no significant difference in pedestrian accidents was found in comparisons with exclusive signal phasing, concurrent phasing, and no pedestrian signals (Zegeer et al, 1985).

A significant downside to exclusive phasing is that delay is increased for both pedestrians and motorists. Critics note that most pedestrians cross against the light while traffic still has the right-of-way, leaving motorists to wait unnecessarily during the all-red. For *most* pedestrians the concurrent signal may be just fine – they treat every signal as if it’s concurrent anyway. Unfortunately this creates the “little old lady” problem in the minds of many transportation engineers who fear the all-red phase remains only to serve that minority of pedestrians who have the greatest need for a pedestrian-protected phase.

Boston Exclusive signals are used at most crossings except a few dense areas in the financial district and along Massachusetts Avenue. Out of 750 signaled intersections, only 75 have concurrent timing. Officials would prefer to implement more concurrent signals and are slowly doing so, but are restrained by the difficulties of implementation and community response.

During a Rudin Center visit, staff members observed two intersections with pedestrian-exclusive phasing. The jaywalkers there were bold even by New York standards. And little wonder, when compliance meant waiting one and one-half minutes at times for the WALK signal to appear. On some cycles staffers didn’t observe a WALK signal at all unless the pushbutton was activated. This was in the middle of a weekday.

Conversion at one location circa 1980 on Massachusetts Avenue was accompanied by a before-and-after study. WATCH FOR TURNING VEHICLES signage was placed at the intersection to inform pedestrians of the transition. The result was fewer accidents.

A Boston engineer stressed that there should never be a case where pedestrians have exclusive protection at certain times of the day but not others. It is reasonable to vary the timing or activation method of signals, but never the phasing. That inconsistency places pedestrians in danger.

SUFFICIENT PEDESTRIAN CROSSING TIMES

While the standard designed walking speed is 1.0 meter or 4-feet per second, it is generally recognized that older pedestrians and large pedestrian volumes require longer crossing times. The forthcoming AASHTO Pedestrian Guide will recommend use of a standard 3.5 foot per second rather than four.

New York City N.Y.C. DOT officials report that walk periods are lengthened during non-peak hours, when the priority is shifted from rush-hour motorists to pedestrians.

Philadelphia A Department of Streets engineer stresses that Philadelphia is a “walking city” and should remain that way. The department therefore provides minimum green time beyond standard recommendations. Where some cities will provide only 4 or 5 seconds of a solid walk signal, Center City Philadelphia provides 7 seconds or more. They use the 4-foot per second standard walking speed in signal timing, and the 3-foot per second near designated schools and senior facilities.

RIGHT TURN ON RED (RTOR) RESTRICTIONS

The permissive right-turn-on-red (RTOR) allows motorists to make a right turn at a red light after coming to a complete stop. Where the law was adopted between 1974 and 1977, crashes increased dramatically in states that adopted the law compared to those that did not. Despite safety concerns the practice continues because of benefits in reduced energy consumption, positive environmental impacts and reduced operational delays.

After adoption of a permissive right-turn-on-red, pedestrian crashes involving right turn maneuvers increased by 79% in urban areas, compared to 57% for all areas. A 110% increase was found for elderly persons (Zador et al. 1982). Motorist disobedience is high at RTOR intersections, with a 1985 study showing that 57% of motorists failed to make a full stop before turning right on red (Cynecki and Zegeer). ITE recommends that where pedestrian volumes are high (3,500+ daily), this turn should be prohibited, either full- or part time (ITE Toolbox). Most pedestrian advocacy groups and many transportation officials strongly assert that all urban areas should restrict right turn on red. It should be noted that a blind person, in particular, is at a disadvantage where right turn on red is allowed.

Where pedestrian volumes are high, some cities prohibit RTOR with a NO TURN ON RED sign (or the more effective NO TURN ON RED sign with a red ball in the center). For areas where a right turn would be acceptable during certain times, a variable message NO TURN ON RED/blank out sign is recommended (ITE Toolbox p192). The forthcoming AASHTO Pedestrian Guide will recommend the prohibition of free flowing right-turn-on-red in all urban areas.

Philadelphia The city prohibits RTOR throughout its Center City. Restrictions are divided between the 6am - 6pm signs and the full-time restrictions. Officials do not feel there has been confusion among motorists over the part-time indications. In general, the

restriction has been eased since its inception as the community and city officials become more comfortable with the RTOR movement.

New York City Right-turn-on-red is prohibited throughout the city.

Atlanta RTOR is prohibited at downtown locations and those with line-of-sight restrictions. The Department of Public Works suggests trying a sign that reads “Right Turn on Red AFTER Stop” since he sees a high incidence of rolling stops at the permissive right turn.

6. DEVICES – PEDESTRIAN SIGNAL CONTROL

PEDESTRIAN SIGNAL INDICATORS (WALK/DON'T WALK)

Pedestrian signal heads are widely used in urbanized areas because they remove ambiguity for users, clearly establishing the right of way. Yet confusion over the meaning of the signal phases is well documented, and studies have not proven any benefits to pedestrian safety. Meanwhile, transportation departments use up valuable resources to maintain the signals.

The MUTCD recommends the use of pedestrian signal indicators in instances where:

- traffic signals are installed based on meeting minimum pedestrian volume (4C-4);
- an exclusive pedestrian interval is provided;
- vehicle signals are not visible to pedestrians;
- the crossing is within a school zone.
- The signal heads are also encouraged where multiphase traffic signals may be confusing for pedestrians, or pedestrian push buttons are in use.

Observational studies of more than 4300 pedestrians found that pedestrian crossing behavior appears to be more affected by the presence or absence of traffic than it is by signal indication. If pedestrians can safely cross, they will do so regardless of the signal (ITE, *Plaques*).

A 1985 study of pedestrian crashes at 1300 signalized intersections in 15 U.S. cities provides a valuable database for comparing signal treatments. No significant differences in pedestrian crash rates were found between intersections with no pedestrian signals versus intersections with concurrent pedestrian signals (Zeeger et al, 1985). In the conclusion to his study Zeeger wrote:

The results of these analyses, while raising questions about the effectiveness of current pedestrian signalization practice are not believed to justify the widespread elimination of pedestrian signals. It is recommended, however, that city and state agencies take a closer look before indiscriminately installing pedestrian signals at all traffic-signalized locations. Pedestrian signals are expensive to install and maintain and they may not be justified at many locations (Zeeger, 1985, p44).

A major criticism of the signal heads is that pedestrians do not understand the meaning of the signal indications, particularly the flashing DON'T WALK/raised hand (Robertson, 1977). Only 12% to 28% of pedestrians interviewed in a 1995 FHWA study understood the meaning of the flashing DON'T WALK and only 24% to 29% of all signal cycles observed had full compliance with the flashing DON'T WALK indication (Knoblauch, 1995).

New York City Of the city's 11,000 traffic signals, 85% have pedestrian indicators. The Department of Transportation explains that this high proportion grew out of concerns over liability.

Philadelphia The Department of Streets provides side-mounted red, green and yellow

ball signals visible to pedestrians at every controlled intersection. The department does not feel pressured, in general, to provide the indicators. They install them in downtown at departmental discretion – usually where pedestrians number 100 per hour for four hours and the crossing width is greater than 20 feet.

Washington DC At some intersections in the Dupont Circle area, signal phases are coordinated meaningfully with the motorist signal phase. The walk signal lasts the length of the leading pedestrian indicator when all traffic has the red; the flashing DON'T WALK means turning traffic should be watched for; the solid DON'T WALK means that cross traffic is being released.

Atlanta The community expects the signals and that they are routinely provided.

COUNTDOWN WALK SIGNAL

A new indicator, added to conventional pedestrian signal heads, counts down the seconds (e.g. 12-11-10) remaining to clear the intersection, beginning at either the WALK indication or with the flashing DON'T WALK indication. The steady DON'T WALK appears as the countdown signal reaches zero.

The countdown device addresses confusion among pedestrians about the standard flashing “DON'T WALK” or raised hand that prompts pedestrians to clear the crosswalk. Surveys in Hampton, VA revealed that 88% of pedestrians felt that the countdown signals were clearer than the conventional displays and 82% felt that the new heads were an improvement.

A number of negative predictions about the signals have not been realized at a limited sample of sites. Pedestrians in Boulder, for instance, better understand the clearance interval phase and are making informed choices rather than dashing into the crosswalk.⁶

Still, there is limited experience with the new devices. Some officials express concern that pedestrians will misjudge the time needed to cross and will step off the curb in the final seconds. Others argue against the increased equipment needs and maintenance requirements.

Boston Installation of the countdown signals at two different mid-block crossings teach a valuable lesson about successful placement. While both the Congress Street and Hyde Park Avenue signals resulted in overall positive effects on pedestrian compliance, one works better than the other.

Both arterials carry two lanes of traffic in either direction, but the Congress Street location has a median, and pedestrians still rely on the gaps in traffic. In comparison, the Hyde Park location has no median and a much more complex traffic situation. A heavily used commuter parking facility plus an adjacent bus loop entrance creates a complex situation where pedestrians rely more on the countdown signal in making their decision to

⁶ Joe Paulson, traffic division engineer for Boulder's public works department.

cross.

Both locations feature additional signage that cautions drivers to watch for pedestrians. Officials stress that signals are not visible to cross-street motorists for fear motorists will anticipate the green and rush the intersection as the timer reaches zero.

Advocates at Walk Boston are supportive of the countdown signal. They claim that it provides needed information to the user – much better than the ambiguous flashing DON'T WALK signal.

See photos, details, suppliers: <http://www.walkinginfo.org/pedsmart/count.htm>

LEADING PEDESTRIAN INTERVAL PHASE (LPI)

The LPI permits pedestrians to assert themselves in the crosswalk several seconds before the release of potentially conflicting vehicles. Typically, a red signal is prolonged for traffic traveling parallel to pedestrians, giving pedestrians the opportunity to begin crossing the street before cars turn into the crosswalk. This pedestrian “head start” is primarily used where there is a heavy concentration of turning vehicles.

Protected pedestrian intervals are associated with significantly lower pedestrian crash rates than locations with only concurrently timed signals. Crash rates decline at LPI-equipped intersections regardless of pedestrian volumes. A study at three urban intersections in St. Petersburg, FL showed that a three-second LPI decreased pedestrian conflicts from the baseline of 3.0, 2.1 and 3.3 per one hundred to 0.1, 0.1 and 0.2 per one hundred (Van Houten).

The LPI is an inexpensive solution. The negative effect is the reciprocal loss of green time for vehicles.

New York City Results of a N.Y.C. DOT study at four Manhattan intersections with heavy turning movements showed the positive effects of LPI use. Vehicle-pedestrian crashes were reduced by an average of 69% and by 1,483% when factored for the severity of the crash. (King)

Philadelphia In a city with a large proportion of one-way streets and heavy pedestrian volumes, the LPI is used primarily at intersections with right-turning movements, as well as for some left-turning movements, as at a T-intersection.

Baltimore Traffic engineers use 5-to-7-second intervals at eight locations near the Inner Harbor that experience heavy volumes of turning traffic (i.e. double turning lanes). Officials feel the motorist volumes “can’t afford an exclusive pedestrian phase which would hold traffic back”. LPI phasing is timed to allow pedestrians to walk half way or more into the roadway in order to be visible to turning motorists.

Atlanta After two years of use, the LPI timing has proven highly effective, particularly for the elderly, who need ample time to assert themselves in the roadway. The timing is in use at approximately 10 locations, mainly those with heavy left-turn movements.

7. DEVICES – CROSSWALKS

A WORD ON CROSSWALKS

The results in Table 3 show that walking tends to be most dangerous in newer Southern and Western metro areas. Pedestrians may be forced to walk alongside high-speed roads without any sidewalks and often must contend with crossing wide, busy streets with no median and few safe crossing- points. Intersections are often designed with wide, sweeping curves that allow cars to keep moving at high speed but increase the crossing distance and danger for pedestrians. Zoning codes typically require businesses to be fronted by a large parking lot, forcing pedestrians to thread their way through a maze of parked cars to reach their destinations.

In such sprawling environments, the combination of wide roads without pedestrian facilities and high-speed traffic can prove deadly. The national data show that walking is most dangerous in places without a basic network of pedestrian facilities – in other words, sidewalks and crosswalks.

English-style crosswalk description and photos: *(Research, Development, and Implementation of Pedestrian Safety Facilities in the United Kingdom* Publication no. FHWA-RD-99-089 December 1999). <http://www.fhwa.dot.gov/fhrc/safety/pubs/99089/intro.htm>
The National Center of Bicycling and Walking: <http://www.bikewalk.org/crosswalks.htm/>

MARKED VERSUS UNMARKED CROSSWALKS

Can the presence of a crosswalk actually be detrimental to pedestrian safety? The issue of marked versus unmarked crosswalks is often debated.

Several studies have been completed over the past 25 years on the subject. Some have concluded that motorists are more likely to stop for pedestrians in marked crosswalks, rather than unmarked, and that marked crosswalks are safer and more preferred by both pedestrians and motorists than unmarked crosswalks under most conditions.

Other studies have concluded that marked crosswalks give pedestrians a false sense of security when crossing the street. Inadequate scanning and heavy reliance on California's crosswalk law was reported in San Francisco in 1983 (Liebermann). B.F. Herms' five-year study in San Diego generated controversy by showing that pedestrian collision rates at marked crosswalks were twice that of unmarked crosswalks. Those results were questioned when it was noted that the most vulnerable users, the young and old, prefer to cross at marked crosswalks.

The effectiveness and utility of marked crosswalks has been reaffirmed in surveys of both users and traffic officials in numerous studies (Zegeer and Zegeer).

Los Angeles Marked crosswalks are periodically reviewed and some are not reinstalled if there is no compelling reason to identify a preferred crossing point (active retail area, bus stops, far from signal, etc.) A major study by the City of Los Angeles Department of

Transportation indicates that pedestrian accidents have been reduced by 61% as a result of selective removal. (Pedestrian accidents throughout the city are down 30% over 10 years and 20% in the last 5 years, despite an increase in the number of pedestrians walking). The L.A. DOT's 20-point pedestrian safety program (1999) includes a helpful explanation of the study that prompted the crosswalk policy:

The Los Angeles Marked Crosswalk Study analyzed 104 unsignalized locations along arterial streets where marked crosswalks were either removed or not re-installed after resurfacing. The 104 marked crosswalks were removed between December 1982 and February 1991. The before and after study periods were identical in duration at each location, with an average of 7.3 years.

The results show that when only the legs of the intersections that previously had the marked crosswalks are considered, pedestrian accidents declined from 116 to 31, a reduction of 73%. The results also show that when both legs (previously marked and unmarked) of the intersections are considered, pedestrian accidents declined from 129 to 50, a reduction of 61%.

At 72 of the 104 locations, at least one of the adjacent intersections is signalized. Thus, crosswalks were removed in many cases to encourage pedestrians to cross at the nearby signal. At the other 32 of the 104 locations, where neither of the adjacent intersections is signalized, pedestrian accidents declined from 47 to 14, a reduction of 70.2%. At the adjacent 64 unsignalized intersections, pedestrian accidents were 24 in the "before" period and 21 in the "after" period. Thus, there was no increase at the adjacent locations.

Where marked crosswalks are installed, controls that exceed state and national guidelines are installed to maximize the visibility of the crossing and the pedestrian. The controls include pavement markings, warning signs, and red curb. (L.A. DOT, 1999)

Atlanta Safety at transit stops is one of the biggest problems in the metro area. Seven-lane roads with center turn lanes were built in the 1970s. Many had signals placed a half mile to one mile apart. No provision was made for pedestrians trying to cross to bus stops. Many of the stops lie along suburban arterials where many poorer residents do not own cars and are forced to walk the unfriendly road. A recent consultant study recommended an English-style treatment with center medians and signaled crossings with vehicle detectors.

Officials at the Department of Public Works feels it will take a citizen task force or an elected official to draw attention to the problem and implement the recommendations, but says that money would be available from the State DOT Safety Fund.

Philadelphia Continental (a.k.a. zebra) markings are provided in all business corridor districts, at adjoining intersections in school and playground zones, and at any point where transit connections are made. While all controlled streets are marked with crosswalks, uncontrolled streets in the same intersection are not.

MID-BLOCK CROSSWALKS

Like the marked versus unmarked crosswalk debate, the mid-block crossing has both advocates and detractors. While some cities are paving over mid-block crosswalks altogether others are enforcing them with signals. Advocates of mid-block crossings hold that they offer greater safety over intersection locations, and that pedestrians should not have to walk great distances out of their way to cross the street. Arguments against them cite both interference with vehicle traffic and decreased safety for the pedestrian.

Results of a user's survey completed by pedestrians who regularly crossed a 1-km long divided urban boulevard in downtown East Lansing, Michigan found that pedestrians preferred mid-block crosswalks. It was also evident that the crosswalk location relative to the origin and destination of the pedestrian was the most influential in determining crossing locations (Akin). The fact that pedestrians are inclined to cross at points most convenient to them may support the installation of crosswalks to protect them at those points.

Los Angeles Mid-block crosswalks have been present for seventy years in Los Angeles and number about 40 in the downtown. Installations are mainly at high pedestrian activity centers with long blocks (660+ feet). In the last 30 years, the city has begun signaling most of the mid-block crossings.

Philadelphia The compact city has blocks of just 500 feet in length, and the Streets Department discourages mid-block crosswalks, reasoning that a 250 foot walk to the corner is not a hardship that requires installation of a mid-block crossing. While there are some signaled crossings in downtown the department has fought the Park Service over crossings in the historic district of Independence Mall where Streets feels that building entrances and thus pedestrian flow should be oriented toward corners.

Baltimore The city tries to avoid mid-block crossings, both for safety of pedestrians and traffic flow considerations.

Atlanta The city considers its 400-foot blocks too short to warrant mid-block crosswalks so current policy is to pave over the markings where they exist.

CROSSWALK DESIGN

Crosswalk markings are meant to alert oncoming motorists that pedestrians may be entering the roadway. They also highlight for pedestrians the recommended (and presumably safest) crossing locations. But their presence is more than a safety device. The markings signal street users that walking is expected and even encouraged. As with roadways that don't have sidewalks, a person can walk where there are no crosswalk markings, but will they want too?

Pedestrian advocate Michael King feels that the style of pavement markings is irrelevant because the striping does not provide enough of a visual cue to change motorists' likelihood of yielding. That faction feels that only the more prominent indicators (e.g. standing bollards) work.

Officials at the Department of Public Works in Atlanta also finds the design irrelevant in city centers where speeds are of or below 30 mph, but for a different reason. At those speeds the cars aren't going fast enough to require more than the double stripe crosswalk marking.

New York City. Higher-visibility markings (zebra stripes for instance) are currently installed at higher volume crossings like Times Square. N.Y.C. DOT is unconvinced that the markings are having the desired effect on motorists, but they do know that crosswalks improve a community's perception that their needs are being met.

Los Angeles. Special ladder-style markings are increasingly used in hopes of improving poor yielding behavior among motorists. According to L.A. DOT's John Fisher current studies show that 30% to 50% of motorists do not yield to the pedestrian when given the opportunity.

RECESSED STOP LINE

Moving the white stop bar for drivers farther back from the crosswalk (4 feet or more) gives pedestrians and drivers a better look at each other and more opportunity to avoid conflict.

If met with compliance the recessed stop bar has numerous benefits:

- It can reduce the likelihood of multiple threat crashes where one vehicle has stopped to let a pedestrian cross in a crosswalk and the pedestrian is struck by a trailing vehicle in the adjacent lane.
- It can also mitigate motorists' tendency to overshoot the stop line and invade the crosswalk area - pushing pedestrians out into parallel travel lanes.
- Trucks with limited forward visibility are especially prone to striking pedestrians that they can't see in crosswalks. Pedestrian fatalities in crashes with trucks were more likely than with other vehicles to occur at intersections, at traffic signals, during daylight hours, and to involve older pedestrians. Obstruction of truck driver visibility, caused by the design of truck cabs, appears to be a major contributing factor in crashes at intersections (Retting, 1993).
- A further advantage to the advanced stop lines is that bicyclists can wait in bicycle lanes several meters ahead of other travel lanes. The bicyclist will be much more visible to traffic and can get into the intersection quickly when the light turns green.

Moving the line back somewhat decreases the area available for queuing motorists. Some officials state that they cannot accept the tradeoff. The counterargument is that on an 800-foot block, a 5 or 10-foot setback means a reduction of automobile holding to 795 or 790 feet, an acceptable trade-off for improved visibility.

Atlanta Crosswalks are made twelve to fifteen feet wide in order to mitigate the tendency of motorists to overshoot the crosswalk. Attempts to employ the recessed stop line met with widespread disobedience.

New York City On Park Avenue South, along Union Square, motorist compliance with stop lines is encouraged because the traffic light is placed practically above the stop line. This nearside placement of the signal may work because “what motorist wants to stop beyond the light so that he can’t see when to GO?”

SENSORED CROSSWALKS

Pedestrian sensor technology can detect pedestrians entering (or leaving) a crosswalk and automatically “call” the Walk signal and/or warning device that alerts motorists to pedestrian presence. No pedestrian action is required, addressing the problem of pedestrians who do not use the push button (51% in one study). These detectors can also extend the clearance interval to allow slower persons to finish crossing.

The sensors complement or replace pushbutton technology at otherwise uncontrolled intersections like mid-block crosswalks. Problems reported with the new technology include false and missed calls, but adjustments often improve operations. Two types of sensors have been used – microwave radar (similar to those used in supermarkets) and pressure sensitive tiles.

Where pedestrian crossings are frequent but do not justify a full traffic signal, the sensors are one-quarter the cost of a full signal.

Los Angeles. “Smart Crosswalks” with microwave radar detectors have been placed in about seven locations. The program is popular, and initial results indicate that the sensors and alerts significantly improve the percentage of motorists yielding to pedestrians.

See photos, details, suppliers: <http://www.walkinginfo.org/pedsmart/nookit.htm>

CROSSWALK ALERT SIGNALS

A variety of unique measures are being tried by some localities to reinforce pedestrian right-of-way at crossings. The special signals can be activated by active (push button) or passive (sensor technology) activation.

Flashing Overhead lights

Flashing yellow lights are a common sight at mid-block and especially school crossings. Criticisms include the fact that lights are *yellow* rather than *red*, usually meaning to slow down rather than stop. Many transportation officials indicated that positive controls that explicitly state the right-of-way are preferable.

In-Pavement Lighting

A flashing row of lights is embedded in the pavement on both sides of the crosswalk. Activated by either a push-button or through pedestrian detection by an automated device, the lights increase the distance at which motorists become aware of the crosswalk.

They then automatically shut off after the time required for a pedestrian to safely cross the street.

Los Angeles. L.A. DOT rejected in-pavement lighting which had been tested with positive results in Santa Rosa. L.A. DOT reasons that the low-lying in-pavement lighting is only apparent to the first motorist in the platoon. Therefore, the lighting would be effective only on lonely highways where gaps were already sufficient to make pedestrian crossings. The DOT has chosen flashing lights above the roadway instead.

See photos, details, suppliers: <http://www.walkinginfo.org/pedsmart/tlite.htm>

8. DEVICES – ENCOURAGING PEDESTRIAN COMPLIANCE

SIGNS TO ENCOURAGE PEDESTRIAN COMPLIANCE TO SIGNALS

Pedestrians often do not understand the meaning of pedestrian signal indications (see Pedestrian Indicators above) that may result in poor compliance with signals. Pedestrian behaviors like crossing against the signal are involved in about half of pedestrian injuries, (Zegeer 1985, p11). Informational signage explains the meaning of signal indicators or gives a “heads up” to pedestrians, reminding them to be responsible for their own safety.

Educational placards describing the pedestrian signal phases are commonly incorporated into instructional signs for pushbutton activation.

ITE completed a report in 1997 that evaluated various educational plaques, relying largely on a 1995 FHWA observational study conducted in Virginia, Maryland and New York (ITE, *Pedestrian Information Plaques*). The study found no change in pedestrian signal compliance once the plaque was present. However, it was noted that less than one-third of the pedestrians interviewed actually saw the placard at the intersections. A follow up survey found that exposure to the placard in print resulted in a significant increase in understanding of the phases of the pedestrian signal.

In its summary, ITE concluded:

Special pedestrian information plaques appear to be more a response to a problem of public understanding than one of safety. The effectiveness of special information plaques appears very limited, but, at the very least, it provides the traffic engineer with a public relations tool, an opportunity to do something in response to complaints. (ITE, p 6)

Boston Part of a Boston Pedestrian Protection Program launched in 1999 includes compelling signage and sidewalk art throughout the city, designed to reach people at some of the high-traffic locations throughout Boston. BTD was involved along with other agencies, but no data is available to measure their effectiveness. Sample language used in the signs included: “YOU DON’T COME WITH AN AIRBAG. PRESS THE BUTTON”, and “CRUNCH. THWACK. THUD. SOUNDS LIKE A GOOD IDEA NOT TO DART INTO TRAFFIC.”

The signs were in response to results of a one-year observational study at a dozen of the city’s most dangerous roadway intersections:

- Only 12% of pedestrians crossed at the crosswalk with the “Walk” signal.
- One-third of pedestrians were clearly jaywalking (crossing at least five feet from crosswalk).
- While nearly 95% of drivers yielded to pedestrians when pedestrians had the right of way, only 50% of drivers yielded to pedestrians who were crossing against the light. Even fewer slowed down for jaywalkers.

- At five of the 12 sites, at least 20% of drivers were speeding. (11/9/99 Press Release, Mayor's Office).

Philadelphia Within the city signs warn "Pedestrians Must Yield on Full Green" and incorporate a green ball. When the right turn arrow appears, pedestrians are not permitted to cross, but must wait for the full green.

SIGNS TO IMPROVE PEDESTRIAN LOOKING BEHAVIOR

Turning vehicles, especially left-turning vehicles are disproportionately involved in pedestrian crashes at intersections (Zegeer, et al 1985, p18). Several devices encourage pedestrians to scan for turning vehicles before stepping into crosswalk.

Both low- and high-tech measures have been tested and proven to reduce pedestrian conflicts with turning vehicles, at least in the short term. These range from signs and pavement markings to auditory and animated pedestrian signals.

Pedestrian advocates fear that such measures put the burden of safety too much on the pedestrian, blurring the legal requirement for motorists to yield to pedestrians. Most officials expressed concern over liability and effectiveness in the long term, commenting that even a flashing yellow beacon will lose its novelty and effectiveness over time.

Boston The Transportation Department posts WATCH FOR TURNING VEHICLES signs where exclusive pedestrian phasing is converted to concurrent timing. They find the signage helpful to pedestrians during the adjustment period. (Signs are also posted for vehicles that read YIELD TO PEDESTRIANS WHEN TURNING.) The department otherwise posts the signs only in response to complaints, where pedestrians report a threat from aggressive motorists.

Clearwater, FL The new SignalEYES device features a pair of blue eyes that scan from side to side for 2.5 seconds at the start of the WALK indication. The eyes were incorporated as part of the pedestrian signal at two sites in downtown Clearwater, FL. Instances of pedestrians not looking for turning vehicles decreased from 32% to 10% and from 26% to 5%, respectively. Introduction of concurrent SignalEYES display and WALK indication further reduced the percentage to 3%. The introduction of the LED signal head without the SignalEYES display produced no change in pedestrian behavior (VanHouten).

Similar results were found in a study of auditory pedestrian signals.

In **Detroit** and **Milwaukee**, a PEDESTRIANS WATCH FOR TURNING VEHICLES sign was found to be effective at each of the four test sites, particularly relative to right-turn vehicle conflicts. The signs had no proven effect relative to left-turn related conflicts (Zegeer 1985).

One untested concern mentioned by Zegeer is that pavement markings may not be the safest option if they encourage the pedestrian to look down rather than scanning for

potential hazards.

See photos, details, suppliers for SignalEYES: <http://www.walkinginfo.org/pedsmart/eyes.htm>

AN IMPROVED PUSHBUTTON

The pushbutton suffers from a lack of respect borne of mistrust, non-use and non-compliance. Pedestrians often don't see the button, don't understand which leg of the intersection it controls, don't realize it is working, or have to wait so long for a walk signal following activation that they do not wait, leaving traffic stopped unnecessarily after they have crossed.

A study in Detroit and Ann Arbor found only 51% of crossing pedestrians pushed the button to actuate the pedestrian signal, and 66% of pedestrians were observed starting to cross during the flashing or steady DON'T WALK interval. The violation rate ranged from a low of 34% at one site to a high of 71% at another (Zegeer 1985).

Most pedestrians don't realize they may not get enough time to cross safely if they do not push the button and they rely on the vehicular green to make their crossing. In Boston cross traffic from the minor street is commonly given only seven or eight seconds, while pushbutton activation grants 20 seconds.

In its *Toolbox* ITE recommends that municipalities keep pedestrian waiting time to 30 seconds or less and provide signs designating the street controlled (e.g. PUSH BUTTON TO CROSS MAIN STREET).

See photos, details, suppliers on Red Light Indicator: <http://www.walkiz.org/pedsmart/iloom.htm>

Philadelphia Pedestrians at actuated signal locations are given adequate time to cross even when they do not activate the push button.

Boston A new device that addresses pedestrian mistrust has been tried in a number of Canadian cities and in Boston. A red indicator light is added to the push button face to communicate to pedestrians that the device is functioning and their call has been received. Rudin Center staff observed an intersection with the red indicator light on each pushbutton. The light did seem to discourage the need people felt to press the button multiple times, but did not seem to affect crossing behavior. In this case the red light (and button itself) was quite small, and barely noticeable at first glance.

PEDESTRIAN BARRIERS

Pedestrian fences are meant to prohibit pedestrians from crossing at high-risk locations and instead channel them to crossings with the least chance for vehicular conflicts.

Barrier fences have a varied success rate and varied popularity across location. One sure finding is that the barriers achieve compliance only if they extend far enough to insure that the shortest route will be the alternatively designated crosswalk. If the pedestrian can simply walk around the end of a barricade (say 5 feet beyond the entrance to his

desired path) he will do that and proceed, rather than walking to a designated crossing that is farther away. Likewise, a height of about 4 feet is necessary to keep pedestrians from easily stepping over the barriers.

New York City. During the 1997-1998 holiday season the police department installed barriers at 10 midtown intersections to prevent pedestrians from blocking vehicles turning onto one-way avenues. Pedestrians were directed instead to new crosswalks set 30 feet from intersections. Barricades initially confused and inconvenienced pedestrians, particularly the elderly and disabled (*New York Times*, 4/11/98). And the scheme inconvenienced all walkers by forcing pedestrians to cross three times instead of one. Some sidewalk vendors were enraged because the barricades practically eliminated their walk-by business (*New York Times* 4/11/98).

Transportation consultant Charles Komanoff has calculated that it takes 16% longer than it used to (741 seconds, compared with 640, on a typical stroll) to walk the length of the experiment area, from the northwest corner of 50th and Avenue of the Americas to the northeast corner of 50th and Lexington. Even if a car's travel time has been improved as much as 30 percent, Mr. Komanoff said, that savings is far outweighed by the time loss for pedestrians – perhaps by a factor of eight, he said – because walkers vastly outnumber cars (*New York Times* 4/13/98).

The mayor's office came under criticism for sanctioning the barriers and the press warmed to the topic, reporting that the police chief who first came up with the barricade scheme did so while "stuck in traffic, sitting in a left-hand-turn situation" (*New York Times*, 1/7/98).

Two years later though, most of the barricades are still in place, and signals have been added.

Atlanta Prior to 1996, the Streets Department installed French barricades in front of hotels in the downtown area in response to a high accident rate. The barricades extended from corner to corner along each block. Pedestrians complied by crossing at corners, and there was no reported complaint from the hotels nor the convention bureau. The barriers were considered unsightly though and came down in preparation for the Olympics in 1996. More of the barriers have been ordered and the department hopes to re-install them. Future plans include replacing the current design with more attractive wrought-iron fencing.

Los Angeles One barrier located near a university campus has achieved only moderate compliance. The barrier extends along a street dividing dorms from academic buildings to discourage crossings at an unsignalized intersection. Accompanying signs direct pedestrians to a more appropriate corner. However, a barrier only 8 feet long does not deter many in the agile population of students.

9. DEVICES – ENCOURAGING MOTORIST COMPLIANCE

PARKING RESTRICTIONS

Vehicles parked on the street can create a visual screen that prevents motorists and pedestrians from seeing each other – a particular problem at intersection and other crossings. A common response to the problem is to implement parking bans at specific times at high-risk locations near corners, sometimes called daylighting. The downside of such restrictions is lost parking space which affects adjacent businesses. Also, non-compliance among motorists is chronic in many cities.

It is interesting that in a recent ITE handbook the first recommendation under the heading Parking Restrictions is a recommended alternative to parking restrictions: “Where there is parking, curb extensions should be built where pedestrians cross.” (*ITE Toolbox*, p. 193)

In fact, curb extensions (neck downs) do solve the problem of visibility by projecting pedestrian space beyond the parking lane into view of travel lanes. The neck down does this without removing valuable parking spaces and offers many other benefits, along with a few problems of its own.

However, most cities implement bans on parking near crosswalks with a variety of signs and other controls. The main challenge is enforcement, with motorists intent on finding a parking or standing space.

Philadelphia The application of a large painted X in a box, marked on the pavement in restricted spaces, has generated motorist compliance greater than what had been achieved with signs. The painted graphic is applied 3 to 5 feet on either side of driveways, and at controlled intersections.

In one case - at an intersection with a main street where visibility was a problem – demand was high from the community for an all-direction control. The X was applied at the problem corner and solved the problem.

Los Angeles Red pavement markings enforce the ban on parking near corners and other crossing points. Compliance has been “generally good.” The Department has faced some political difficulty from storeowners, but they are working it out.

New York City Parking is restricted at high-risk locations with historically high accident rates or reported poor visibility. NO STANDING ANYTIME signage is placed in those locations. However, officials agree that enforcement is critical and its effects are short lived.

Baltimore It is very difficult politically to restrict parking in Baltimore. Currently they use only NO STOPPING signage, but with no threat of towing as there is for other rush hour arterial parking restrictions.

PEDESTRIAN LIGHTING

Improving illumination of pedestrians is effective particularly at intersections and at dangerous curves where sight distances are reduced. Lighting also has the most positive cost-benefit ratio compared with other safety improvements such as new traffic signals or median barriers, according to the Insurance Institute for Highway Safety (Status Report, 1998).

In commercial or downtown areas, specialty pedestrian-level lighting may be placed over the sidewalks to improve pedestrian comfort, security, and safety. Mercury vapor or incandescent lighting is often preferred as pedestrian-level lighting. Low-pressure sodium lights are low-energy use lights, but have a high level of color distortion (TRB *Toolbox* p182).

Philadelphia The Streets Department reports that private interests – property owners or business improvement districts, for instance, have responsibility for sidewalk, and thus pedestrian-specific lighting. However, the department is looking at new streetlights that combine the pedestal and mast arm to illuminate the crosswalk. Attractive new “torch lighting” has been installed on sidewalks. The new lighting is brighter and spaced more closely together to aid pedestrian safety and comfort. An ordinance and city approval is required for all such installations, mainly due to the electrical power required.

Atlanta The 1996 Olympics was a catalyst for significant improvements to downtown lighting. Before the upgrade, 6-7 candles were used as the standard for street lighting, and 1-1.5 candles were in use on sidewalks. The 28 – 32 foot lights often rose above the tree canopies, blocking light from illuminating the sidewalk below.

Following the redesign, new lights rise only 12-14 feet from the sidewalk and beneath the tree canopy. While the sidewalk lights are only 1.5 candles the street lights were lowered to 4 candles. Because of the reduced contrast the perception is that the sidewalks are brighter. That effect is heightened because lights are oriented to illuminate the vertical building face. The effect is aesthetically appealing and pedestrians feel safer.

Los Angeles Historic 1920s lighting is maintained for ambience in older areas of the city, but only modern poles and lighting are installed at intersections. The ornamental lighting that directs light upward is interspersed with modern lighting, aimed downward at the street and at pedestrians.

FLUORESCENT STRONG YELLOW-GREEN (SYG) PEDESTRIAN SIGNS

A jolting new color has been tried in a number of cities, exclusively at crosswalks and bicycle crossings. While the yellow-green color has won support in communities, studies conducted by FHWA and state authorities have been inconclusive in determining whether the signs effect any measurable changes in driver behavior. The new color will be included in the 2000 MUTCD for use in pedestrian, handicapped, bicycle, and school crossing signs.

Federal approval for use of the SYG signs was given in June 1998 and by California DOT in December 1998. Traffic engineers recommend limited use of the new color to help

preserve novelty and surprise for motorists. But while the new color is universally more visible according to surveyed respondents, a field evaluation of fluorescent yellow-green pedestrian warning signs found only marginal improvements in perceived safety at the crossing sites and no significant reduction in motor vehicle-pedestrian conflicts (Clark).

New York City The Department of Transportation is placing the new signs at all school crossings, where they do stand out even on an overcast winter day. Rudin Center staff note, however, that they clash with surrounding historic districts such as Stuyvesant Square Park.

Baltimore The signs have been placed at the stadium, and along Pratt in the Inner Harbor, and the program is expanded. They will be used in the suburbs in special instances, such as at roundabouts.

Philadelphia The City does not use the new color. The Department of Streets has opposed use of the signs not only because their benefits are unproven, but because the signs have a shorter life span (5 years versus 7).

Pennsylvania DOT had not yet approved the devices when 3M first marketed them to the city, making it easier to resist. Later, though, the department was charged by the Mayor to explain why it was not implementing the signs. Their defense was a convincing argument for the bottom line, based on the increased expense of the signs. At present the department may in fact find an application for the signs at high-speed mid-block locations along routes like US 1, JFK Boulevard.

Atlanta Based on state requirements the new color is used only in school zones, due mainly to the added expense of the color. Officials at the Department of Public Works doubt the long-term effectiveness of the signs. The local advocacy group, PEDS, which feels that the standard crosswalk symbol is over-used and holds no meaning for motorists, regardless of color, echoes this sentiment.

YIELD TO PEDESTRIANS SIGNS

Left and right-turn movements at signalized intersections have been found to be three to six times more hazardous to pedestrians than through movements mainly because drivers fail to observe or yield the right of way to pedestrians. Studies have found that the signs significantly reduce conflicts involving both left and right turning vehicles, though there are conflicting opinions among city officials and advocacy groups as to whether the devices are effective in practice.

In a study of four intersections in Detroit and Milwaukee the sign was found to be effective in reducing turning conflicts, and in particular, right-turning conflicts. Left-turning vehicles were not significantly affected. The signs were equally effective for low, medium, and high traffic volume levels (Zegeer 1985).

Another study of 12 intersections in two smaller cities found that the sign was significantly more effective in reducing left-turn conflicts, though overall effects were

positive for both turns. Not surprisingly, the incidence of conflicts between pedestrians and turning traffic decreased as the pedestrian group size increased regardless of the presence of the sign (Abdulsattar). Based on the results of that 1996 study, it was recommended that the Turning Traffic Must Yield to Pedestrian signs be considered for inclusion in the *Manual on Uniform Traffic Control Devices*.

Philadelphia Signs are placed at entry points around the periphery to Center City warning “State Law – Yield to Pedestrians.” The purpose is to sensitize motorists as they enter the area to watch for and take care with those on foot.

Boston The Transportation Department found that the use of the “Yield to Pedestrians in Crosswalk” signs were effective at unsignaled crosswalks, but not at crosswalks where a signal exists. One engineer described pedestrians as “less cautious” in signed crosswalks where they feel more empowered to walk against the light.

Atlanta The signs are used primarily to enforce pedestrians’ priority at permissive right-turn-on-red locations.

SUPPLEMENTARY PEDESTRIAN CROSSING CHANNELING DEVICE (SPCCD)

SPCCDs are traffic safety cones with no metallic parts, secured in the middle of the road at a crosswalk. The cones incorporate a graphic panel which reads with some variation of “YIELD TO PEDESTRIANS IN CROSSWALK”.

The device, sometimes called the “soft sandwich,” has met crash test standards and has proven effective at prompting cars to yield. Official feedback to New York State DOT was “positive and favorable” - the only reported complaint being that the devices are expensive (about \$125) and they sometimes need to be replaced after a season of use. Agency memos also stipulated that the devices are considered supplementary and should be placed in addition to any other necessary signs and pavement markings required at a crosswalk. New York State DOT, which first developed the device, reports that that some locations had trouble with theft of devices and of motorists vandalizing the devices by trying to run them over.

A number of state MUTCDs permit use of the device, often with stronger language: STATE LAW. YIELD TO PEDESTRIANS IN YOUR HALF OF THE ROAD. New York, New Jersey and Washington states have all implemented the cones. Common placement is at mid-block crosswalks in conjunction with high-visibility striping. Officials interviewed feel they are best used in relatively low-volume arterials. Pedestrian advocacy group Walk Boston feels that SPCCDs placed mid block have been successful in the Boston area, especially at transit stops where people rush across to catch bus or light rail. Populous city and town retail strips which generate heavy crossing activity by pedestrians are good locations, as are school areas.

U.S.DOT requires that the device’s color be traditional orange or the new fluorescent green, except for the graphic panel. A national version of the device will be included in the MUTCD by late 2000.

Philadelphia In 1999, Pennsylvania DOT gave the Philadelphia Health Management Corporation a grant with which they helped the Police Department purchase twenty soft sandwich devices. The signs were distributed, one per police precinct, and the police placed them where they saw fit, often near schools and high accident locations. The accompanying safety campaign ended but the cones are still in place.

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10. DEVICES – ROADWAY DESIGN

ELIMINATE REDUNDANT STREET SPACE

Converting excess space to pedestrian areas or bike lanes helps keep vehicles in more compact and predictable formation, limiting erratic driver behavior, and encouraging slower speeds. Redundant space can range from overly wide lanes to unused parking areas to stretches where wide roadways are essentially wasted because of narrower bottlenecks up the road. Space removed from the roadway can be given back to pedestrians in a form that is much more appealing to all road users.

The forthcoming *AASHTO Pedestrian Guide* will recommend a maximum lane width of 11 feet for urban areas (except where bike lanes and heavy bus use must be accommodated), and parking lanes of seven to eight feet maximum.

New York City There are many locations in Manhattan where redundant street space has been converted into attractive places for pedestrians. The most notable examples are along lower 6th Avenue in Greenwich Village and SOHO, where the roadway used to have a range of widths from 100 feet to as much as 250 feet wide. Beginning in 1974, four plazas were created out of what had been redundant street space. Father Demo Square at Bleecker Street was doubled in size, and trees and seating areas were added. Father Fagan Square at Prince Street was converted to a plaza; a triangle between Broome and Spring Streets was doubled in size, making room for additional landscaping, and a half-acre plaza was created between Canal and Grand Streets.

Sheridan Square in the West Village, once a striped asphalt wasteland, has also been reclaimed. A community association raised about half the funds needed to turn the unused space into a garden. The other half of the funding came from N.Y.C. DOT.

A 1988 report for the Manhattan Borough President's office, *Walking in Manhattan*, commented that "the reclaiming of redundant street space is an area where DOT and the Parks Department continue to display remarkable vision." The report recommends a joint departmental publication titled *Green Streets: Designing Public Spaces while Rebuilding Infrastructure*.

CURB RADII

One goal of intersection design outlined in the Boston Transportation Department's Streetscape Guidelines (7/99) reads as follows: "Curb radii at intersections should be designed to accommodate average turning traffic, without encouraging excessive vehicle speeds."

The TRB *Toolbox*, p. 182 makes the following recommendation:

A wide curb radius typically results in high-speed turning movements by motorists. Reconstructing the turning radius reduces turning speeds, shortens the crossing distance for pedestrians, and improves sight distance between pedestrians and motorists. Ideal curb radii are in many situations tighter than any modern guide would allow.

Older cities frequently have radii of two to five feet, without suffering any detrimental effects. Appropriate radii also depend on whether there is a parking or bicycle lane, in which case the effective radius allows the curb radius to be tighter, say five feet. If those lanes are not present, the radius might be up to about 15 feet and 25 feet for arterials streets with a substantial volume of turning buses, trucks or both. Tighter turning radii are more important where street intersections are not at right angles.

Philadelphia Streets Department officials report the city has predominantly 10 to 15-foot radii at corners, and they discourage anything beyond 20 feet. 30- to 35-foot radii are hugely problematic. Where does one place stop signs, stop lines, etc.

NECK DOWNS (CURB EXTENSIONS)

Neck downs (a.k.a. corner extensions, bulb-outs, bump-outs, side walk expansions) narrow roadways by extending the sidewalk or curb line into the street, reducing pedestrian crossing distance, and improving the ability for motorists and pedestrians to see each other.

Motor vehicles parked at corners present a serious threat to pedestrian safety because they block sight lines, hide pedestrians and other vehicles, and make turning particularly difficult for emergency vehicles and trucks. Neck downs physically enforce parking restrictions.

The restricted street width sends motorists a visual cue, encouraging slower speeds at intersections or mid-block locations with curb extensions. Turning speeds are also reduced with curb extensions (ITE *Toolbox* p185). Neck downs reduce roadway space available for illegal or aggressive motorist actions such as failing to yield to pedestrians, making high-speed turns and passing in the parking lane. It has also been observed that motorists are more inclined to stop behind the crosswalk at a neck down, and that pedestrians are more inclined to wait on the neck down rather than in the street.

One benefit to vehicle movement is that the shorter crossing distances may permit less signal time to be devoted to the pedestrian phase.

Criticisms include problems of restricted turning movements for large trucks and emergency vehicles as well as street cleaning and plowing considerations. However, the fire department in Cambridge, MA much prefers them to the problem of cars parked at corners. Trucks can always go over a curb; not so a parked car. As with pedestrian refuge islands, neck downs can cause concern to cyclists who are forced closer to motor vehicles.

Boston Neck downs have been present and effective in Center Street, West Rockaway in

Boston for ten years. Where there is parking, experience recommends a neck down two feet narrower than the parking lane, extending six feet into the street: less than that is not enough to discourage drivers from parking at the crosswalk. Beyond 6 feet makes snow removal difficult.

Philadelphia Narrow streets are the norm throughout most of downtown. One exception is JFK Boulevard, which runs from the 30th Street train station to City Hall. Neck downs have been installed at key intersections along the route to compensate for a width that is not pedestrian friendly. Other installations include Historic East Market Street, Chestnut Street, Washington Avenue, and Market Street in West Philadelphia.

http://www.bikewalk.org/curb_extensions_and_curb_radii.htm

PEDESTRIAN ISLANDS

Pedestrian islands break up the distance a pedestrian must travel to cross a roadway. Often the islands are integrated with medians dividing two-way travel lanes or provided as triangular spaces between through lanes and designated right-turn lanes.

The effect of refuge islands and medians on pedestrian safety has been studied in the United States and abroad in recent years. A 1993 study for the Federal Highway Administration compared the safety impact of raised curb medians, two-way left-turn lane (TWLT) medians, and undivided crossings in three large metropolitan areas. The study found that in CBD areas streets with raised medians have lower *pedestrian* crash rates compared with streets with painted two-way left-turn lane or undivided streets. The study also noted that the CBD *vehicle* accident rates at raised medians, for both mid block and signalized intersections, are higher than that of TWLT medians and undivided cross sections. However, a greater percentage of raised median vehicle accidents are of lower severity (property damage only) than that of TWLT and undivided cross sections (Bowman).

While raised medians are popularly know as “refuge” islands, pedestrian advocacy groups point out that there is a negative connotation to the term, which suggests that pedestrians should fear and be separated from vehicular traffic. Advocates at Walk Boston are divided over refuge islands. Some see the island as a dangerous, unfriendly place to corral pedestrians. This is especially true when engineers shorten crossing times in conjunction with medians or other refuge spaces in an attempt to stagger pedestrians’ crossing movement. They feel pedestrians must have enough time to make the entire crossing. Others feel that any refuge is good; for those pedestrians who start across too late and for those slower pedestrians who simply need more time.

Baltimore and **Boston** officials mention that some pedestrian islands were lost during a re-paving at a time when political tendency was to follow rigid AASHTO standards. Boston noted an increase in collisions following the removal.

Atlanta The city has quite a few right-turn islands for pedestrians, “some the size of Oahu,” according to officials at the Department of Public Works. Getting pedestrians past

the large turning radii movements is a problem since the state standard demands a 35' radius. Therefore the city often goes with a 35' radius in conjunction with the pedestrian island. The signals do not have split-phased signals to formally separate the two crossing segments.

SLOW TRAFFIC EXITING HIGHWAY OFF-RAMPS INTO URBAN AREAS

Cars hurtle at high speeds off of ramps onto urban roads, even though they are approaching traffic lights or pedestrian crossings. Ideally, engineers should avoid allowing these configurations that dump freeways abruptly onto urban streets. The forthcoming AASHTO Pedestrian Guide will prohibit use of the cloverleaf interchange in all urban areas.

Former Director of Traffic Calming for N.Y.C. DOT Michael King dismisses alert devices such as rippled asphalt and flashing lights in favor of redesign and re-signalization. He recommends conversion of ramps to right angle intersections.

New York City A red strobe light on the red signal head alerts oncoming motorists at locations on the Prospect Expressway and at 48th Street and the FDR Drive that they must stop. The opening of the Park Avenue tunnel on 33rd Street is blocked by jersey barriers and a 'quick curve' to prevent pedestrians from crossing on the north side of 33rd and to prevent vehicles from turning in front of the tunnel mouth.

Baltimore The city currently uses standard two flashing yellow lights, alternating right and left sides of the exit.

Philadelphia In the last 3 years the Streets Department has started to "judiciously" implement red strobe lights at the meeting between ramp and intersection. At some ramps motorists coming off of Highway 95 travel a half mile before getting to an intersection, making it easy to forget they ever left the highway. The idea behind the strobes is to get their attention and remind them that they have.

SUFFICIENTLY WIDE SIDEWALKS

According to ITE's Traffic Safety Toolbox (p.180), a minimum width of five feet for a sidewalk or walkway will allow two people to pass comfortably or to walk side by side. Much wider sidewalks should be installed in heavily traveled downtown areas. A buffer zone of four to six feet is desirable as a separation from the street. In downtown or commercial districts, it is appropriate to include street furniture in the buffer zone.

In congested areas like those around transit stations or other points of interest the sidewalks are so crowded at peak hours that movement becomes painfully slow. Walkers face the choice of stopping altogether or overflowing into the street.

Los Angeles The Planning Commission adopted wider sidewalk standards in 1999 which will increase sidewalk widths by 20% (12 feet versus 10 feet) on Major Highways. In addition, community plans can designate pedestrian-oriented streets where sidewalks are

increased to 17 feet on a selective basis. The Department of City Planning, the Bureau of Engineering, and the Department of Transportation jointly prepared the revised standard street widths.

Philadelphia City streets are typically 12 feet wide from curb to property line. The Streets Department reports they must be constantly vigilant regarding vendors and sidewalk cafes that try to inch their way into pathways that are supposed to remain clear for walking. Another challenge is business owners who demand that sidewalk space be taken to create insets for loading and unloading zones. The Department does its best to recommend alternatives such as signs restricting parking in those areas.

Atlanta The 10-12 foot sidewalks in downtown were retrofitted for the Olympics with added trees and tree grates along with furniture. The result was a sidewalk of only 8 feet, but officials at the Department of Public Works report that pedestrian volumes have not warranted more. They say the cost of taking sidewalk space from travel lanes is very expensive because of restructuring drainage facilities.

SAFE SIDEWALK SURFACES

Engineers aim to create streets with the smoothest possible driving surface for driver comfort and minimum wear and tear on automobiles. At the very least the same degree of effort should go into creating a smooth and safe walking surface for minimum wear and tear on pedestrians.

Attending a Women's City Club meeting in New York, one Rudin Center staff member asked a woman of about 75 her recommendations for a better walking environment. The septuagenarian's first response was immediate and focused – "give us sidewalks in good condition. This is terrible!" she added, gesturing to a stretch of East 21st Street as she walked. This is an active older woman who walks regularly to attend functions required by her many activities. While she doesn't appear feeble, she has slowed down, walks more carefully, and can't rely on her eyesight the way she once did.

SIDEWALK SWEEPING

The *Green Machine* is a new sidewalk vacuum cleaner with two brooms, a powerful vacuum and even a sanitizer. While street sweepers are a common sight, the idea of a machine that specifically cleans sidewalk areas is a new one that is catching on quickly. Unlike conventional street cleaners, the Green Machine can clean uneven surfaces such as brick and cobblestone sidewalks and streets. The machines issue a polite warning: "Caution: Sweeper Approaching."

Chicago At the mayor's request, the city bought nine of the green sweepers in 1998 to clean downtown sidewalks in an area bounded by Oak, Congress, Franklin and Michigan. Streets and Sanitation employees operate the machines on shifts that go around the clock. Each machine picks up an average of 5,000 cigarette butts a day, a result of recent No Smoking ordinances in office buildings.

Local businesses like the green machines. The Berghoff Restaurant and the Greater State Street Council each donated \$10,000 toward the purchase. Each sweeper costs about \$22,000. The green machines have not replaced the jobs of Streets and Sanitation workers who sweep curbsides clean, usually over a two- to three-block area, which can take them most of the day. One green machine can clean that same area in 20 minutes (*Chicago Sun-Times*, August 10, 1998, NWS pg. 20).

New York City In Times Square, a green machine called "Felix" is programmed with actor Tony Randall doing his Felix Unger character. The machines grind glass bottles and shred aluminum cans for recycling. They also pick up gum, animal waste, cigarette butts and other garbage and shoot it into standard plastic garbage bags. A driver guides the machine, either while sitting in an attached chair or walking behind.

The machines are used in the Vatican, Westminster Abbey, San Francisco, and Baltimore.

See photos, details, suppliers: <http://www.appliedsweepers.com/>

SIDEWALK SNOW REMOVAL

Snow removal efforts in urban areas must consider sidewalks as well as streets. New technology with improved removal methods may offer help to the special challenges posed, but is still on the drawing board at this time (see PennDOT case below).

Streets departments reported a range of compliance among property owners for snow removal on their sidewalks from very poor (Boston) to satisfactory (Philadelphia). Minneapolis and St. Paul were cited by Walk Boston as good examples of owner compliance, even on retail strips.

A bigger concern in compact urban cores has been getting the plows onto smaller side streets, and the mountainous snow banks formed at corners following "successful" plowing of streets. One engineer felt that considering snow removal from a pedestrian aspect was "stretching things a bit." But with sidewalk sweepers spreading across cities, can sidewalk plows be far behind?

Pennsylvania Department of Transportation (PennDOT) was chosen by FHWA in winter 1996-1997 to lead development of a new snow blower intended to remove snow from congested metro areas.

The Department developed a 31-foot, rear-discharge snow blowing conveyer, resembling a conventional snow blower but placing the snow directly into the bed of a truck following in the same direction and lane as the blower. It was hoped that the new blower could be used on urban streets and bridges where traditional snow blowers are ineffective due to the limited area to blow snow. However, Ray Rugh (717 787-1567) of PADOT reports that the conveyer is too big at 31 feet for urban areas, and that too many trucks and truck maneuvers are required of the device to be effective in compact urban areas. A single truck bed can be filled in 18 seconds.

CONSTRUCTION ZONES

Adequate control for pedestrians should be provided at construction sites. Continuously protected walkways should be provided where pedestrians would expect to walk. When absolutely necessary, pedestrians may be routed to the other side of a street, in which case a safe crossing point must be provided along with sufficient advance notice of the detour.

Just as road work is accompanied by rerouting of motor vehicles, road work and construction projects should take care to accommodate the pedestrian, for whom significant and unexpected detours pose a greater inconvenience.

Boston The advocacy group Walk Boston bestowed their Golden Shoe Award on the Central Artery Business Committee for their excellent work at rerouting pedestrians during an enormously disruptive and lengthy reconstruction project.

Philadelphia All development projects are required to meet first with the Streets Department and the Police Foot Traffic Division. Contractors must agree to provide a protected pedestrian walkway in order to obtain their sidewalk/street use permit. Officials at Streets feel that the relationships built between the city and the finite number of contractors they deal with has benefited pedestrians. Contractors know the expectations, and Streets reports about a 70% compliance rate.

ENHANCEMENTS – LANDSCAPING AND AMENITIES

Urbanist William H. Whyte understood the importance of creating an environment that would draw and nurture the person on foot. His comments on what makes an inviting public plaza are all applicable to streets as well.

Elements of good pedestrian spaces may include:

- **Seating** [either formally with benches and chairs or informally with ledges]
- **Water** [fountains, bridges over waterways, even minor canals and creeks in urban spaces or rivers as in Chicago]
- **Art** [From large sculptures to pavement inlays]
- **Food** [street vendors and outdoor seating at cafés should be encouraged]

Houston. The large scale of the buildings and monotony of the terrain in much of downtown Houston gives a walker the impression that he has covered a very long distance when in fact he's traveled only 2 blocks. There is no street level retail. The only activity, as William H. Whyte noted 25 years ago, seems to be the drive-through windows for parking garages and bank tellers.

There is no parking along the wide avenues, making their great expanses even more daunting to cross. Yet there is extra capacity on in-town streets; all the congestion seems to be out on the freeway. In response to these conditions, or maybe causing them, most Houstonites traverse their downtown through underground tunnels, which protect them from the intense monotony and heat above.

On a downtown street running between several cultural institutions and the new ballpark, restaurants and boutiques have brought life downtown. Property owners immediately requested wider sidewalks. Five lanes were reduced to two; neck downs and angled parking were added. The sidewalks were widened and trees planted. A fountain bubbles. The entire feeling of that eleven-block strip changed for the better. People have come to enjoy walking in Houston under a canopy of trees.

New York City

Not long ago, the two concrete traffic islands in Midtown, near Macy's, were symbols of a blighted New York. Grandly named Herald Square and Greeley Square, they were cracked slabs with scraggly bushes along the edges and some benches, where homeless people dozed and drug dealers rested between sales. Today, the little triangles - shaped like a bow tie, between 32nd and 34th Streets at Broadway and Sixth Avenue, one of the city's most congested intersections - are another world. Lunchtime on a Friday hundreds of people gather to sit in the sun or in the shade of the honey locust trees, reading, talking, drinking and eating. They set out their lunches on the small tables and have the unusual urban luxury of arranging the light wooden chairs however they wanted - alone, in big groups, or in twos for intimate conversations (New York Times, *Islands in the Stream of Traffic Provide an Escape*, June 4, 2000).

REMOVAL OR CONSOLIDATION OF SIDEWALK HAZARDS

Although collisions with motor vehicles represent serious problems for pedestrians, tripping and falling are also a primary cause of pedestrian injuries, particularly among older pedestrians.

Sidewalks should be kept clear of poles, sign posts, newspaper racks, and other obstacles that could block their paths or become a tripping hazard. Benches, water fountains and other street furniture should be carefully placed to allow for unobstructed paths for pedestrians. (ITE Traffic Safety Toolbox p. 181)

New York City The Department of Transportation has implemented a Geographic Information Systems (GIS) project to document the presence of all objects on corner quadrants. The goal of the database is to aid in conforming to the city's "clear corner" ordinance. The clear zone includes the sidewalk, 10 feet into the block from the building line (from N.Y.C. DOT web site – *Pedestrian Information*).

Philadelphia The city has begun planning for newsstand *corrals* - new structures to be placed away from corners. The highway division has a list of current box locations. A constant battle continues in which newspapers claim 1st Amendment Rights to defend box placement.

Houston and New York City are implementing consolidated parking meters. The meters reduce clutter along the curb and are more resistant to coin theft than traditional parking meters.

Boston Several full-scale models of street furniture for the city's new Coordinated Street Furniture Program were available on public display behind City Hall on Congress Street

during March and April. The model included a public pay toilet, a newsstand, and a bus shelter.

According to a press release from the mayor's office, Phase I of the furniture program includes the installation of eight Automatic Public Toilets (APTs) that are self cleaning and flushing; 250 bus shelters; nine information kiosks; and four newsstands. A number of "news condos" will also be installed. Pedestrian traffic, bus routes, community input, sidewalk width and other factors will determine the siting of these amenities. It is expected that the first toilets will be complete by fall 2000.

The manufacturer Wall USA also agreed as part of its contract to build a production and maintenance facility in Boston's Empowerment Zone that will provide about 40-50 people with jobs. It will provide maintenance for Boston's furniture.

In response to the 1998 RFP, companies competed for the right to locate their street furniture products free of charge to the City of Boston, in return for the privilege of deriving revenue from the sale of city approved advertising installed on the products.

GENERAL WAYFINDING SIGNAGE

The November '99 Planning Magazine did a spread on efforts in Dallas, Bethesda, Houston, Newark and Seattle to create wayfinding systems that can bring a large city down to scale by pointing out attractions, adding historical explanations, delineating unique neighborhoods, and locating amenities.

The success of a way-finding system is hard to quantify but the benefit of the signs may be that they not only direct walkers to many important destinations but reinforce safety by directing people to crosswalks and through safe areas.

Philadelphia *The Walk!* Philadelphia sign program is an extension of the popular Direction Philadelphia vehicular signs. The signs are the same as those being installed by the Center City District. They are being installed at locations outside of the CCD within Center City by the Foundation for Architecture so that the entire downtown will be marked with pedestrian signs. The signage is color coded by sub-area and is placed at pedestrian eye level. The traffic unit of the Streets Department funds and coordinates the signs jointly with the Foundation. A future phase of the program will expand the signage to the next level of detail by installing small interpretive signs at places of interest that are already listed on the directional signs.

Atlanta An effort somewhat related to wayfinding is aimed at drivers but may benefit pedestrians as well. The Department of Public Works recently began to place street signs above intersections rather than on corners. The new signs elicited positive response from the community, who appreciated not having to concentrate of looking for hard-to-find street names while behind the wheel. Less distracted drivers must be safer for pedestrians. The city continues to put up about 200 signs yearly, as the budget allows.

Houston Houston's way-finding system incorporates public art to tell the story of Houston and to create an identity for the Uptown section. New charcoal street signs are elliptical in shape and use white letters to evoke a futuristic feeling. Streetlights were retrofitted to make them more aesthetically compatible with the signs. The \$10 million project, complete in 1998, created six arches over the crosswalks at major intersections with the intent of encouraging pedestrian activity. A series of mini-parks with public art were also created to enhance the pedestrian experience. The streets are still quite wide and the traffic heavy, however, minimizing the overall improvement of the pedestrian experience.

Seattle The consultant hired to develop a pedestrian way-finding system that integrates bicycle and transit quickly concluded that such a system would be a waste since the vehicular signage here is so out of control. Mayor Paul Schell agreed and ordered that all unnecessary signs be taken down. The city has now compiled a visual inventory of what doesn't belong and a hierarchy of what should stay.

EXCLUSIVE URBAN GREENWAYS FOR NON-MOTORIZED TRAFFIC

While many cities have established greenways as part of a recreational network, there is an opportunity to plan and use these routes as alternative transportation routes as well to serve work, shopping, and social trips.

New York City Hudson River Park on Route 9A provides bike and walking paths that are separate from automobile traffic (opened summer '99). With much less hoopla, a continuous bike and walking path has been pieced together on the east side of Manhattan for access from 20th Street all the way to Battery Park City and continuing north to join the Hudson River Park.

Minneapolis The 29th Street Corridor Project (opened summer '99), also called the Midtown Greenway Project, involved the rehabilitation of a five-mile abandoned rail bed, accomplished with TEA-21 funding. The corridor is 100 feet wide, 5½ miles long, and passes under 40 bridges.

Seattle The Urban Trails Program has constructed three major urban trails totaling 30 miles that promote non-motorized transport, serving more than two million people.

Atlanta The local PATH organization has partially completed a 10-mile route from Stone Mountain to the city's core built mainly with federal funds. Alternative transportation advocates in the area are not satisfied with recreational routes like this one because they are not planned to connect areas of activity. Their isolated locations render them useless as meaningful transportation routes.

PART-TIME GREENWAYS

Only temporary barriers and signage with hour and vehicle size restrictions are required to implement a time-share of the street network. Weekend, summer and lunchtime hours can be set in parks, shopping areas and others where the needs of a high-volume of pedestrians outweigh those of automobiles for a safe and pleasant pathway.

New York City In Central Park cars are not allowed in the park on weekends or between 10 and 3 on weekdays during the summer months to make the park more hospitable for other users. Flexible streets also exist at Fulton Street in Brooklyn and at lunchtime on Fulton Street in downtown Manhattan.

Philadelphia Fairmount Park closes its West River Drive to motor traffic on weekends. DOT notes that nearby residents complained, feeling that more privileged park visitors were being given special treatment over residents.

11. DEVICES – OTHER TECHNIQUES

DATA COLLECTION

Transportation and planning departments would be well-served by a database of city streets that can be recalled in an instant for the purpose of cataloging signs, signals, curb treatments, parking restrictions, etc. One valuable resource in this daunting task is a GeoSystem solution.

Boston The Transportation Department has used GeoSystem technology to document 750 miles of city streets in the form of continuous video, recorded from a moving van. A user selects a street, intersection, or even address from the GIS map, and sees a video of the area from right- left- or front facing perspectives, and from three levels of vertical perspectives. Resolution is sufficient for the user to zoom in closely on signage and other details of the streetscape.

Interestingly, other city departments such as Law and Assessing, who need the reliable documentation of before and after information, have used the video catalog.

Colorado Springs The Department of Public Works' Streets Division is using a \$10,000 - \$15,000 backpack GPS system from Compass.com out of Denver to document all street corners. In eight months their scouts rated 40% on 40 criteria. Presence and condition of handicapped access followed by concrete work were listed as two of the departments major concerns based on backlogs of complaint requests.

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Los Angeles L.A. DOT has received a grant from the State Office of Traffic Safety to update and enhance its traffic incident record system. The new system will enable engineers to receive and analyze the patterns of incidents, including pedestrian-related incidents, more expeditiously.

TEMPORARY TRIAL IMPROVEMENTS

Before creating permanent new infrastructure, some cities have first tried experimental, temporary devices at very low cost. This allows for a trial period in which effectiveness can be measured and adjustments made.

While temporary treatment is better than none at all, the tendency for such ugly temporary treatments to remain long-term makes such treatments unpopular in neighborhoods. They are perceived as eyesores. The treatment must be designed into fabric of street and must look good.

Seattle, WA; and Las Vegas, NV have installed roundabouts made out of barrels or sandbags.

New York City Mulrey Square was traffic calmed with new curb extensions, widened sidewalk, and refuge islands all done in paint. Columbus Circle in NYC received similar treatment. The city also uses wooden horses as barriers during school crossing times that act as neck downs to prevent fast turning movements.

Philadelphia has created some bump-outs with jersey barriers, where some have been in use for three years awaiting approvals for conversion to a permanent and more attractive solution.

EDUCATIONAL AND ENFORCEMENT CAMPAIGNS

A number of ticketing and warning blitzes have been tried in cities across the country in an attempt to ease gridlock and/or make streets safer for pedestrians. The value of their effectiveness in the long term is not definite.

Only those educational programs aimed at children have consistently proven to have long term benefits. Zegeer (1991) reports that pedestrian educational programs have been found to reduce 20% to 30% of pedestrian accidents involving young children. For the remainder of pedestrians, the effects aren't so clear.

Advocacy group Walk Boston does not feel that such campaigns are effective on jaywalking behavior. They are resigned that pedestrians will cross where and when they like for the most part.

Philadelphia Operation Crosswalk (1997 – 1999) used funds via the Philadelphia Health Management Corporation (PHMC), a non-profit institution concerned with public health and safety.

The mayor's office acted as coordinator between PHMC and the police department, who agreed to accompany the educational campaign with enforcement for a three month period.

Intersections were chosen based on accident data from the state DOT via the local traffic department. 460,000 leaflets were distributed and outside agencies, including insurance concerns, offered to help fund them in a citywide campaign. Because of the short life of the campaign, which ran from January through April, statistics could not prove any safety benefits as a result of the campaign, but official and community feeling was that there had been a beneficial effect.

The following year Councilwoman Happy Fernandez launched a second campaign with pro-bono contributions from an ad agency. Television ads were broadcast and print ads appeared in buses, on subways, and in bus shelters. Police agreed to step up enforcement at the same time. In 1999, Pennsylvania DOT gave the Philadelphia Health Management Corporation a grant to purchase pedestrian safety devices. Some of the money was shared directly with the police department over time to enable enforcement activities. Other

monies helped PHMC continue their outreach activities.

Philadelphia police have a division of Foot Traffic whom the Streets Department report are very effective. They would like to see the division expanded.

Washington DC In April-June 1999 D.C. police tried several enforcement measures.

Pedestrians were warned about jaywalking but not ticketed. Between May 10 and June, warnings to jaywalkers dropped from 1,164 to 567 which could indicate either improved compliance or relaxed enforcement.

Cars blocking the intersections and running red lights were ticketed. Police noted that the number of tickets for running red lights remained constant while the tickets for cars blocking intersections dropped dramatically. This may have been helped by the "NO GRIDLOCK PLEASE" sign erected by the BID in February at 14th Street, F and K Streets. Fliers were also handed out by the BID explaining that jaywalking causes gridlock. Many pedestrians did not know the definition of jaywalking or that they were committing it. The Metropolitan Police Department defines jaywalking as "walking so as to create a hazard" which can include walking out of the crosswalk's white lines and crossing against the light.

St. Petersburg, FL A 1998 campaign of positive reinforcement was instituted by the Florida Department of Transportation for \$95,000. At eight intersections, researchers measured how often drivers yielded at crosswalks and then posted the results on roadside signs. Police stopped drivers who did not wait for walkers and gave them promotional gifts as rewards. Organizers also distributed fliers.

LIGHT EMITTING DIODES (LEDs)

New Light Emitting Diodes (LEDs), used for red lights and pedestrian signals, are supposed to last 10 times as long as incandescent stop lights and appear brighter.

TRB found a signal intensity of 25 cd minimizes the frequency of both "too bright" and uncertain responses regardless of size, distance, or technology, or whether the message is signal or text.

Testing on 48 senior citizens was conducted on bright, sunny days, though no testing included worst case condition of direct sunlight on signal face. (TRB '97)

Caltrans converted 60,000 red light and pedestrian signals statewide to LEDs, 10/97. **Boston** did the same for all red lights, red arrows and walk signals, changing 3,600 signals at a rate of 200 a month (5/99). **Baltimore** is very happy with them, especially where very good visibility of signal is important.

Oregon DOT in 1993 installed 2,212 red LED lamps in 12 in. balls, 12 in. arrows, 8 in. balls and pedestrian "hand" symbols. Oregon notes:

- Lamps reduced power consumption in Oregon by 88% and operating costs by 26%.
- Lamps are warranted to last 5 years.

- Lamps continue to operate after several of the 620 individual LEDs fail, making the lamp more reliable.
- Longer life has reduced the number of emergency calls for lamp failures.

Philadelphia has converted all red traffic signals, and are converting greens right now. ITE has no specifications for the yellow signal so there is currently no move to convert those. Philadelphia has been a lead agency during LED testing.

Los Angeles While the L.A. DOT was one of the early testers of the new technology, they have so far passed on the option of installing it. One reason is that early versions did not hold up to the claims of a life span 10 times that of current technology.

The main concern voiced by John Fisher of DOT is one that has not been mentioned by other cities. With a lengthened maintenance cycle (7 to 10 years) the DOT is wary of the eventual major capital improvement for all 4200 traffic lights. While the maintenance budget is assured for the current practice of replacing bulbs every 18 months, the capital budget would not be assured. The city is taking a wait and see attitude.

VIDEO ENFORCEMENT

Red light running accounted for over 6% of pedestrian crashes in a study of 15 cities (Zegeer, Opiela, Cynechi, 1985). Activated by loops in the pavement, red light cameras photograph the license plate and sometimes the driver of any vehicle entering an intersection after the light has turned red. Warnings or citations can be sent to offenders. Speeding and double-parking can be discouraged with similar measures.

Richard Retting explains the effectiveness of the cameras. "The real advantage of automated enforcement is this deterrent effect. We can't convince most motorists they might be in a crash, but with automated enforcement we can convince them they'll get a ticket if they break the law. The threat of a ticket, not the fear of a crash, is what prevents deliberate traffic violations."⁷

The introduction of red light cameras has consistently reduced the incidence of red light running in cities that have measured its effect. Oxnard, California experienced a 42% reduction.⁸ Where increased driver compliance spilled over to non-equipped intersections as well.

The use of the cameras has spread to a number of cities. Those who haven't yet taken the plunge cite concern over responsibility for operating the cameras, a wait-and-see approach, or various approvals. Atlanta officials want the cameras but state approval is currently held up by concerns in some parts of the state that the cameras will worsen a reputation for setting speed traps as revenue generators.

⁷ Insurance Institute of Highway Safety, *Status Report*, Vol 35, No. 3, March 11, 2000.

⁸ "Evaluation of Red Light Camera Enforcement in Oxnard, CA, "Accident Analysis and Prevention 14 (1982), pp 219-234)

New York City In 1999, the Department of Transportation reported a 40% reduction in red light violations at intersections with the camera. Community response has been positive from groups like Transportation Alternatives, a pedestrian and bicycle advocacy group with 6,000 members in New York City.⁹ Rudolph E. Popolizio P.E., Chief of the Red Light Camera Program for NYC has posted a description of that city's experience on the NACTO web site. The write-up includes a history of the RFP procedure, tips on site location and loop placement, cost, fine structures, and an interesting cautionary tale about privacy issues:

Lawmakers raised concerns on the issue of privacy. We had an unconfirmed report that one photographic monitoring system (not in New York City) had been shut down because it used frontal shots; to avoid this problem, we use only rear view photos. By so doing, we are only able to cite the registered owner of the vehicle because we cannot identify the driver. However, this has a positive side to it. If the violation had been treated as a moving violation, (driver identification needed) then all revenue would pass to the State (except for administrative fees) and points would be assessed against the driver's license. If for some reason the program proved to be unsuccessful or contained a major fault, it was conceivable that a driver could have been unfairly penalized. To reverse a wrong of this nature would not only be costly and time consuming but very difficult to rectify.

Montgomery County MD. The county learned some valuable lessons as an early testing ground for a red light program:

- Officials learned that the camera they installed using a \$50,000 federal transportation grant could not be used to ticket motorists – only to issue warnings. A locality cannot make money off a federal grant.¹⁰
- The digital cameras used at first (from Peek Traffic Systems, Inc.) had more problems than the standard wet-film models. Malfunctions ranged from computer failures and image clarity problems to overheating on hot days. Failure of the system's telephone line to download information means the camera has to be reset manually.¹¹ The advantage of the digital cameras is that they provide real-time information and don't require manual retrieval of film. Peek and other manufacturers continue efforts to make digital cameras more reliable.

Baltimore The Department of Transportation is happy with their contract, which requires that the contractor for the cameras bear the burden of maintenance. This means it is up to the contractor to maintain profitability if he chooses to switch to digital from wet film cameras. Wide media coverage including camera locations preceded implementation, though no signs identify camera locations.

Los Angeles L.A. DOT videotapes parents near 21 schools who double-park when dropping off or picking up children then issues citations by mail. The program has

⁹ Transportation Alternative's 1999 Recommendations to the City; www.transalt.org.

¹⁰ Bruce Mangum, Sr. Engineer for Mont. County transportation systems management section (8/13/98 *Bethesda Gazette*)

¹¹ per Michael Kinney, county engineer as quoted in *Gazette*

significantly reduced the illegal behavior.

See photos, details, suppliers: <http://www.redlightcamera.com/photoseq.html>
NYC Red Light Camera Experience: NACTO web site "Best Practices" page: <http://www.nacto.org/>
Further information from Montgomery County is available at <http://www.dpwt.com/redlight/>
Victoria, Australia established the Traffic Camera Office in Jun 1990 and had 35 total cameras in 1989. Their web site is <http://home.vicnet.net.au/~tco/index.htm>.

REDUCING NUISANCES

Noise and air pollution, along with dirty or snowbound sidewalks may not be the responsibility of transportation departments, but they do pose a significant assault on the walkability of cities.

Cars and utility vehicles, insulated by design from their surrounding environments, are protected from the horn honking that drivers direct at each other, while the vulnerable pedestrian is assaulted with a harmful decibel level of noise pollution. The Council on the Environment of New York City recently published the decibel level for common sounds, stating that sustained exposure to noise higher than 85 decibels can cause permanent hearing loss. An air-conditioner, for example, creates a noise level of 75 decibels, while honking horns, jackhammers and loud music each create 120 decibels.

Not all cities perceive honking as a problem. In Atlanta, loud car radios are a much larger nuisance.

Pedestrians and bicyclists are also the street users most at risk from vehicle exhaust. The young are particularly susceptible to pollution-related asthma.

New York City The Metropolitan Transportation Authority included plans to purchase a large proportion of clean-fuel buses, along with traditional diesel, in its latest budget. Meanwhile the Department of Transportation has been active in converting its franchised buses and city fleet to clean vehicles.

Los Angeles In June 2000 the South Coast Air Quality Management District Board in California unanimously adopted new rules that would force the use of cleaner-burning alternative fuels in public vehicles in the Los Angeles Metropolitan area.¹²

The action immediately bans the purchase of diesel buses by transit operators in Los Angeles, Riverside and San Bernardino counties that operate more than 100 buses. They will be allowed to purchase buses that run on natural gas, methanol, electricity or fuel cells instead. Operators with 15 to 99 buses were given until July 1, 2001, before being required to buy alternative fuel vehicles. The lone exception is for articulated buses, which can still be diesel powered. Low sulfur diesel is currently be considered by the Board and will be permitted if it can be proven to be as clean as the other fuels.

¹² This rule is distinct from and even stricter than the measure passed by the California Air Resources Board in late February which gives agencies ten years to comply with tighter emissions standards.

The mandate emerges from the AQMD's conclusion last year that diesel emissions are responsible for most of the cancer risk in the region, which includes Riverside, San Bernardino and Orange counties. The Sacramento Bee reported that urban areas hard hit by ozone such as Houston and Dallas are looking to the California board's measure as a model for similar measures. (*Mobilizing The Region: A Weekly Bulletin from the Tri-State Transportation Campaign*, Electronic Edition Number 275, June 26, 2000)

CROSSWALK MARKING MATERIALS

Thermoplastic Markings

Textured Thermoplastic Crosswalk markings are placed in the pavement while the hot asphalt is being rolled. This provides a much longer life span that heightens long-term visibility and reflectivity.

Inlay tape

According to the Transportation Research Board, the best material today from marking crosswalks is inlay tape. It is highly reflective, long lasting, and slip-resistant. Although initially more costly, it is more cost-effective than paint or thermoplastic in the long run; it is most cost-effective when laid down as a street is being re-paved.” (TRB *Toolbox*, p182)

Philadelphia. The Streets Department has had trouble in the past marking textured crosswalks. An engineer comments that “if he can mark it, he has no problem with it”. Raised crosswalks however, are a serious threat to traffic movement, because they slow traffic unnecessarily and impede flow. Thermoplastics are used extensively, replacing inlay tape in most cases. City forces are trained and have been installing the thermoplastic or inlay tape markings successfully since the mid-70s. Officials are very pleased with the longer life and higher visibility. Expectation is for the markings to last the life of the road, which allows re-paving and re-marking maintenance to be coordinated.

Salt Lake City Because the material can be slippery when wet, Public Works installs two sections of ladder-style markings on either side of a section of unmarked asphalt, which provides nearly identical visibility to the approaching motorist and mitigates the slip hazard. (*Improving Conditions for Bicycling and Walking: A Best Practices Report*, FHWA 01/98, p23)

Baltimore Thermoplastics are in use and working moderately well. The main concern is that workers who install these and inlay tape require a higher degree of skill. That concern is the reason Baltimore hasn't even tried the recommended installation as hot asphalt is being rolled.

Boston Director of Technology Tom Kadzis said that although thermoplastics were used extensively, he is not convinced that the material is being optimally applied. If not applied *perfectly*, he says, the thermoplastic cracks, doesn't wear as long as it should. More labor is required for reapplication because the former application must be sanded

down first. The state requirement is only for two parallel lines, and this is insufficient.

Los Angeles. Thermoplastic is used in most cases, especially with high-visibility ladder style markings. The application is more labor intensive but can last seven years without maintenance.

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14. MORE INFORMATION

Many resources proved invaluable during compilation of this chapter. In the category of authoritative reference, we recommend two works by the Institute of Traffic Engineers (ITE). *The Traffic Safety Toolbox* includes a chapter on Designing for Pedestrians which provides concise overviews and guidelines for pedestrian-sensitive treatments. ITE's *Design and Safety of Pedestrian Facilities* covers a broader range of recommended practices in a more comprehensive manner. Material from both guides proved useful although neither focused specifically on urban areas. ITE publications are available to order online at <http://www.ite.org> or telephone: 202-554-8050 x130.

Some state and local transportation authorities have compiled their own recommended practices. A strong entry in this category is Washington State's *Pedestrian Facilities Guidebook*. The guide covers intersections, crossings, sidewalks and walkways, and general design considerations. That document is available free online in Acrobat format at <http://www.wsdot.wa.gov/hlr/PDF/PedFacGB.pdf>.

Mean Streets: Pedestrian Safety and Reform of the Nation's Transportation Law (1997) by the Surface Transportation Policy Project and the Environmental Working Group challenges the status quo with makes-you-think statistics on pedestrian safety and ranks the largest 25 metropolitan areas for pedestrian safety — Pittsburgh and Milwaukee took first and second place. The main focus of the report though is explained in its subtitle. *Mean Streets* convincingly outlines why federal, state and local laws are insufficient regarding pedestrian safety and how public spending on pedestrian safety is woefully out of proportion with other transportation spending - while 13% of traffic fatalities are pedestrians, less than 1% of federal spending goes to pedestrian safety projects. *Mean Streets* is available free in Acrobat format at <http://www.ewg.org/pub/home/reports/meanstreets/mean.html>. A recently released 2000 edition is now also available. See the STPP website, below.

Another project analyzed data from three years of pedestrian fatalities in New York City (1994-1997) to determine cause and culpability. *Killed by Automobile: Death in the Streets in New York City (1994-1997)* by Charles Komanoff and Members of Right of Way is available in Acrobat format at http://www.panix.com/~jlefevre/cars-suck/research/kba_text.pdf.

Professional journals provide articles by transportation experts addressing theories on traffic safety, apply those theories, and produce research results that help determine the value of certain safety initiatives to different environments. Some noteworthy journals are *The Transportation Research Record*, *Transportation Quarterly*, *Accident Analysis and Prevention*, the *ITE Journal*, and the *Journal of Safety Research*, among others.

Numerous organizations now have web sites that were immensely helpful. Some of the most interesting sites are listed below. None has a specifically urban focus but they share a lot of good general information on topics from federal policy and funding to statistics on pedestrian safety to design guidelines to educational conferences and programs.

GENERAL RESOURCES

Federal Highway Administration -Bicycle and Pedestrian Program:

<http://www.fhwa.dot.gov/environment/bikeped/>

The Pedestrian and Bicycle Information Center (PBIC)

The Center is a program of the University of North Carolina Highway Safety Research Center in cooperation with the Association of Pedestrian and Bicycle Professionals.

<http://www.walkinginfo.org/main/index.htm>

The USDOT and FHWA's Pedestrian Safety Roadshow

The purpose of the Roadshow is to assist communities in developing their own approach to identifying and solving the problems that affect pedestrian safety and walkability.

<http://www.ota.fhwa.dot.gov/walk/>

The FHWA's Pedestrian and Bicycle Safety Research Page

<http://www.tfsrc.gov/safety/pedbike/pedbike.htm>

The FHWA's Design Guidance for Accommodating Bicycle and Pedestrian Travel:

<http://www.fhwa.dot.gov/environment/bikeped/Design.htm>

The National Center for Bicycling and Walking.

This site provides lots of good technical guidelines for pedestrian planning including Curb Ext. & Radii, Signal Timing, Signing And Marking, Pedestrian Amenities, Reconfiguring Arterial Streets, Bridges, Traffic Calming, Maintenance, Walkways, Intersections, Crosswalks, Curb Ramps.

<http://www.bikewalk.org/>

New York Department of Transportation Pedestrian Information

http://www.ci.nyc.ny.us/html/dot/html/get_around/ped/pedest.html

Surface Transportation Policy Project (STPP) – includes Mean Streets 2000

<http://www.transact.org/>

Walkable Communities, Inc.

Walkable Communities, Inc. is a non-profit corporation, established in the state of Florida in 1996. It was organized for the express purposes of helping whole communities, whether they are large cities or small towns, or parts of communities, i.e. neighborhoods, business districts, parks, school districts, subdivisions, specific roadway corridors, etc., become more walkable and pedestrian friendly.

<http://www.walkable.org/index.htm>

LOCAL PEDESTRIAN (& BIKE) ADVOCACY GROUPS

Transportation Alternatives, New York City: <http://www.transalt.org/>

PEDS, Atlanta: <http://www.peds.org/>

Walk Boston: <http://www.walkboston.org>

Walk San Francisco: <http://walksf.org/>

BayPeds, San Francisco: <http://www.baypeds.org/index1.html>

WALK DC: <http://www.walkdc.org/>