Pedestrian Safety Guidelines

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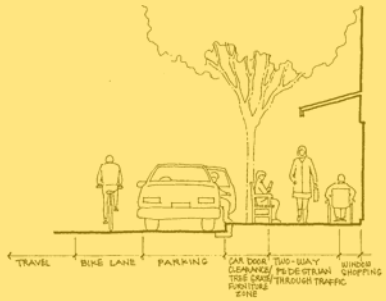

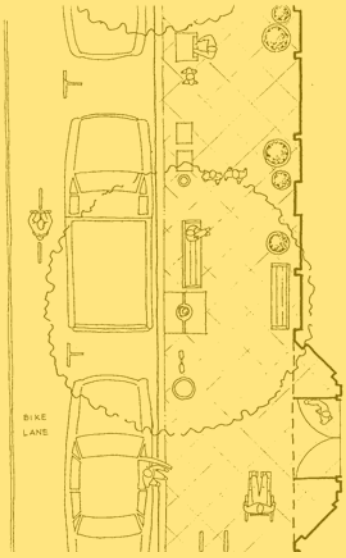

City of Sacramento
Public Works Department
Traffic Engineering Division
1000 I Street, Suite 170
Sacramento, CA 95814

Adopted by City Council January 9, 2003

Department of PUBLICWORKS CITY OF SACRAMENTO

DEPARTMENT OF PUBLIC WORKS

OFFICE OF THE DIRECTOR

CITY OF SACRAMENTO
CALIFORNIA

660 J STREET
SUITE 250
SACRAMENTO, CA
95814-2800

PH 916-808-7100
FAX 916-264-5573

Dear Pedestrian Safety Advocate:

The City of Sacramento's Strategic Plan mission is "to protect, preserve and enhance the quality of life for present and future generations." To that end, the Department of Public Works has prepared, in collaboration with **Walk**Sacramento, Dan Burden of Walkable Communities and the Sacramento Disabilities Advisory Commission, the attached **Pedestrian Safety Guidelines** to enhance pedestrian safety in our city.

Pedestrians are the most vulnerable of all roadway users. Especially so, are children and seniors citizens. In fact, studies have shown that a pedestrian struck by a vehicle going 35 MPH has only a 20% survival rate. The pedestrian has legal rights and responsibilities to use the roadway as provided in the California Vehicle Code.

The **Pedestrian Safety Guidelines** were adopted by City Council on January 9th, 2003 and are intended to provide residents, staff, safety advocates, developers, and consultant's information on the current best practices to enhance pedestrian safety for existing areas as well as new developments. These guidelines are also available on the City's website at www.pwsacramento.com/traffic/publications.html.

Thank you for your interest in enhancing pedestrian safety in the City of Sacramento. I hope you find these **Pedestrian Safety Guidelines** helpful in making our great City the walking capital of the country.

Sincerely,

Michael Kashiwagi, Director
Department of Public Works
City of Sacramento

Department of PUBLICWORKS CITY OF SACRAMENTO

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ACKNOWLEDGEMENTS

Mayor
Heather Fargo

City Council
Ray Tretheway
Sandy Sheedy
Steve Cohn
Jimmie R. Yee
Lauren Hammond
Dave Jones
Robbie Waters
Bonnie J. Pannell

City Staff
Robert P. Thomas, City Manager
Betty Masuoka, Assistant City Manager
Thomas Lee, Deputy City Manager
Mike Kashiwagi, *Director of Public Works*
Martin Hanneman, *City Traffic Engineer*
Fritz Buchman, *Development Services*
Ed Cox, *Bicycle and Pedestrian Program Coordinator*
Michael Whipple, *Public Works ADA Coordinator*
Mehrdad Nazeri, *Capital Improvement Projects*
Steve Pyburn, *Development Services*

Citizens
Ron Anderson, *WalkSacramento*
Anne Geraghty, *WalkSacramento*

Consultants
Fehr & Peers Associates, Inc.
Steven Brown, *Principal in Charge*
Seleta Reynolds, *Project Manager*

Reviewed by
Dan Burden, *Walkable Communities*

References

Alan Jacobs *Great Streets*
Designing Sidewalks and Trails for Access Part II, FHWA
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Department of PUBLIC WORKS CITY OF SACRAMENTO

EXECUTIVE SUMMARY

The City of Sacramento's Department of Public Works, Traffic Engineering Services Division commissioned the Pedestrian Safety Guidelines which support the following two City Strategic Plan goals:

1) Enhance and Preserve the Neighborhoods,
2) Improve and Diversify the Transportation System.

This document is intended to serve as a reference guide for staff, citizens, and developers when determining the best engineering solutions to pedestrian safety concerns. A comprehensive pedestrian safety strategy contains a three-pronged approach including engineering, enforcement, and education programs. This guide focuses on physical elements, such as pedestrian crossing treatments and intersection design. It documents the best practices related to numerous pedestrian treatments including pedestrian signals, pedestrian refuge islands, compact intersections, sidewalks, and crosswalks.

HOW TO USE THIS DOCUMENT

The section below outlines how to use this document if you are a citizen, staff member, or developer.

IF YOU ARE A CITIZEN…

You should use this guide to determine the best location for crosswalks in your neighborhood and other places you walk. You can also use the guide to get information about current city policies regarding crosswalks, pedestrian signals, and other elements of pedestrian safety.

…SEE CHAPTERS ONE AND TWO

IF YOU ARE A CITY STAFF MEMBER…

You should use this document to determine the best practices for improving pedestrian safety on existing streets and in development areas. This document contains information on innovative crosswalk treatments as well as optimal intersection design.

…SEE CHAPTERS TWO AND THREE

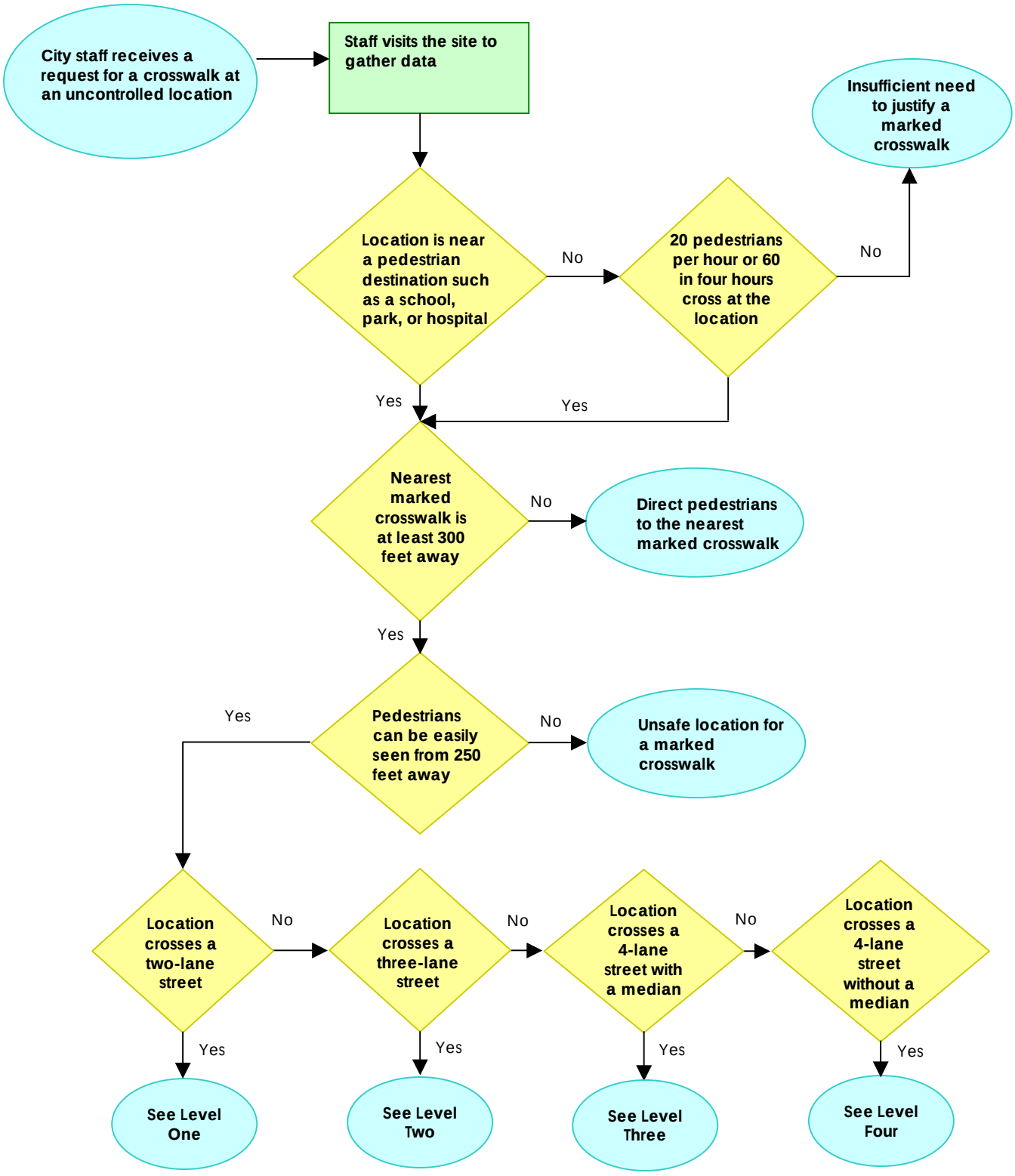
IF YOU ARE A DEVELOPER…

You should use this document to determine the best practices for improving pedestrian safety and walkability.

…SEE CHAPTER THREE

One of the most vital strategies to prevent collisions involving pedestrians is to ensure they cross the street at the safest location and to ensure that the locations where pedestrians are likely to cross are as safe as possible. A large portion of this document is devoted to determining when and how to treat pedestrian crossings, whether at signalized or unsignalized locations. The following page contains a flow chart to help readers determine the best crossing treatments for different types of streets at uncontrolled locations.

CROSSWALK PLACEMENT FLOWCHART FOR UNCONTROLLED LOCATIONS



The following charts summarize the type of crossing treatments appropriate on different streets.

LEVEL ONE: TWO LANE STREETS

Number of Cars (average daily traffic)	Posted Speed		
	30 miles per hour or less	35 miles per hour	40 miles per hour or more
Up to 15,000 cars per day	Triple-four	Triple-four	Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p.41-42)
15,000 cars or more per day		Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p.41-42)	Pedestrian signal or bridge (see p.42, 45)

LEVEL TWO: THREE-LANE STREETS

Number of Cars (average daily traffic)	Posted Speed		
	30 miles per hour or less	35 miles per hour	40 miles per hour or more
9,000 cars or fewer per day	Triple-four	Triple-four	Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p. 39-40)
9,000-12,000 cars per day		Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p. 41-42)	
12,000-15,000 cars per day	Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p. 41-42)		Pedestrian signal or bridge (see p. 42, 45)
15,000 cars or more per day		Pedestrian signal or bridge (see p. 42, 45)	

LEVEL THREE: FOUR OR MORE LANES WITH A RAISED MEDIAN

Number of Cars (average daily traffic)	Posted Speed		
	30 miles per hour or less	35 miles per hour	40 miles per hour or more
9,000 cars or fewer per day	Triple-four	Triple-four	Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p. 41-42)
9,000-12,000 cars per day		Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p.41-42)	Pedestrian signal or bridge (see p. 42, 45)
12,000-15,000 cars per day	Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p.41-42)		
15,000 cars or more per day	Pedestrian signal or bridge (see p. 42, 45)	Pedestrian signal or bridge (see p. 42, 45)	

LEVEL FOUR: FOUR OR MORE LANES WITHOUT A RAISED MEDIAN

Number of Cars (average daily traffic)	Posted Speed		
	30 miles per hour or less	35 miles per hour	40 miles per hour or more
9,000 cars or fewer per day	Triple-four	Triple-four plus a pedestrian refuge or other Level 1 device (see p. 39)	Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p. 41-42)
9,000-12,000 cars per day	Triple-four plus a pedestrian refuge or other Level 1 device (see p. 41)	Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p. 41-42)	Pedestrian signal or bridge (see p. 42, 45)
12,000-15,000 cars per day	Triple-four plus a pedestrian refuge, overhead flashing beacons, or other Level 1 and 2 devices (see p. 41-42)		
15,000 cars or more per day	Pedestrian signal or bridge (see p. 42, 45)	Pedestrian signal or bridge (see p. 42, 45)	

"Good streets have places to walk with leisure and safety. They are where you can meet people. They invite you to do that. The best streets are comfortable"
- Alan Jacobs
Great Streets

INTRODUCTION

The Pedestrian Safety Guidelines provides a "best practices" guide to pedestrian safety. The Safety Guidelines are divided into three parts:

- Existing Conditions
- Safe Crossings
- Development Areas

The Existing Conditions section is a compendium of all City programs and practices, both formal and informal, related to pedestrian safety. The Safe Crossings section explores best practices related to pedestrian crossing treatments. This section outlines conditions under which it is safe and desirable to mark a crosswalk. It defines crossing treatments and includes a toolbox of treatments for various crossing conditions. The third section identifies model guidelines for pedestrian safety in development and re-development projects.

The Safety Guidelines were developed with the cooperation of a committee that met monthly for six months. Committee members included representatives from Traffic Engineering, Development Services, Project Delivery, and two representatives from ***Walk***Sacramento. Dan Burden, of Walkable Communities, Inc. also reviewed the guidelines.

Regional and local pedestrian planning efforts provide a backdrop for this report. In October 2001, the Sacramento Safe Communities Project, composed of the Snell Safety Center, ***Walk*** Sacramento, and the Greater Sacramento Safe Kids Coalition, held a Pedestrian Summit funded by the California Department of Health services. Currently, the City of Sacramento has begun a development of a Pedestrian Master Plan.

PEDESTRIANS RIGHTS AND RESPONSIBILITIES

Per the 2002 California Vehicle Code (CVC) section 21949: "The Legislature hereby finds and declares that it is the policy of the State of California that safe and convenient pedestrian travel and access, whether by foot, wheelchair, walker, or stroller, be provided to the residents of the state."

Per CVC 21950

(a) "The driver of a vehicle shall yield the right-of-way to a pedestrian crossing the roadway within any marked crosswalk or within any unmarked crosswalk at an intersection, except as otherwise provided in this chapter."

(b) " This section does not relieve a pedestrian from the duty of using due care for his or her safety. No pedestrian may suddenly leave a curb or other place of safety and walk or run into the path of a vehicle that is so close as to constitute an immediate hazard. No pedestrian may unnecessarily stop or delay traffic while in a marked or unmarked crosswalk."

Per CVC 21954

(a) "Every pedestrian upon a roadway at any point other than within a marked crosswalk or within an unmarked crosswalk at an intersection shall yield the right-of-way to all vehicles upon the roadway so near as to constitute an immediate hazard."

(b) "The provisions of this section shall not relieve the driver of a vehicle from the duty to exercise due care for the safety of any pedestrian upon a roadway."

CHAPTER ONE
EXISTING CONDITIONS

In 2000, California police agencies reported 14,506 pedestrians injured with 689 killed on their roadways. In 2001, the Sacramento Police Department reported 267 pedestrian collisions with twelve pedestrian fatalities. Of these 267 reported collisions, the pedestrian was deemed at fault in 109 or 41% of the time.

In an August 2002 study titled *"Pedestrian Safety in California: Five Years of Progress & Pitfalls"* released by the Surface Transportation Policy Project California Walks, ranked Sacramento 23rd out of 58 California cities as most dangerous for pedestrians.

Approximately five percent of all trips in the Sacramento area are made on foot.[1] However, collision data for the year 2000 shows that 32% of all traffic fatalities were pedestrians. These statistics mirror nationwide collision and census figures – while only three percent of all trips are made on foot, 14 percent of traffic fatalities are pedestrians. Pedestrian injuries and fatalities are consistently disproportionate to the number of trips made by this mode because pedestrians are the most vulnerable road user, and street design has typically focused on reducing congestion for automobiles, while ignoring the need for pedestrian safety.

10th and I Streets in Downtown I I I I

[1] Travel survey prepared by DKS Associates for the Sacramento Area Council of Governments (SACOG) as referenced in the Sacramento Pedestrian Summit Strategic Plan, page 6

Cities traditionally build wide, multi-lane streets (see example below) to maximize storage space and reduce delay for vehicles. While these streets may be successful at reducing congestion, they lengthen the amount of time that a pedestrian is exposed to traffic as he or she crosses the street. The City of Sacramento presently has several programs and policies in place to address this concern. This section summarizes various programs that impact pedestrian safety.

Azevedo Drive – South Natomas

1.1 TRAFFIC ENGINEERING SERVICES

The Traffic Engineering Services (TES) Division of the Public Works Department is most immediately concerned with pedestrian safety. Traffic Engineering Services oversees signal design and timing, crosswalk installation, and new infrastructure projects. Staff from this division investigate collision statistics and approve construction plans for all roadway projects.

The City of Sacramento has a comprehensive Neighborhood Traffic Management Program, designed to slow speeds, enhance safety, and improve livability on residential streets. The City's traffic calming program, administered by Traffic Engineering Services, has the potential to decrease the pedestrian injury rate by slowing speeds and lowering traffic volumes on local streets.

Crosswalk installation is another key element of pedestrian safety. Traffic Engineering Services developed the high-visibility "triple-four" crosswalk and has a process in place of evaluating candidate locations for new crosswalks.

The City has two strong programs that target young pedestrians. Traffic Engineering Services implements the Captain Jerry Traffic Safety Program, an educational outreach program designed to raise elementary school children's awareness of a host of traffic safety issues, including pedestrian safety. The Captain Jerry program reaches about 5,000 children annually. The Kids X-ing Program, administered by the

"The driving goal of traffic calming is to improve neighborhood livability by reducing the impact of traffic in residential neighborhoods, which promotes safe and pleasant conditions for all users of local streets."

- City of Sacramento Neighborhood Traffic Management Program

Neighborhood Services Department, is a grant-funded program that places senior citizen crossing guards at local schools.

The above programs demonstrate a commitment to pedestrian safety. The Pedestrian Safety Guidelines will refine and strengthen the department's existing practices. The following pages describe the above-mentioned programs and policies in greater detail.

TRAFFIC CALMING

NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM

The City's strategy is to move traffic safely and efficiently through the use of signal systems on the arterials while taking a neighborhood-based approach to calming traffic on residential and collector streets. This strategy relies upon the Neighborhood Traffic Management Program (NTMP) to implement traffic calming projects in residential areas of the City with inappropriate traffic speeds or volume. The goal of the NTMP is, **"To improve neighborhood livability by reducing the impact of traffic in residential neighborhoods, which promotes safe and pleasant conditions for all users of local streets**."[2] The City Council adopted the NTMP in December 1995, and 26 neighborhoods are currently participating. The principles of traffic calming identified in the NTMP apply to both existing and planned neighborhoods.

Neighborhood Entry Sign

[2] *Sacramento Citywide Traffic Calming Guidelines 2nd Draft*, 1/3/01, p.2

The NTMP's process begins with a neighborhood meeting, to which all residents and business owners (if applicable) are invited. Staff from the Public Works Department explains the program and raise awareness about various traffic calming measures. At this meeting, residents have the opportunity to sign up and participate on a Traffic Calming Committee (TCC).

The TCC takes a proactive role in creating a Phase I traffic calming plan. The traffic-calming plan utilizes signage, striping, speed humps, traffic circles, and chokers after careful consideration of traffic data gathered and comments received from a resident survey. These changes, along with police enforcement and educational outreach are the outgrowth of regular TCC meetings. Upon receiving a majority favorable vote, Phase I is followed with a 3-6 month evaluation period where after data is collected and presented to the neighborhood. Due to the high costs, traffic circles are initially installed using temporary devices. After the monitoring period, the neighborhood votes a second time to determine if the traffic circle should be removed or replaced with a permanent design. Phase II includes implementation of a more restrictive traffic calming program, consisting of hardscape improvements that restrict access to the neighborhood.

The City has guidelines for the installation of speed humps, although the NTMP tends to include a broader range of other devices such as speed tables and raised crosswalks. Speed humps may be installed on streets where the

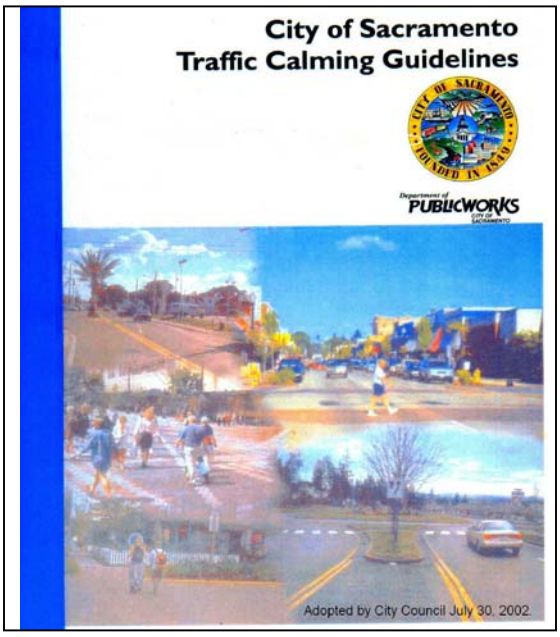
City of Sacramento Traffic Engineering Services Division (916) 264-5307

http://www.pwsacramento.com/traffic/index.html

85th percentile speed, or the speed at which 85% of vehicles are at or below, is five miles an hour above the posted speed limit. The speed limit on residential streets is 25 miles per hour. Speed humps are placed 250-300 feet apart for best results.

TRAFFIC CALMING GUIDELINES

The City adopted Traffic Calming Guidelines in July 2002. Development Services will utilize the Guidelines when reviewing planned development to ensure that neighborhood designs do not create conditions favorable to speeding or cut-through traffic. The Traffic Calming Guidelines establish optimum lane widths, block lengths, and system geography (i.e. a series of collectors with a deviating path, rather than a long, direct collector that might invite cut-through traffic). The NTMP will utilize the guidelines in educating neighborhoods about traffic calming devices and determining the design guidelines and warrants for each device.



The NTMP strives to meet its goal through three primary objectives:

- **To improve driver behavior, concentration, and awareness;**
- **To reduce speeds and traffic volumes; and**
- **To enhance the neighborhood environment.**

- NTMP

PEDESTRIAN CROSSING POLICIES

SIGNAL TIMING

The Department of Public Works uses a four-foot-per-second crossing time for pedestrians at signalized intersections, consistent with Caltrans standards. The crossing period includes both the WALK and the FLASHING DON'T WALK (FDW) phases. The number of seconds allocated to the FDW phase is determined by dividing the width of the intersection (in feet) by four. For example, at a 48-foot wide intersection, the total time allocated for a pedestrian to cross the street is 16 seconds – four seconds for the WALK phase, and 12 seconds for the FDW phase.[3]

Certain locations where signal timing is instrumental in reducing the delay for drivers, the number of seconds allocated to the FDW phase is determined by measuring to the middle of the lane farthest from the curb and dividing that measurement (in feet) by four. At locations with high numbers of older adults, the City uses a crossing speed of three and a half feet per second. Unless there is a high incidence of collisions due to red-light running, the City does not generally include an all-red phase at most intersections.

Pedestrians are legitimate users of the transportation system and they should, therefore, be able to use this system safely.

- Pedestrian Crash Types, FHWA

Pedestrian Signal Head

[3] (48/4)+4=16

There are some notable exceptions to the City's signal timing practice. At intersections with wide medians i.e. Capitol Mall, especially those with pedestrian signal heads or pushbuttons located in the median, the phases (WALK and FDW) are determined by measuring the distance to the median rather than the far-side curb. The City will often allocate more time to the WALK phase due to the excessive width of the street (up to 90 feet), rather than using this measurement to derive an exceptionally long FDW phase. At most of the downtown intersections where signals are all pre-timed (rather than actuated by approaching traffic), more time is allocated to the WALK phase.

Capitol Mall

ACTUATED SIGNALS

While all downtown traffic signals are pre-timed, all of those outside the downtown area are "fully actuated" or "semi-actuated". At a "fully actuated" signal, a pedestrian must push the button to activate the pedestrian signal head. Signals such as this are often located in outlying areas with low pedestrian volumes and high traffic volumes.

At a semi-actuated signal, a pedestrian will always get the WALK sign across the minor street, but will not receive a WALK signal to cross the major street unless s/he pushes a button. When traffic engineers determine signal timing, the timing is often contingent upon pedestrian crossing speeds and the width of the street.

At some locations, "green time" for vehicles on a side street must be set according to the amount of time a pedestrian needs to cross the major street and may be longer than vehicles would need. In certain instances, giving a large amount of "green time" to accommodate pedestrians can increase congestion on the major street. At these locations, traffic engineers may utilize fully or semi-actuated pedestrian signal heads and install pedestrian pushbuttons so that the side street only gets a long amount of "green time" when a pedestrian is present.

Pedestrian pushbutton at 24th Street and Fruitridge Road

SIGNAL INNOVATIONS

Sacramento uses two innovative treatments at selected intersections: the Leading Pedestrian Interval (LPI) and the pedestrian countdown signal. The LPI is a period of time, usually between three and five seconds, when vehicles in every direction receive a red signal (called all-red time). While vehicles have an all-red phase, pedestrians get a WALK signal, allowing them to establish their presence in the crosswalk before autos get a green light in the same direction. A study for the Insurance Institute of Highway Safety demonstrated that LPIs reduce the number of pedestrian/vehicle conflicts per 100 pedestrians to almost zeros.[4] The LPI is especially effective at intersections with a high number of conflicts between left or right-turning vehicles and pedestrians. The LPI is currently in place at four intersections: I Street at 9th, 10th, and 13th Streets and at 10th and J Street.

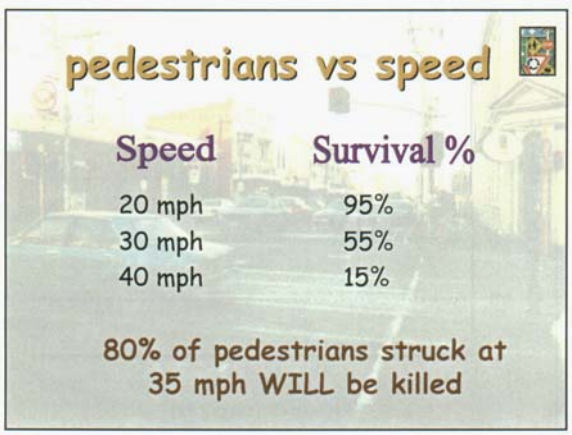
The Department of Public Works has installed pedestrian countdown signals at North 12th Street/North B Street, and 4th Street and J Street and plans to implement them at Stockton Boulevard/Fruitridge Road and 5th Street and J Street intersections. Pedestrian countdown signals display the amount of time left in the clearance interval (the FDW phase of the pedestrian signal) in seconds. Pedestrian countdown signals have been shown to improve pedestrian compliance with signals and reduce pedestrian "dashes" into the crosswalk. They are useful at wide intersections.

Pedestrian countdown signal at North 12th and North B Streets

[4] Van Houten, Ron et al; *Field Evaluation of a Leading Pedestrian Interval Signal Phase at Three Urban Intersections*, Insurance Institute for Highway Safety, April 1997, Arlington, VA.

CROSSWALK INVESTIGATION

Traffic Engineering regularly receives requests from the public to establish marked crosswalks at uncontrolled locations. Investigators utilize a standard field survey sheet to assist engineers in making a determination about whether to mark crosswalks at these locations. Uncontrolled locations may be intersections with no stop signs or signals; intersections with a minor street stop sign but no control on the major through street; and at mid-block locations.



Investigators create a diagram of the location including (but not limited to) the location of existing signs and markings, bus stops, streetlights, and curb ramps. They also note adjacent land uses, roadway widths, the proximity of the pedestrian generator (such as a park, school, retail center, library, etc.), and the location where most pedestrians cross the street.

Investigators record the most recent three-year collision data, traffic volumes, and posted speeds. They identify the age of the pedestrians and record more subjective observations such as driver/pedestrian behavior and interaction and whether or not there are sufficient gaps in traffic for pedestrians to cross the street. Finally, investigators make recommendations to mark the crosswalk; leave the location unmarked; or defer to the judgment of a traffic engineer.

If the investigator or Traffic Engineer elects to mark a crosswalk at an uncontrolled location to channelize pedestrians to the safest location,

they utilize a "Triple Four Crosswalk" design. This design offers maximum visibility to both drivers and pedestrians. It is marked with thermoplastic, rather than regular paint, to ensure that it has a high degree of reflectivity and will perform well over time. Measurements of the triple four crosswalks have been modified to provide a "triple-six" and "triple-eight" (see illustration below). These crosswalks, partnered with standard pedestrian crossing signs in advance of and adjacent to the crosswalk, channel pedestrians to safe crossing locations and alert drivers to the presence of pedestrians.

At signalized intersections that have unique configurations or signal operations as well as heavy pedestrian traffic, the City will install high-visibility crosswalks. Two signalized intersections: 7th/K Streets and 12th/K Streets have high-visibility crosswalks to further challenlize pedestrians.

A pedestrian waits for the walk signal at 12th and K Streets

1.2 YOUTH PROGRAMS

Captain Jerry

Public Works employee Jerry Way started the Captain Jerry Traffic Safety program in 1992. Investigators from Traffic Engineering send letters to local elementary schools offering to present information at a student assembly about traffic safety, focused on four elements:

- Pedestrian safety
- Bicycle safety
- School bus safety
- Seatbelt safety

Staff from Traffic Engineering bring a portable traffic signal to the school and demonstrate the safe way to approach a crosswalk, using the **"Stop, Look, and Listen!"** message. The program recommends crossing at signalized locations with marked crosswalks, but emphasizes that if there is no marked crosswalk or signal, it is still legal and safest to cross from a corner rather than a mid-block location. Following the presentation, staff follow-up with a survey to ensure that the presentation was appropriate to the audience, entertaining, and clear.

The Captain Jerry Traffic Safety program has an accompanying brochure aimed at parents that is posted at Adult Community Centers. The brochure, **"Let's Keep our Kids Safe,"** outlines the same message delivered to children during the school assembly. It includes sections on scooter and vehicle safety as well as guidance for parents.

Funded by the State of California Office of Traffic Safety, through the Business, Transportation, and Housing Agency, and the Federal Highway Administration

Kids X-ing

"Kids X-ing" is currently a federally funded program, implemented by the City of Sacramento's Department of Public Works starting in 1997; it is now administered by the Neighborhood Services Department. The program places crossing guards at Sacramento elementary schools. Thirty-five schools within the Sacramento City Unified School District, North Sacramento School District, Del Paso Heights School District, and Robla School District have thus far benefited from the program. The federal funding expires after five years, and schools are expected to incrementally assume the cost of the program over the five-year period. The program is designed to be cost effective by using senior volunteers and student-operated crossing guard programs.

Picture courtesy of the Captain Jerry brochure

The crossing-guard training program contains several elements: information about bicycle and pedestrian collision types, applicable sections of the California Vehicle Code, first aid, filing accident reports; and signing, striping, and traffic controls that relate to school crossings.

Safe Routes to School

The City of Sacramento has Safe Routes to School maps and is on file with Traffic Engineering Services. The City applies for Safe Routes to School projects that appear on its Capital Improvement List.

1.3 DEVELOPMENT SERVICES

The City's Development Services Division subject to a plan check

and review conducts developers who wish to build in the City of Sacramento. This Division works with developers as they draft their construction documents and plan layouts. As the agency responsible for new streets, sidewalks, and street improvements, Development Services is in a unique position to affect pedestrian safety by requiring that all facilities meet high design standards. Development Services has an array of standards for new and re-development plans. These standards represent accepted minimums and maximums utilized by many California cities.

North Natomas Sub-division

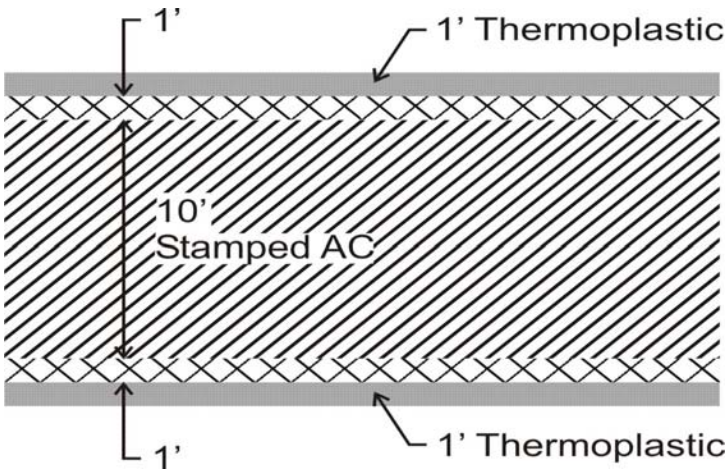
Development Standards

Development plans are subject to the City's 1999 *Street Standards*, the *Design and Procedures Manual and Improvement Standards*, and the *Standard Specifications for Public Works Construction* (currently under revision). The *Street Standards* are adopted by City Council and incorporated into City code. The *Design and Procedures Manual and Improvement Standards* and the *Standard Specifications for Public Works Construction* are Public Works manuals designed to communicate City code to developers. The *Street Standards* establish cross sections and minimum widths for new streets based on the size and type of the development. The *Street Standards* also include measurements for other elements of the cross section such as parking, planting strips, sidewalks, medians, and bicycle lanes.

Standard Specifications for Public Works Construction is a manual detailing the type of

materials required for construction projects. Recently, the City developed an informal standard for textured crosswalks. This standard draws upon experience indicating that low-vision pedestrians can better identify the crosswalk if white lines border it.

FIGURE 1.2 TEXTURED CROSSWALK



Current practice for installing textured crosswalks. The center is stamped to simulate bricks.

The Design and Procedures Manual and Improvement Standards contains basic guidance for developers in preparing their improvement plans including applicable standards. The Manual also contains typical street widths, shown in the table on the following pages. Recently, the City revised its policy to recommend 10-foot lanes for residential areas whenever possible instead of 12-foot lanes. This policy change is not yet reflected in the current Street Standards, which are under review.

Table 1.1 Typical Street Widths and Elements[5]

Designations	Base R/W Width (in feet)	Average Daily Traffic	Planter Strip	Elements per Side
Minor Residential	41	0-2,000	Optional	12.5-foot lane Two-foot gutter Five-foot Sidewalk
Residential	51	2,000-4,000	Required	12.5-foot lane Two-foot gutter Six-foot planter Four-foot sidewalk
Commercial	49	0-7,000	Optional	12-foot lane Eight-foot parking (includes two-foot gutter) 4.8 foot sidewalk
Major Commercial	61	7,000-14,000	Required	12-foot travel lane Eight-foot parking (includes two-foot gutter) 6.6-foot planter Four-foot sidewalk
Industrial	53	0-7,000	Optional	12-foot lane 10-foot parking stall (includes two-foot gutter) Five-foot sidewalk
Major Industrial	65	7,000-14,000	Required	12-foot lanes 10-foot parking stall (includes two-foot gutter) Six-foot planter Four-foot sidewalk
Minor Collector	47-61	4,000-7,000	Required	12-foot lane Optional: Seven-foot

[5] See Appendix A for drawings

Table 1.1 Typical Street Widths and Elements[5]

Designations	Base R/W Width (in feet)	Average Daily Traffic	Planter Strip	Elements per Side
				parking stall (includes two-foot gutter) 6.5-foot planter Five-foot sidewalk
Collector	59-73	4,000-7,000	Required	12-foot lanes Optional: Seven-foot parking stall (includes two-foot gutter) Five-foot sidewalk
Divided Major (4 lanes)	103	14,000-24,000	Required	One 13-foot and one 11-foot lane 14-foot median/turn pocket (three-foot gutter) Optional: seven-foot parking stall Optional: Six-foot bike lane 8.5-foot planter Six-foot sidewalk
Divided Major (6 lanes)	117	24,000-36,000	Required	13/11/13-foot lanes 14-foot median/turn pocket (three-foot gutter) 7.4-foot planter Six-foot sidewalk

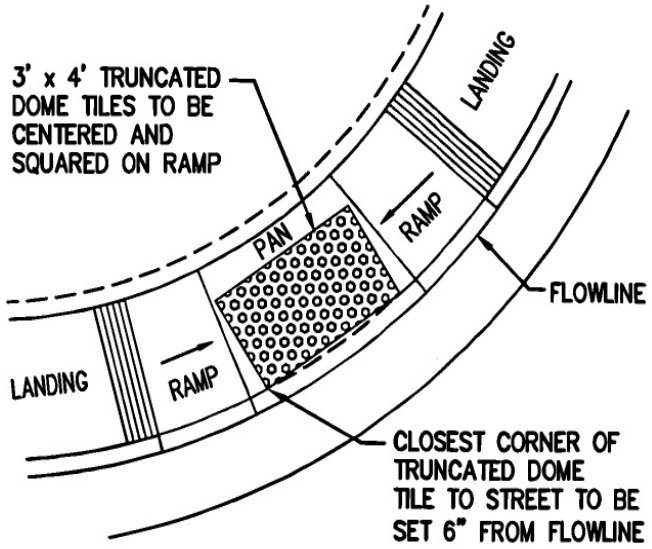
1.4 ADA TRANSITION PLAN

On January 9, 2001, the City of Sacramento adopted a Transition Plan for curb ramps designed to provide a schedule to bring the City's curb ramps into compliance with the 1990 Americans with Disabilities Act (ADA). Congress passed the ADA as companion legislation to the 1964 Civil Rights Act and Section 504 of the 1973 Rehabilitation Act. The ADA addresses five major components:

- Title I: Employment
- Title II: Public Services
- Title III: Public Accommodations
- Title IV: Telecommunications
- Title V: Miscellaneous Provisions

Title II directs local agencies to adopt a Transition Plan outlining physical improvements to ensure that persons with disabilities have access to programs, services and activities. The City of Sacramento adopted a Transition Plan in 1992, to make all City facilities accessible.

FIGURE 1.3 TRUNCATED DOME



CURB RAMP PRIORITIZATION

The City of Sacramento performed a survey of intersections throughout the City. By dividing the City into 12 sections, curb ramps were evaluated based upon the ADA Accessibility Guidelines. The City surveyed all intersections in the central downtown area as pedestrians use this area heavily. The results of the survey are housed at Public Works, available for public examination upon request.

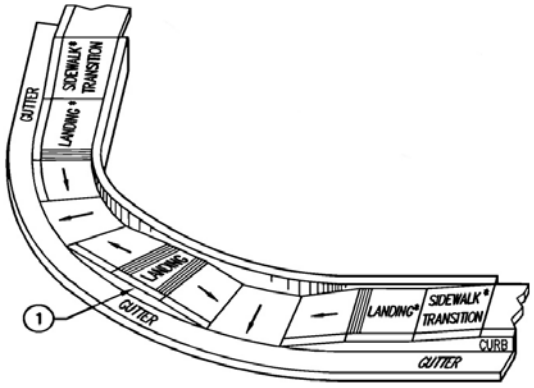
The City's ADA Advisory Group created the priority for new construction and reconstruction of curb ramps throughout the City. The City allocates funding each year for the construction/reconstruction of 1,500 curb ramps. Re-surfacing projects and private development also contribute to the City's construction / reconstruction of curb ramps.

Two curb ramps at a corner on H Street and 20th Streets

CURB RAMP DESIGN GUIDELINES

The City's Project Delivery Division maintains definitions and standards for Curb Ramp Elements. These Standards state, **"When a curb ramp slope is less than 6.67% then the ramp shall have truncated domes."** Dual curb ramps are desirable to direct pedestrians to the correct alignment of the crosswalk, and the standards state that, where feasible, **"opposing curb ramps shall align."** The standards contain graphic and written descriptions of curb ramp requirements. Measurements in the standards are minimums, while slopes are maximums. While it is desirable to have symmetrical designs, engineers may approve asymmetrical ramp measurements in order to meet the dual ramp requirement.

FIGURE 1.4 DUAL RAMP



AUDIBLE SIGNALS

Audible signals are installed on a request basis. The request comes to the Public Works ADA Coordinator and the evaluation process is started:

- Public Works ADA Coordinator talks with the requestor and determines the need for the audible signal.

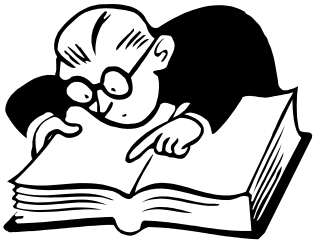
- Traffic Engineering Services checks the intersection equipment to see if it is appropriate for an audible signal, if not then;
- Electrical engineers determine if the electrical is adequate for an audible signal.

When these steps have been approved, the installation is scheduled and completed.

1.5 MUNICIPAL CODE

The other regulatory document that all City departments must abide by is the Municipal Code. Four sections of the code address pedestrian travel and safety. They are summarized below.

The City of Sacramento Municipal Code addresses pedestrians in Titles 10 and 12. Title 10 (*Vehicles and Traffic*) regulates pedestrian travel generally while Title 12 (*Streets, Sidewalks, and Public Places*) applies to the walking environment – streets, sidewalks and other public spaces.



Section 10.20 (*Pedestrians*) of Title 10 notes that the City will mark a crosswalk **"where the City Traffic Engineer determines that there is particular hazard to pedestrians crossing the roadway."**[6] The City of Sacramento requires that pedestrians cross in a crosswalk when there is a marked crossing location within 300 feet. This requirement is a further refinement of the California Vehicle Code (CVC) regulation that requires drivers to yield to pedestrians crossing at an intersection, whether or not there is a marked crosswalk.[7]

Title 12 (*Streets, Sidewalks, and Public Places*) concerns sidewalk obstructions and includes a

[6] Section 10.20.010 *Crosswalks—Establishment, Designation, and Maintenance*
[7] CVC Section 21950

section on pedestrian malls, such as the K Street Mall, that specifically precludes roller skates, in-line skates, and "any device having wheels"[8] from operating on the mall. **"Pedestrian Malls"** are specific areas of the City described within Title 12.

Other relevant sections of the Municipal Code include Titles 16 (*Subdivisions*) and 18 (*Additional Development Requirements*). These two sections address subdivision and development requirements. Title 16 establishes maximum block lengths (1,500 feet, except in the case of cul-de-sac streets which may be up to 500 feet long) and minimum corner radii (20 feet). This title also defines minimum curve radii for various land uses. Residential uses have the smallest radii while arterial streets have the largest. Title 16 requires the implementation of trails that are shown in the General Plan or adopted specific plans. It also allows for 10-foot minimum pedestrian ways as needed for access to schools, shopping centers, or other pedestrian destinations.

Title 18 (*Additional Development Requirements*) contains provisions for development fees in various parts of the City. This Title also includes minimum and maximum widths for one-car and two-car driveways, as well as minimum driveway lengths, measured from the property line.

[8] Section 12.44.080 *Roller Skates Prohibited*. Exceptions such as wheelchairs, City maintenance, and emergency vehicles are included in Section 12.44.060 *Exceptions*

CHAPTER TWO
SAFE CROSSINGS

Well-marked, high visibility pedestrian crossings accomplish dual goals. They prepare drivers for the likelihood of encountering a pedestrian, and they create an atmosphere of walkability and accessibility for pedestrians. Recently, the Federal Highway Administration (FHWA) published an exhaustive report on the relative safety of marked and unmarked crossings. In California, it is legal for pedestrians to cross any street, except at unmarked locations between immediately adjacent signalized crossings or where crossing is expressly prohibited. The provision of marked crossings is a vital element of the pedestrian environment, and cities must balance pedestrian mobility with safety. The City of Sacramento currently has an informal method of evaluating uncontrolled and mid-block locations for crosswalk installation detailed in Chapter 1.

This Chapter describes recommended best practices for formalizing the method of evaluating potential crosswalk locations and trail crossings. It includes information about signalized and unsignalized locations, intersection design, and innovative treatments for at-grade crossings. The best practices generally follow the recommendations of the Pedestrian Summit regarding **"Safe Street Crossings."**[9]

[9] "Design, build, and illuminate pedestrian crossings to enable safe passage for all pedestrians at reasonable locations (every 300 feet) on major arterials. Mark…all legal crosswalks on major roadways with 12,000 or fewer vehicles per day. Provide audible signals on major roadways and arterials. Pilot test in-street lighting technology." P.31, F

WHY SHOULD A CITY HAVE A CROSSWALK INSTALLATION POLICY?

Development of a crosswalk policy guides the City in making decisions about where basic crosswalks (two parallel stripes) should be marked, where crosswalks with special treatments, such as high visibility crosswalks, flashing beacons and other special features, should be employed and where crosswalks should not be marked due to safety concerns resulting from volume, speed or sight distance issues.

The first step in identifying candidate crosswalk locations is to identify community interests in walking and pedestrian desire lines (the places people would like to walk). This information forms a basis for identifying pedestrian crossing improvement areas and prioritizing such improvements, thereby creating a convenient, connective and continuous walking environment. However, the information about where people would like to walk is only half of the equation.

The other half of the equation is where is it safest for people to walk. Of all road users, pedestrians have the highest risk because they are the least protected. National statistics indicate that pedestrians represent 14% of all traffic incident fatalities despite the fact that walking accounts for only 3% of total travel trips. According to a recent analysis of pedestrian crash types, pedestrian collisions occur most often when a pedestrian is attempting to cross the street at an intersection or mid-block location. [10]

Crosswalk policies help create clear expectations for both citizens and traffic engineers.

[10] *Pedestrian Crash Types, A 1990's Information Guide*, FHWA; This paper analyzed 5,076 pedestrian crashes that occurred during the early 1990's. Crashes were evenly selected from small, medium, and large communities within six states: California, Florida, Maryland, Minnesota, North Carolina, and Utah.

WHY DO CITIES MARK CROSSWALKS?

Crosswalk Function:

- Creating reasonable expectations where pedestrians may cross a roadway
- Predictability of pedestrian actions and movement
- Channelization of pedestrians to designated crossing locations
- Providing pedestrian linkages

Advantages of marked crosswalks:

- They help pedestrians find their way across complex intersections
- They designate the shortest paths
- They direct pedestrians to locations of best sight distance
- They encourage people to walk

In pedestrian-friendly cities, crossing locations are treated as essential links in the pedestrian network. At locations between signalized intersections, pedestrians cannot cross legally without a marked crosswalk. When there are pedestrian generators in these locations, planners and engineers recognize the need to create safe, convenient crossing opportunities. Without crosswalks, especially at mid-block locations, pedestrians must either detour to a controlled crossing location or jaywalk.

2.1 RESEARCH

The 2002 Federal Highway Administration study of pedestrian collisions at marked and unmarked crosswalks is widely recognized as the best resource for determining appropriate locations for marked crosswalks at uncontrolled locations.[11]

This study is used because:

- It is extensive. It examined motor vehicle/pedestrian collision rates at a large number of crossing locations not limited by roadway characteristics in four different cities.
- It is thorough. The collision rates were broken down by roadway characteristics (two-lane and multi-lane roads with various speeds and traffic volumes) in order to give the clearest picture of pedestrian safety at each type of location.

Few California cities have crosswalk installation warrants or formal policies, but the following cities used the 2002 study, as well as its early incarnation in 1999, to guide their crosswalk installation policy:[12]

- Palo Alto, CA
- Walnut Creek, CA
- San Luis Obispo, CA
- San Jose, CA

"Regardless of whether marked crosswalks are used, there remains the fundamental obligation to get pedestrians safely across the street."

- Charlie Zegeer
(See footnote 3)

[11] Zegeer, Charles V., Stewart, J. Richard, and Huang, Herman, "Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines, " University of North Carolina Highway Safety Research Center for Federal Highway Administration, February 2002

[12] Outside California, the City of Portland's crosswalk policy is to install pedestrian crossings every 400'.

2002 FHWA STUDY SUMMARY

OBJECTIVE

To compare pedestrian crash occurrence at marked versus unmarked crosswalks at **uncontrolled** intersections throughout the U.S.

DATA

- 1,000 marked and 1,000 unmarked crossings,
- No school crossings,
- Mid-block locations were included,
- Crash history (5 years), pedestrian volumes, traffic volumes, number of lanes, speed limit,
- 229 pedestrian/vehicle collisions in the sample.

KEY FINDINGS

Marked crosswalks without traffic calming treatments, traffic signals, pedestrian signals, or other substantial crossing improvement under the following conditions are less safe than unmarked crossings:

- Where the speed limit exceeds 40 miles per hour
- On a roadway with four or more lanes without a raised median or crossing islands that has an ADT of 12,000 or greater
- On a roadway with four or more lanes with a raised median or crossing island that has an ADT of 15,000 or greater

No study has conclusively answered why marked crosswalks are sometimes less safe than unmarked crossings. Several authors have theorized that pedestrians do not exercise due caution at marked crosswalks. Additionally, without advance warnings such as signs or overhead flashers, drivers may swerve around stopped cars without seeing the pedestrian in the crosswalk (called "double jeopardy"). The table on the following page summarizes the findings of the 2002 study.

Table 1. Recommendations for installing marked crosswalks and other needed pedestrian improvements at uncontrolled locations.*

Roadway Type (Number of Travel Lanes and Median Type)	Vehicle ADT ≤ 9,000			Vehicle ADT >9000 to 12,000			Vehicle ADT >12,000 - 15,000			Vehicle ADT > 15,000		
	Speed Limit**											
	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h	≤ 30 mi/h	35 mi/h	40 mi/h
2 Lanes	C	C	P	C	C	P	C	C	N	C	P	N
3 Lanes	C	C	P	C	P	P	P	P	N	P	N	N
Multi-Lane (4 or More Lanes) With Raised Median***	C	C	P	C	P	N	P	P	N	N	N	N
Multi-Lane (4 or More Lanes) Without Raised Median	C	P	N	P	P	N	N	N	N	N	N	N

These guidelines include intersection and midblock locations with no traffic signals or stop signs on the approach to the crossing. They do not apply to school crossings. A two-way center turn lane is not considered a median. Crosswalks should not be installed at locations that could prevent an increased safety risk to pedestrians, such as where there is poor sight distance, complex or confusing designs, a substantial volume of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices. Adding crosswalks alone will not make crossing safer, nor will they necessarily result in more vehicles stopping for pedestrians. Whether or not marked crosswalks are installed, it is important to consider other pedestrian facility enhancements (e.g., raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic-calming measures, curb extensions), as needed to improve the safety of the crossing. These are general recommendations; good engineering judgment should be used in individual cases for deciding where to install crosswalks.

** Where the speed limit exceeds 40 m/h (64.4 km/h) marked crosswalks alone should not be used at unsignalized locations.

C= Candidate sites for marked crosswalks. Marked crosswalks must be installed carefully and selectively. Before installing new marked crosswalks, an engineering study is needed to determine whether the location is suitable for a marked crosswalk. For an engineering study, a site review may be sufficient at some locations, while a more in-depth study of pedestrian volume, vehicle speed, sight distance, vehicle mix, etc, may be needed at other sites. It is recommended that a minimum of 20 pedestrian crossings per peak hour (or 15 or more elderly and/or child pedestrians) exist at a location before placing a high priority on the installation of a marked crosswalk alone.

P= Possible increase in pedestrian crash risk may occur if crosswalks are added without other pedestrian facility enhancements. These locations should be closely monitored and enhanced with other pedestrian crossing improvements, if necessary, before adding a marked crosswalk.

N= Marked crosswalks alone are insufficient, since pedestrian crash risk may be increased due to providing marked crosswalks alone. Consider using other treatments, such as traffic-calming treatments, traffic signals with pedestrian signals where warranted, or other substantial crossing improvement to improve crossing safety for pedestrians.

Department of PUBLIC WORKS CITY OF SACRAMENTO

2.2 CONTROLLED APPROACHES

The following is the recommended pedestrian treatment at signalized or stop-controlled locations. A controlled approach is any leg of an intersection with a stop sign or signal, including two-way stops.

High-visibility crosswalk in New York City

- **Mark Crosswalks on all controlled approaches (i.e., legs of the intersection) with pedestrian signal heads** using standard crosswalk markings (two white lines) or high-visibility markings, such as the "triple four" included in Chapter 1. Install advanced stop bars seven feet before the crosswalk at signals. Advanced stop bars are white lines, 24" wide, installed prior to the crosswalk. They are effective in preventing drivers from stopping in the crosswalk. Remove curb ramps where pedestrian crossings are prohibited so that visually impaired individuals know where crossings are not allowed. Where the accident data or observations of conflicts identify a crosswalk of particular concern, consider special treatments (identified below under "Solutions").

- **Pedestrian signals should be timed for a pedestrian travel speed of 3.5 feet per second[13].** If there are special land uses such as senior centers or schools within 100 feet of the intersection, slower walking speeds should be considered.

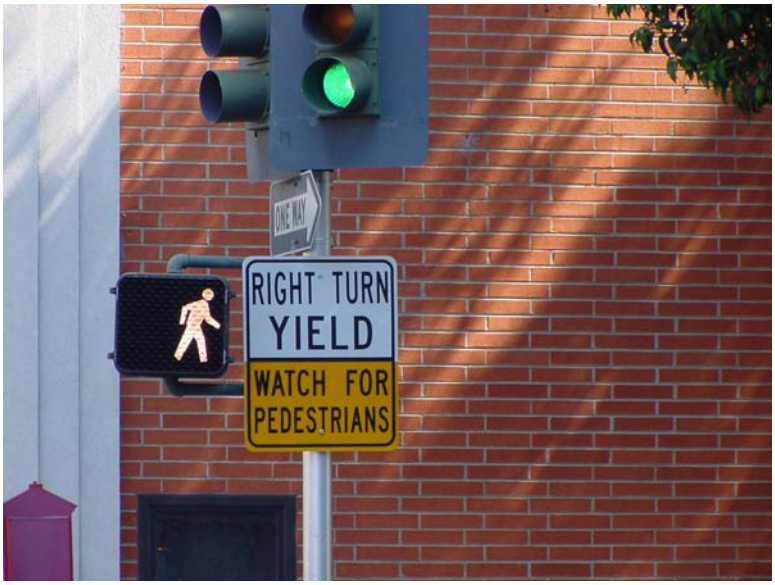
[13] U.S. Department of Transportation, *Designing Sidewalks and Trails for Access, Part II: Best Practices Design Guide,* 2001recommends a maximum crossing speed of 3.5 feet per second.

SOLUTIONS

At locations with high pedestrian volumes and pedestrian-vehicle conflicts, the following measures are means to enhance the safety of pedestrian crossings:

- Right Turn on Red restrictions at locations with high numbers of right-turning vehicles and heavy pedestrian volumes,
- Reduced corner radii to slow the speeds of right-turning vehicles,
- "Watch Turning Vehicles" pavement stencil and signage,
- Signal phasing accommodations such as early release of pedestrians ("Leading Pedestrian Interval") during signal phasing and provision of protected left-turn phases for vehicles,
- Introduction of all-red phasing for vehicles while pedestrians have a walk signal in all directions (called a "pedestrian scramble phase"),
- "Yield to Pedestrians" signs, and
- Animated Eye LED pedestrian signals.

Pavement stencil in Halifax, Nova Scotia



Sign at 12th St. and J St.

EXCEPTIONS

The following situations are exceptions to the practice of marking crosswalks on all controlled approaches:

- **Crossing locations with heavy right- or left-turn volumes** that occur at the same time as pedestrians cross the path of the turning vehicle where protected signal phasing (such as left-turn arrows) or other solutions outlined above are infeasible.[14]

- **Intersections with inadequate sight distance[15] of pedestrians.** Elimination of crosswalks in these instances should only occur after other solutions have been deemed infeasible.

10th St. and L St.

- **Heavy or light rail crossings**. The California Public Utilities Commission (CPUC) is responsible for regulating at-grade crossings. The PUC no longer allows new at-grade crossings (pedestrians and cars crossing rail tracks) unless there are extraordinary circumstances.

- **Construction Area's**. Pedestrian circulation in construction areas should remain open unless determined by the Traffic Engineer to be unsafe.

L St. and 15th St.

[14] Alternative pedestrian crossings should be identified and it may be necessary to install barrier treatments to reinforce that pedestrian should not cross at the location without a marked crosswalk

[15] Unrestricted sight distance of pedestrians by motorists should be at least ten times the speed limit (for example, 250 feet for a street with a speed limit of 25 miles per hour.)

Animated Eye LED signal

CHOOSING THE RIGHT TREATMENT

There are a number of innovative treatments for pedestrians at signalized intersections, mostly related to pedestrian signals.

HIGH NUMBERS OF TURNING VEHICLES

- The **Animated Eye LED Signal** is an effective tool for reminding pedestrians to watch for turning vehicles. It would normally be used at intersections with large numbers of turning vehicles (vehicles turning left or right into the crosswalk).

- **Early Release** or Leading Pedestrian Interval time, described on page 12, allows pedestrians to establish themselves in the crosswalk, reducing conflicts between pedestrians and turning vehicles.

15th Street and X Streets

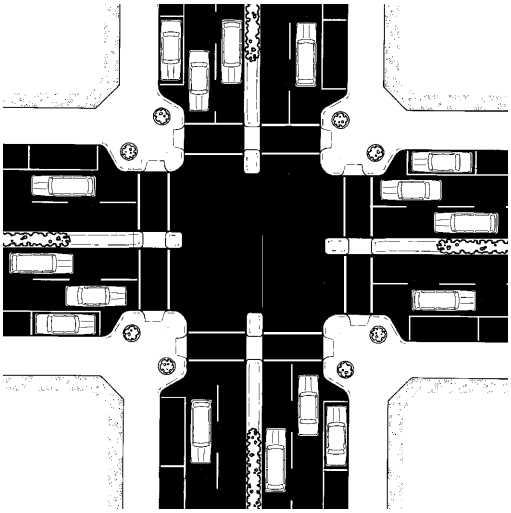
- **Special Pavement stencils** such as "Pedestrians Look Left" or "Watch Turning Vehicles" stencil are used in Salt Lake City, Halifax, N.S., Canada, and the UK to remind pedestrians to be watchful. These stencils, used in conjunction with special signage, significantly reduced the number of pedestrians not looking for threats at intersections.[16] Additionally, high-visibility crosswalks help channelize pedestrians.

- **"No Right Turn on Red" restrictions** may be used to reduce pedestrian-vehicle conflicts at locations with high numbers of pedestrians and right turning vehicles.

[16] Van Houten, Ron et al, "Special Signs and Pavement Markings Improve Pedestrian Safety," *ITE Journal*, 12/96

PEDESTRIAN TREATMENTS AT CONTROLLED CROSSINGS

CONTROL TYPE	STANDARD TREATMENT	ENHANCEMENTS	DO NOT MARK
Signal	Advance 24" Limit Line seven feet before the crosswalk Dual white lines	Triple-four or other high-visibility stencil Pedestrian refuge island Curb extensions Signal treatments: • Animated Eye • Countdown • Early Release • Scramble Right-turn on red restrictions	Inadequate sight distance
Stop sign	Dual white lines	Triple-four or other high-visibility stencil Pedestrian refuge island Curb extensions	Inadequate sight distance



Medians and curb extensions create short pedestrian crossings

WIDE INTERSECTIONS

- **Countdown signals** are useful at locations with crossing distances greater than 60 feet and pedestrian clearance intervals of greater than 15 seconds or a high pedestrian volume. At wide streets with long clearance intervals, the countdown signal effectively communicates the amount of time left to cross the street. At wide streets with medians, there should be adequate crossing time for the pedestrian to traverse the entire distance and countdown signals should be used as a default. However, at actuated pedestrian signals, an additional, accessible pedestrian push button should be located in the median. The countdown signal and median pushbutton should be used together wherever possible.

- **Pedestrian Refuge Islands** should extend through the crosswalk, with a curb cut for wheelchair accessibility. Refuge islands should be clear of obstructions and have adequate drainage. They should be at least 12 feet long, or the width of the crosswalk (whichever is greater) and 60 feet square. Recommended refuge island widths are as follows:

Speed	Minimum Width[17]
25-30 mph	5 feet
30-35 mph	6 feet
35-45	8 feet

- **Curb extensions** or bulb-outs are appropriate at locations with usable space next to the curb Consider curb extensions at intersections of three or more lanes. Curb extensions should not extend further than six feet into the street adjacent to parallel parking, or 12 feet adjacent to diagonal parking. At locations with no on-street parking, curb extensions should not impede bicycle travel.

[17] where bikes are expected to use the crosswalk, medians should be at least 6 feet wide, the length of an average bike

PEDESTRIAN ACTUATED SIGNALS

All signals in downtown Sacramento are pre-timed (with the exception of 4th Street & J Street); therefore, pedestrians get the signal to walk on every crossing, in every signal cycle. Most signals in Sacramento outside downtown are not pre-timed, meaning vehicles activate them. These signals have pedestrian push buttons, which pedestrians must push in order to get a walk signal and adequate time to cross the street.

- At locations where pedestrian activation is registered for greater than 75% of the peak hour signal cycles, signals should accommodate pedestrian crossings in every peak period cycle.

- At locations that are not on a direct path to a generator with low side-street volumes, signals should be partially actuated; meaning that pedestrians crossing the side streets get a WALK signal on every cycle, but pedestrians crossing the main street must use the pedestrian push button.

- At locations that do not satisfy the location warrants above, where peak hour vehicle congestion occurs and there are high vehicle volumes on all approaches, signals should be fully actuated.

Consider using remote pedestrian detection devices, such as video, infrared or other detection technologies, at signals where slower pedestrians are present. The remote detection can be used to extend the pedestrian clearance interval allowing pedestrians still in the crosswalk additional time to finish their crossing.

When pedestrian push buttons are used, they should be well marked, visible, and accessible to all pedestrians from a flat surface consistent with recommendations from the U.S. Department of Transportation's *Designing Sidewalks and Trails for Access*.

2.3 UNCONTROLLED INTERSECTION CROSSINGS

The following is the recommended, or best practice, for pedestrian treatments at uncontrolled approaches to intersections.[18]

Triple-four or high-visibility crossings with associated signage and pavement legends should be used where:

- Sufficient demand exists to justify the installation of a crosswalk (see next page),
- The location is 300 feet or more from a controlled crossing location,
- The location has sufficient sight distance, or sight distance will be improved prior to crosswalk marking, and
- Safety considerations do not preclude a crosswalk (see Safety Considerations below).

J St. and 17th St.

[18] The most common crosswalk of this type will be the major street crosswalk at intersection where the minor side street has a stop sign and the major street is uncontrolled.

Equivalent Adult Units	
Type	Factor
Child	2
Senior	1.5
Disabled	2

DEMAND

Uncontrolled intersection crossings should be identified as a candidate for marking if there is a demonstrated need for a crosswalk. Demonstrated need is:

- The crossing is on a direct route to or from a pedestrian generator, such as a school, library, senior center, shopping center, park, or employment center.

or:

- 20 pedestrians cross per hour during the peak hour or 60 pedestrians total cross for the highest consecutive four-hour period using the Equivalent Adult Units System; and
- Pedestrians have fewer than five gaps in traffic per five-minute period.[19]

SAFETY

The chart from the FHWA *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Crossing Locations* (see pg. 30) should be used to determine if crosswalks can be striped. In some cases, special treatments (see "Solutions" below for a partial list of special treatments) may be needed to ensure safe crossing. Where safety concerns would continue even with special treatments, pedestrian signal warrants, established in Caltrans' *Traffic Manual*,[20] should be tested to determine whether the crossing warrants a pedestrian signal. In the event that a signal is determined to be inappropriate, other pedestrian safety amenities such as medians and bulbouts should be considered, but the crosswalk should not be marked. Unless pedestrians are prohibited from these crossings, curb ramps should still be provided.

[19] Average number of gaps per five-minute period = total usable gap time in seconds divided by pedestrian crossing rate at four feet per second, multiplied by 12.

[20] As per Section 9.01.2, 100 pedestrians in four hours or 190 in one hour, unless the predominant crossing speed is less than 3.5 feet per second, in which case the warrants can be reduced by half. Additionally, there must be fewer than 60 gaps in traffic per hour as per Section 9.01.1

SOLUTIONS

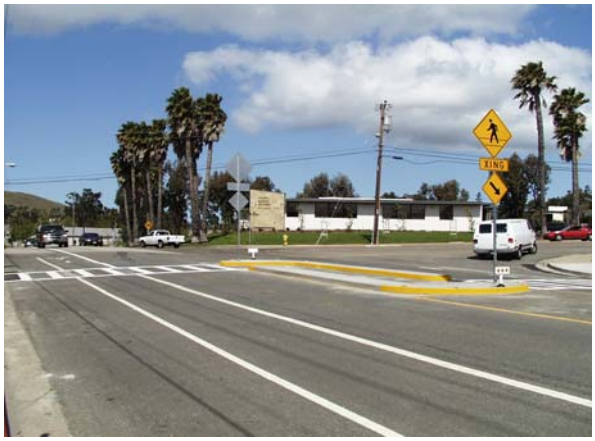
Special treatments should be considered at areas with heightened safety concerns. They are listed in order of intensity.

Level One

- Install **Pedestrian Refuge Islands** on multi-lane streets with ADT of less than 15,000 and 85th percentile speeds of less than 35 miles per hour, following the design guidelines described in "Choosing the Right Treatment."

- The **Split Pedestrian Crossover (SPXO)** is a pedestrian refuge that channels pedestrians, using curb railings, to cross one half of the street; enter the island at one end; walk towards the flow of traffic; and exit at the other end to cross the second half of the street. SPXOs can improve pedestrian safety on streets with ADTs below 45,000; with advance yield markings (triangles 16" wide by 24" long separated by 9" located 30-50 feet in advance of the crossing), "Yield to Pedestrians" signage, and good visibility, especially at night.

- **Curb Extensions or bulbouts** (see "Choosing the Right Treatment", p.36)



SPXO in San Luis Obispo, CA

Overhead signs with flashing beacons

Pedestrian Signal

South Land Park Drive & Zoo

Level Two

- **Overhead signs and flashing beacons** showing the universal pedestrian symbol, including both standard yellow, fluorescent yellow, and LED displays, hang from a mast arm that extends over the street. Flashing red or yellow beacons enhance overhead signs.

- **Raised crosswalk** Using special pavers, concrete, or asphalt, create a raised crosswalk (similar to a speed table). The City's Traffic Calming Guidelines provide design guidelines and a description of the advantages and disadvantages of raised crosswalks.

- **In-pavement flashers** are people activated and may be accompanied by a flashing sign at the crosswalk and advanced flashing sign increase the number of vehicles yielding to pedestrians.

Level Three

- **Pedestrian-actuated signals** (shown to the left) should be used where other methods are infeasible or ineffective.

At locations where none of the above solutions will mitigate safety concerns, or where pedestrian volumes warrant a pedestrian signal, but the signal would degrade vehicle LOS, consider the installation of a grade-separated crossing, if feasible.

2.4 MID-BLOCK CROSSINGS

Raised Crosswalk

Mid-block crossings should be marked where:

- Sufficient demand exists to justify the installation of a crosswalk (see next page),
- The mid-block location is:
  300 feet or more from another crossing location on an arterial street,
  200 feet or more from another crossing location on a collector street, or
  100 feet or more from another crossing location on a local street,
- The mid-block location has sufficient sight distance, and
- Safety considerations do not preclude a crosswalk (see Safety Considerations below).

Where mid-block crosswalks are installed, the standard design should be the triple-four or high-visibility pavement treatment with associated signage and pavement legends.

Uncontrolled crossing on Broadway

DEMAND

Candidate locations for marked pedestrian crossings at mid-block locations must meet the following criteria:

- A pedestrian generator is less than 300 feet away at a location mid-way between signal or stop-controlled intersections, *or* there are pedestrian trip generators on both sides of the street.

or:

- 40 pedestrians cross during a one-hour period or 25 cross per hour for four consecutive hours using the Equivalent Adult Units system.[21]
- Fewer than five gaps in traffic during the peak five minute period.

SAFETY

The chart from the FHWA *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Crossing Locations* should be used to determine if a mid-block crosswalk can be installed or whether special treatments (see "Solutions" below for a partial list of special treatments) are needed to ensure safe crossing.

Where safety concerns would continue even with special treatments, pedestrian signal warrants, established in Caltrans' *Traffic Manual*, should be tested to determine whether the crossing warrants a traffic signal. In the event that a signal is determined to be inappropriate, the crosswalk should not be marked.

[21] Use of a system of Equivalent Adult Units is recommended in order to recognize intersections that require special attention due to the presence of seniors or children, even if they don't meet the volume requirement. These two groups are disproportionately represented in collision and fatality statistics.

SOLUTIONS

Mid-block enhancements are the same as those for uncontrolled intersections, with the following modification:

At locations where none of the enhancements will mitigate safety concerns, or where pedestrian volumes warrant a pedestrian signal, but the signal would degrade vehicle Level of Service (LOS), study the feasibility of a grade-separated crossing.

Sacramento Bicycle and Pedestrian Bridge over Florin Road

2.5 TRAIL CROSSINGS

At locations where a multi-use trail crosses a street, the mid-block or uncontrolled intersection safety warrants should be used to determine whether or not to mark a crosswalk, depending on the location of the crossing.

Trail crossings should be well lit and well signed. At all uncontrolled at-grade trail crossings, traffic calming and signage within 150-200 feet of the crossing should be considered. The crossing should also have signage within 30 to 50 feet of the crossing.

If the crossing does not meet the safety warrants and the nearest signalized crossing location is:

- 300 feet or more away on an arterial street,
- 200 feet or more away on a collector street, or
- 100 feet or more away on a local street.

Signage and landscaping should be used to direct both cyclists and pedestrians to the adjacent signalized crossing.

The distances above balance safety with convenience. A marked crosswalk on a local street with a low daily traffic volume, few lanes, and a low-posted speed represents a relatively low risk to the pedestrian. In this circumstance, directing a pedestrian to a signal further than 100 feet away is an inconvenience disproportionate to the safety concerns associated with a marked crosswalk. On an arterial street with heavy traffic and higher speeds, the safety risk, and therefore, the acceptable level of inconvenience, is greater.

If the nearest signalized crossing is greater than 150 feet away, the location fails the safety tests and other at-grade treatments are infeasible, a grade-separated bicycle/pedestrian crossing should be considered.

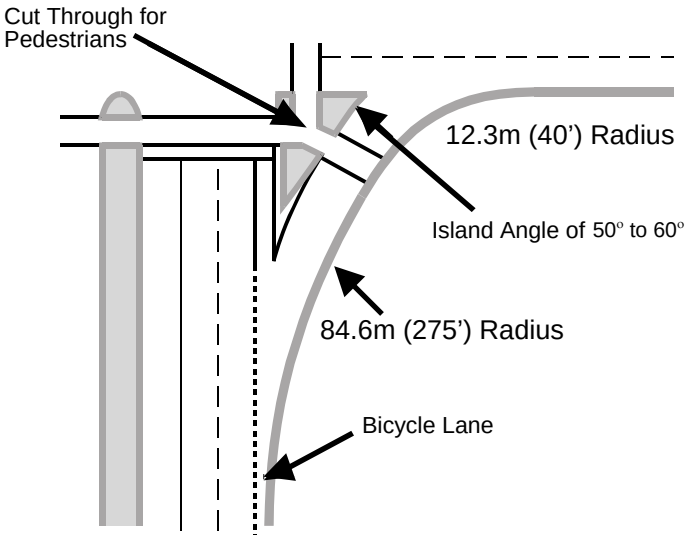
2.6 COMPACT INTERSECTIONS

***Never design more than you need* is the maxim underlying pedestrian-friendly intersections.**

Compact intersections with short crossings and high pedestrian visibility are the most accessible, safe and effective for pedestrians. There are several elements to consider when evaluating an intersection for pedestrian friendliness:

- **Turning Radius** Whenever possible, especially at locations adjacent to pedestrian generators, intersections should be designed with tight corner radii and without "free rights" for vehicles. When "free rights" are necessary, the turning radius should follow the figure below. Curb extensions can help retrofit existing intersections – tightening corner radii, reducing pedestrian crossing distances and raising pedestrian visibility.

Right-Turn Slip Lane
Preferred Design



- **Geometry:** Pedestrian-friendly signalized intersections have no more than two through lanes in each direction, and lane widths of 10 feet for travel and turn lanes.

- **Miscellaneous:** Signalized intersections should be well lit, with pedestrian signals at each crosswalk and short cycle lengths (optimally, no longer than 60 seconds).

- **Signal Visibility:** Signal heads should be located for optimum visibility. If a signal has a permitted left turn phase, one signal should be on the corner pole signal located above the pedestrian signal whenever possible, to focus the driver's attention on the crosswalk and pedestrian signal indication. It will also help alert pedestrians to the presence of left-turning vehicles.

Traffic and pedestrian signals are located adjacent to each other on corner poles to direct driver attention to the pedestrian

"Walkable streets form the backbone of friendly, interactive, safe, secure neighborhoods." – Dan Burden of Walkable Communities, *Street Design Guidelines for Healthy Neighborhoods*

CHAPTER THREE
DEVELOPMENT AREAS
BEST PRACTICES

Sacramento's North Natomas area is one of several fast-developing areas of the City. Most developments are subject to a permit application, wherein City staff may consider and approve the proposed projects. This process offers a forum between developers and the City to educate builders about the benefits of good pedestrian facilities and to ensure that all new developments maintain a high pedestrian safety standard. One method to accomplish this goal is to subject all streets in new and re-developments to the same considerations detailed in the **"Safe Crossings"** chapter. This report recommends safe, high-visibility pedestrian crossings such that all pedestrian generators (shopping centers, libraries, employment centers, etc.) have a marked crossing within 300 feet.

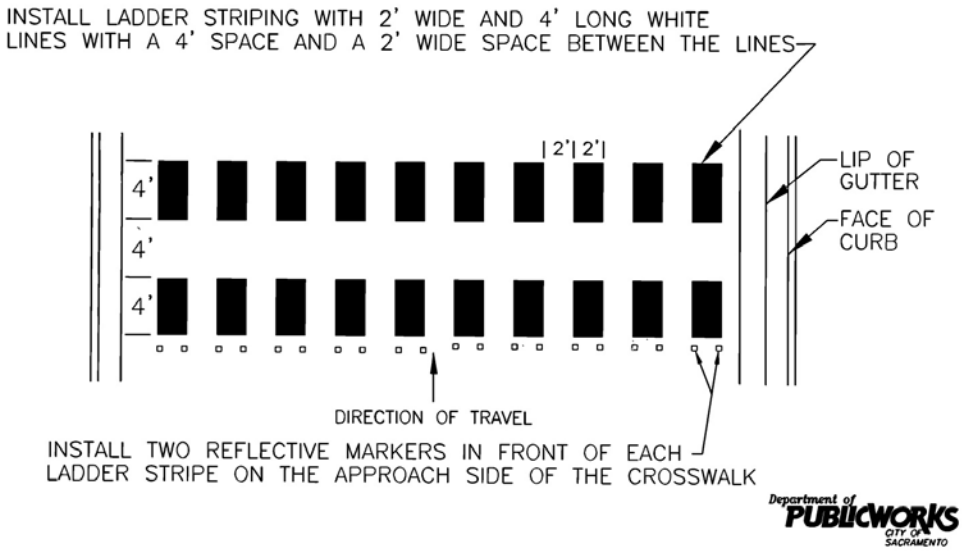
North Natomas Sub Division

3.1 CROSSING TREATMENTS

Textured Crosswalk in Mid-Town

The City employs two types of high-visibility crosswalks: the triple-four and the textured pavement crosswalk. Specifications for these crosswalks are included in Chapter 1. These crosswalks are excellent tools at slower low-volume uncontrolled crossing locations. At a minimum, a high-visibility treatment is recommended at all uncontrolled crossing locations (uncontrolled crossing locations are mid-block sites and intersections without a signal or all-way stop) where a crosswalk is scheduled for installation. The developer should choose a crossing treatment based on the guidelines in Chapter 2, which are a function of volume, speed and number of lanes. Additionally, the "Compact Intersection" recommendations in Chapter 2 offer guidelines for safe pedestrian intersections.

FIGURE 1.1 TRIPLE FOUR CROSSWALK



The crosswalk style is called "triple-four" due to the measurements and spacing of the stripes.

3.2 NEIGHBORHOOD STREET DESIGN

Pedestrian-friendly neighborhood street design improves the safety of the walking environment and fosters an increase in trips made on foot.

Short block lengths, compact intersections, narrow lane widths, and continuous, separated sidewalks create a pedestrian-friendly environment.

- Install **continuous sidewalks, separated by a planter or park strip with a vertical curb** along all new streets next to commercial or residential land uses. Recent research from the FHWA indicates that basic elements such as continuous, separated sidewalk may reduce "walking along roadway" pedestrian/vehicle crashes.[22]

- Follow **block-length recommendations** included in the City's *Traffic Calming Guidelines:*

> "Some street networks leave excessively long blocks without interrupting intersections. Drivers that travel a long distance (500 feet or greater) without being required to slow or stop by traffic control devices can tend to travel at excessive speeds. To minimize this effect, the street network can be designed such that street blocks are interrupted by streets of sufficient traffic volumes to warrant a traffic control device (e.g. a traffic circle or stop sign) on the street of concern."

[22] McMahon, Patrick et al, "An Analysis of Factors Contributing to 'Walking Along Roadway' Crashes: Research Study and Guidelines for Sidewalks and Walkways," Report No. FHWA-RD-01-101

3.3 TRAFFIC IMPACT STUDIES

Traffic Impact Studies and plan checks have not traditionally incorporated measures of pedestrian safety or convenience. This report recommends the following measures for evaluating new and re-development projects.

PEDESTRIAN SAFETY IMPACTS

The following are basic guidelines that could be included in Transportation Impact Studies:

- **Impact on the existing pedestrian system**
  Will the project change the width, routing or conditions of an existing pedestrian facility?
- **Pedestrian travel patterns and access**
  Will the project alter existing pedestrian travel patterns and/or otherwise affect a pedestrian's ability to travel as directly as possible from origin to destination with no circuitous travel, due to any change to the sidewalk or pathway network?
- **Pedestrian circulation and access**
  Will the project reduce or restrict a pedestrian's access to any roadway or site, by decreasing safety, increasing the stress or increasing the delay experienced by the pedestrian? This includes but is not limited to increasing the width of the road or reducing the width of the shoulder, bridge, overpass or underpass.[23]

[23] Pedestrian's stress levels can be quantitatively measured using Pedestrian Level of Service methodology. The PLOS is a spreadsheet with inputs for roadway width, traffic levels, posted speed, sidewalk width, and the presence and measurements of pedestrian buffers including street trees.

- **Safety of Operations**
  Does the project meet or exceed accepted design standards and guidelines, as promulgated by responsible agencies such as the State of California or AASHTO? How will the project enhance/improve safety and connectivity for pedestrians?
- **Internal Pedestrian Circulation**
  Applicants should submit an internal pedestrian circulation plan in order to facilitate the safest, smoothest transition from sidewalk or parking lot to building entrance. The circulation plan should include clearly marked walkways for pedestrians to walk, delineated by textured or colored pavement or pavement stencils. In large parking lots, a continuous sidewalk should be provided in parking lot medians from the parking lot to a marked crossing to the building entrance.

PEDESTRIAN ENTRANCES

All new public buildings, meaning buildings that the public may use, such as shopping centers, should have at least one main entrance immediately adjacent to the sidewalk.

DEVELOPER EDUCATION PROGRAM

In order to raise developer awareness about the benefits of pedestrian safety measures, both to pedestrians and to homeowners, this report recommends the development of a brief brochure detailing the guidelines contained both in this report and in the forthcoming Pedestrian Master Plan. Staff could distribute the brochures during the application process to educate builders about the City's recommendations pertaining to pedestrian safety measures.

APPENDIX A
CITY OF SACRAMENTO STREET STANDARDS
(Currently Under Revision)

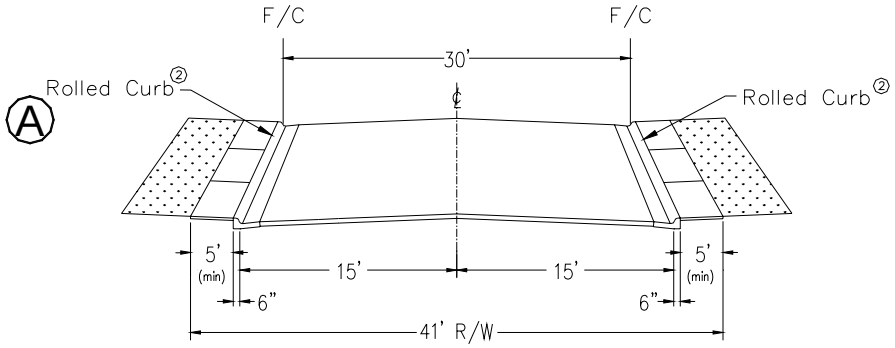
Department of PUBLIC WORKS CITY OF SACRAMENTO

EXISTING STREET STANDARDS

TYPICAL CROSS-SECTIONS

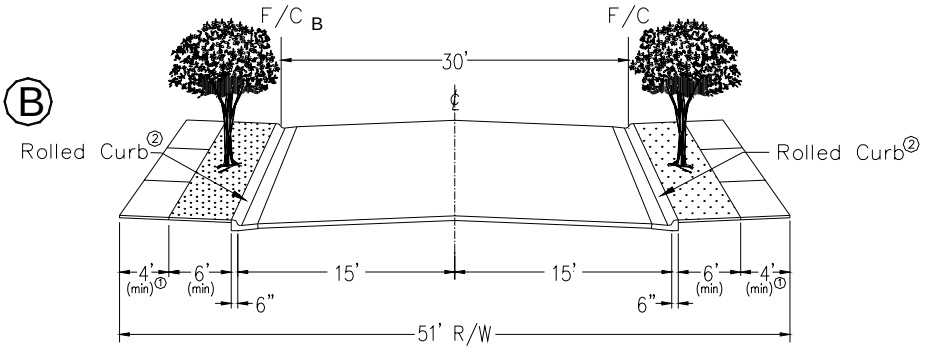
City of Sacramento - Public Works Department

LOCAL RESIDENTIAL STREETS



41' Right-Of-Way

(0-2,000 ADT)



51' Right-Of-Way

(0-4,000 ADT)

① – ADA requires a passing space at an interval not to exceed 200ft. If this requirement is not met, a minimum sidewalk width of 5' is required.

② – Vertical curbs may be constructed in accordance to the vertical curb section of the additional notes. If vertical curbs are chosen, the F/C to F/C dimension must be increased to 32'. The sidewalk width may be decreased to 4'–4" from the requirements in Section A with vertical curbs.

MINOR DEVIATIONS FROM THE STANDARDS REQUIRE THE APPROVAL OF THE DIRECTOR OF PUBLIC WORKS OR THE DESIGNEE.

ALTERNATIVES ALLOWED IN THE P.U.D.

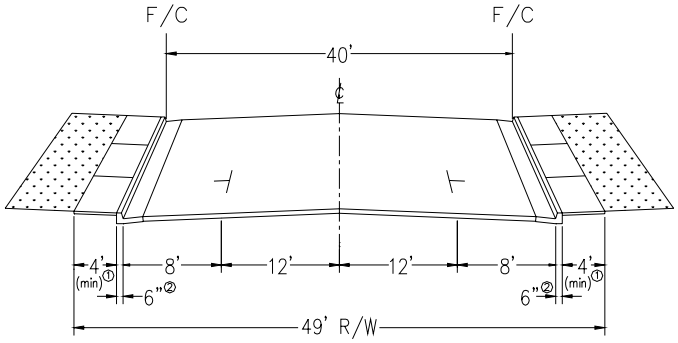
Department of PUBLIC WORKS CITY OF SACRAMENTO

Department of PUBLIC WORKS CITY OF SACRAMENTO

EXISTING STREET STANDARDS
TYPICAL CROSS-SECTIONS
City of Sacramento - Public Works Department

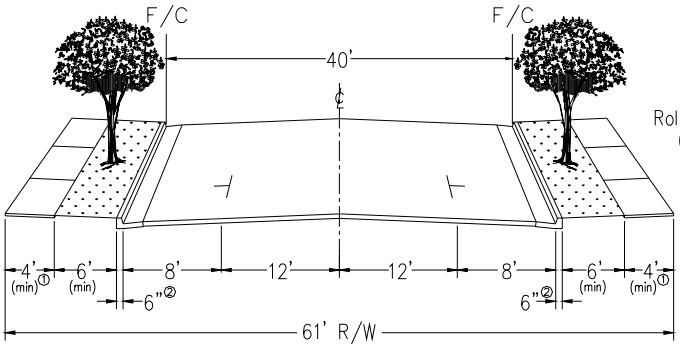
LOCAL NON-RESIDENTIAL STREETS

Ⓒ



49' Right-Of-Way
(0-7,000 ADT)

Ⓓ



Rolled curb permitted (If Traffic Volume is 0-7,000 ADT)

61' Right-Of-Way
(0-14,000 ADT)

① – ADA requires a passing space at an interval not to exceed 200ft. If this requirement is not met, a minimum sidewalk width of 5' is required.

② – See Vertical Curb Section under additional notes.

MINOR DEVIATIONS FROM THE STANDARDS REQUIRE THE APPROVAL OF THE DIRECTOR OF PUBLIC WORKS OR THE DESIGNEE.

ALTERNATIVES ALLOWED IN THE P.U.D.

Department of PUBLICWORKS CITY OF SACRAMENTO

Department of PUBLICWORKS CITY OF SACRAMENTO

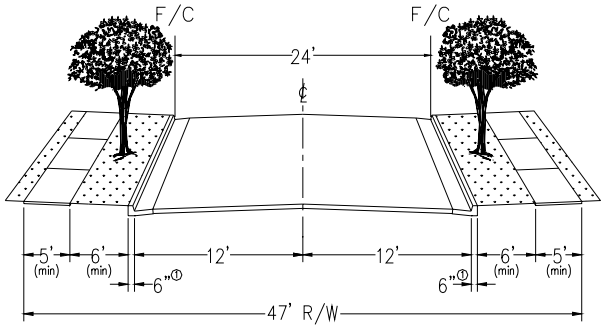
EXISTING STREET STANDARDS

TYPICAL CROSS-SECTIONS

City of Sacramento - Public Works Department

COLLECTOR STREET SYSTEM

Ⓔ



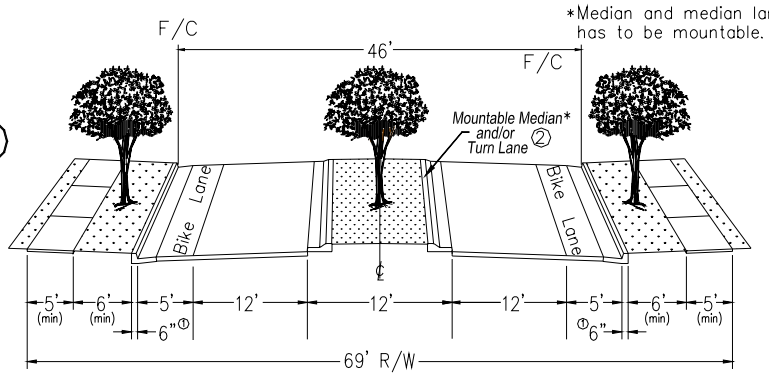
47' Right-Of-Way

(4,000-7,000 ADT)

Parking add 7' per direction.
Bike lane add 5' per direction. ②

Ⓕ

*Median and median landscaping has to be mountable.



69' Right-Of-Way

(7,000-14,000 ADT)

Parking add 7' per direction.

① – Dimensions shown are approximate. See Vertical Curb Section under additional notes.

② – The Director of Public Works or the designee will determine whether a turn lane or a landscaped median is installed.

Department of PUBLIC WORKS CITY OF SACRAMENTO

MINOR DEVIATIONS FROM THE STANDARDS REQUIRE THE APPROVAL OF THE DIRECTOR OF PUBLIC WORKS OR THE DESIGNEE.

ALTERNATIVES ALLOWED IN THE P.U.D.

Department of PUBLIC WORKS CITY OF SACRAMENTO

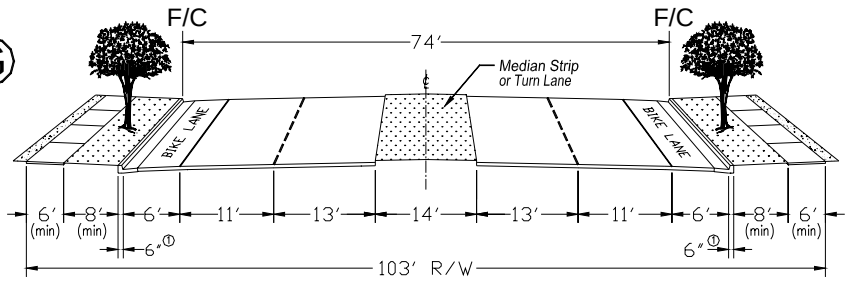
EXISTING STREET STANDARDS

TYPICAL CROSS-SECTIONS

City of Sacramento - Public Works Department

ARTERIAL STREETS SYSTEM

Ⓖ

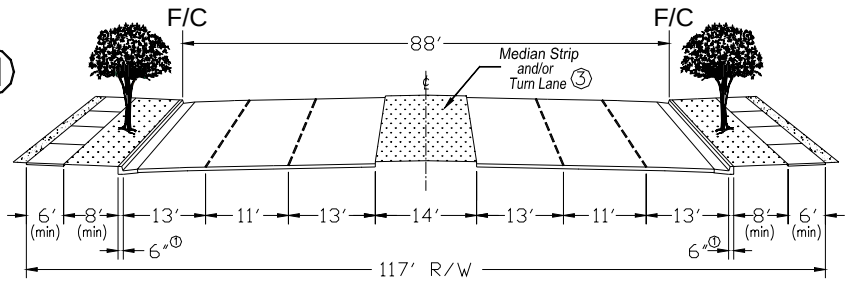


103' Right-Of-Way

Parking add 7' per direction.

(14,000-32,000 ADT)

Ⓗ



Bike lane add 6' per direction. ②

117' Right-Of-Way

(32,000-48,000 ADT)

① – Dimensions shown are approximate. See Vertical Curb Section under additional notes.

② – Bike lanes will be added per the Bikeway Master Plan.

③ – The Director of Public Works or designee will determine whether a turn lane or a landscaped median is installed.

MINOR DEVIATIONS FROM THE STANDARDS REQUIRE THE APPROVAL OF THE DIRECTOR OF PUBLIC WORKS OR THE DESIGNEE.

ALTERNATIVES ALLOWED IN THE P.U.D.

Department of PUBLIC WORKS CITY OF SACRAMENTO

Department of PUBLIC WORKS CITY OF SACRAMENTO