Appendix A: Resources for Design of Pedestrian Facilities

Emeryville Pedestrian and Bicycle Plan

May 2012

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Introduction

A well-connected pedestrian network is a vital component to livable communities, which thrive on multimodal travel for all roadway users, regardless of age or ability. Multimodal travel incorporates the needs of not just motor vehicles in roadway design, but the needs of pedestrians, bicyclists, and transit users as well. The primary goal of the this resource document is to assist the City of Emeryville in creating places that accommodate pedestrians through a set of recommended practices that enhance the walkability of all streets within the City. These guidelines will help the City make decisions about the preferred application of pedestrian treatments in the following areas:

- Special Pedestrian Needs
- Streets and Sidewalks
- Uncontrolled Intersections / Mid-block Crossing Treatments
- Controlled Intersections
- Design Review for Development Projects

The pedestrian enhancements described throughout these guidelines provide street design best practice guidance, which can enhance the safety, convenience, and mobility for pedestrians. In particular, they provide guidance on appropriate treatments for the various locations identified for pedestrian improvements throughout Emeryville. Potential treatment types for each of these areas include different design options for streets/sidewalks, pedestrian crossings, multimodal connections and community vitality.

The *Emeryville General Plan* (2009) defines the concept of "complete streets" as the following:

> "Complete streets are designed and operated to enable safe, attractive and comfortable access and travel for all users. Pedestrians, bicyclists, motorists and public transit users of all ages and abilities are able to safely and comfortably move along and across a complete street. Complete streets also create a sense of place and improve social interaction, while generally improving the values of adjacent property."

Complete streets practices improve the pedestrian realm because they encourage the design of streets with well-connected and comfortable sidewalks, traffic calming measures to manage vehicle speeds and enhanced pedestrian crossings. Incomplete streets—those designed primarily for automobile access—can be a barrier in any community, particularly for people with disabilities, older adults, and children. As noted in the *General Plan* the development of complete streets is essential to move the City towards an integrated pedestrian street network.

References

Federal Standards and Resource Documents:

Guide to the Development of Pedestrian Facilities, American Association of State Highway and Transportation Officials, 2000

Manual on Uniform Traffic Control Devices, Federal Highways Administration, December 2009.

Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials, 2004.

Americans with Disabilities Act Accessibility Guidelines (ADAAG). United States Access Board.

California Standards and Resource Documents:

California Manual on Uniform Traffic Control Devices, Caltrans, January 2010.

Highway Design Manual, California Department of Transportation.

Other Guidelines and Resource Documents:

Emeryville Design Guidelines. City of Emeryville, December 2010.

Park Avenue District Plan. City of Emeryville, 2006.

Transit Cooperative Research Program (TCRP) Report 112/ National Cooperative Highway Research Program (NCHRP) Report 562: Improving Pedestrian Safety at Unsignalized Crossings. Washington D.C.: TCRP and NCHRP, 2006.

Pedestrian Technical Guideilnes: A Guide to Planning and Design for Local Agencies in Santa Clara City, Santa Clara Valley Transportation Authority, October 2003.

Routine Accommodations of Pedestrians and Bicyclists in the Bay Area, Metropolitan Transportation Commission, Available: http://www.mtc.ca.gov/planning/bicyclespedestrians/routine_accommodations.htm, 2006.

Pedestrian Safety Resource Guide, Metropolitan Transportation Commission Regional Pedestrian Committee, Available: http://www.mtc.ca.gov/planning/bicyclespedestrians/PEDSAFETYRESOURCEGUIDE.doc, 2004.

Emeryville Sustainable Green Streets and Parking Lots Design Guidebook, Emeryvillewide Water Pollution Prevention Program, First Edition: January 2009, Available: http://www.flowstobay.org/ms_sustainable_guidebook.php

Special Pedestrian Needs

As the City of Emeryville moves toward complete streets, the vision can expand even further. A complete street should offer equal accessibility for the young and old, disabled and not, and pedestrians, bicyclists, motorists, and transit riders. Designing streets for our most vulnerable populations means that they are safe and accessible for everyone. In addition, a complete street has the potential to contribute to the public health, ecological sustainability, and economic vitality of a community. Depending on the context, it may be a place for people to stroll, shop, rest, or socialize. It may be a major thoroughfare that brings people to their jobs each day. It can also be a quiet residential street where children can safely learn how to ride bikes. An expanded vision of Complete Streets can include policies that aim to improve air quality and reduce noise, provide opportunities for sidewalk cafes and plazas, and offer a roadmap for the sound management of surface runoff water on City streets.

Special Needs for Children

Discussion

Children have special needs in the pedestrian realm. This becomes apparent in school zones where a safe pedestrian environment is vital. Young children are often too small to be in the line of sight of drivers, so without proper designs, streets surrounding schools may not be safe for these young pedestrians. In addition, children walk slower than adults and may not be able to gauge the amount of time needed to cross an intersection. When streets surrounding schools have inadequate pedestrian facilities, parents may be reluctant to allow their children to walk to school, therefore driving children to school for even short distances.

Design Summary

Accommodating children and other vulnerable populations requires special provisions to remove barriers to pedestrian travel. These special provisions include measures such as reducing vehicle speeds and enhancing street crossings around schools. Reduced speed zones near schools, using striping patterns and colors to communicate to drivers that they are within a school zone, and traffic calming measures (described further in "Streets & Sidewalks" on page 6) can facilitate slower vehicle speeds. Reducing crossing lengths through bulb-outs, special crosswalk striping, and median refuges (described further in "Uncontrolled Crossing Treatments" on page 19) provide shorter crossings for children. Technical assistance and funding to implement these enhancements can be done through Safe Routes to School programs. Adequate sidewalk facilities and crosswalks are particularly important to separate children from vehicle traffic around school neighborhoods where children walk and ride their bicycles.

Example

Image Sources: Sacramento City Pedestrian Plan; Dan Burden

Special Needs for Seniors

Discussion

Poor sidewalk and crossing conditions may foster isolation with limited opportunities for seniors' mobility; they need travel options other than driving, whether it be walking or taking transit. Seniors have slower walking speeds and reaction times, and may have other impairments that restrict their mobility, vision, and hearing. Sidewalks and street crossings should be sensitive to these barriers and how they affect the aging population.

Design Summary

Opportunities to improve streets to provide senior mobility include:

- Shortening street crossings with median refuges, sidewalk bulb-outs and adequate curb ramps.
- Installing sidewalk furniture to make walking more comfortable by providing places to rest.
- Adjusting signal timing to account for slower walking speeds.

Treatments like pedestrian refuge islands are particularly important to help seniors cross a street since they tend to walk at slower speeds; if they are unable to make the crossing during the available signal time, a refuge provides a separated place to wait.

Each of these treatments is described in detail on later pages.

Example

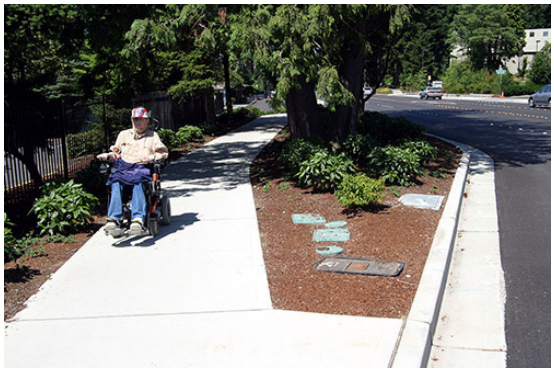


Image Sources: Dan Burden

Americans With Disabilities Act

Discussion

The Americans with Disabilities Act (ADA) protects the rights of people with disabilities, requiring public entities to develop transition plans to bring existing public facilities up to ADA standards. A key component to adequate ADA provision includes plans to improve curb ramps. It sets guidelines for people with disabilities to access public accommodations and commercial facilities. Disconnected sidewalks and unpaved surfaces can prove frustrating to disabled pedestrians. Additionally, pedestrian facilities may not address the needs of those with poor vision without audible or vibro-tactile enhancements. Creating a comfortable and well-connected pedestrian network is important for "complete streets", as well as focusing on the needs of users with disabilities.

Design Summary

Complete Streets strategies will improve intersection designs to expand access for all users. Best practices include improving curb ramps, providing adequate pedestrian clearance intervals, and addressing pedestrian network gaps and sidewalk conditions, which cover many aspects of ADA requirements. Obstacles on sidewalks, such as cracks or misplaced sidewalk amenities, are a primary barrier to pedestrians with visual impairments. Accessible pedestrian signals communicate information about crossings to pedestrians with visual impairments with audible tones or vibrating systems. These accessible pedestrian signals should be placed with guidance from the Accessibility Disability Commission. Truncated domes provide a tactile signal to the visually impaired as they transition between walking paths or sidewalks and conflict areas such as intersections. Direct curb ramps (i.e., two ramps per corner) are preferred whenever possible, to direct pedestrians into a crosswalk instead of the intersection. Bus stops should be located at the far sides of intersections to encourage pedestrians to cross behind vehicles where they are more visible.

Example

Image Sources: Fehr & Peers (top), Dan Burden (bottom)

Streets and Sidewalks

Streets and sidewalks should support the activities and pedestrian levels along the street. Streets should be well-connected to ensure that destinations are within walking distance. Sidewalks should be wide enough to support the expected pedestrian volumes according to the citywide design guidelines. The minimum width for the pedestrian pathway section of a sidewalk is six feet, wide enough for two people to walk side by side. However, sidewalks of this width assume minimal pedestrian traffic. This section provides guidelines to the design of sidewalk widths that meet walking demand and provide buffer space between motor vehicle lanes and sidewalks and space for walking, sitting, and lingering. The guidelines in this section reference and build upon those set forth in the *Emeryville Design Guidelines* (City of Emeryville, December 2010) and *Park Avenue District Plan* (August 2010).

The exhibit below from the *Emeryville Design Guidelines* show the three components of the design of a sidewalk area. These zones are discussed further in the Sidewalk Zones section.

This graphic shows the sidewalk as three distinct components. Area A shows the café entry and outdoor seating. Area B shows a clear travel lane for pedestrians. Area C shows street furniture and lush trees. The result is an active and vibrant sidewalk.

Source: Emeryville Design Guidelines, City of Emeryville, December 2010

Street Connectivity

Discussion

A well-connected street network has seamless connections for pedestrians through continuous sidewalks and pedestrian crossings. A grid-like street network is easy for pedestrians to navigate and distributes traffic evenly. In such a network, frequent crossings and short block lengths result in high connectivity. Travel times and distances for pedestrians decrease with connected streets because there are more opportunities for direct paths of travel.

Design Summary

Internal street connectivity provides connections between streets within a particular area, while external connectivity provides connections to other neighborhoods. New road and pedestrian paths can increase pedestrian activity by creating better connections. If possible, cul-de-sacs should be avoided. However, if dead ends are unavoidable, there are alternatives to provide pedestrian connections.

- Pedestrian Pathways- Connects a pedestrian route to a building entrance when a direct connection is lacking.
- Cul-de-sac connectors- Pathways where streets dead-end to connect people on foot or bicycle to other streets or land uses.
- Avoid large blocks- Buildings on "superblocks" are less connected to the street. Connectivity is important along the street as well as between buildings. An intersection density of at least 150-400 intersections per square mile is recommended for pedestrian-friendly blocks and street networks.

Example

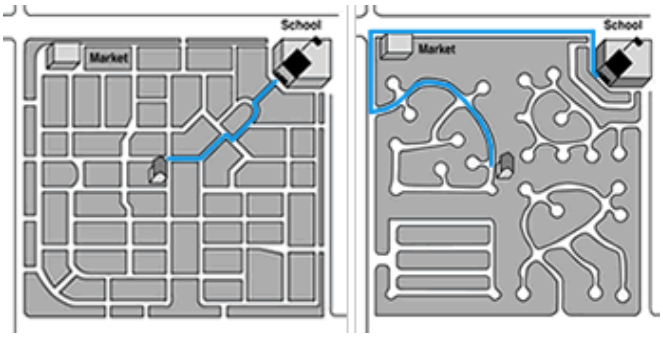


Image Source: http://www.saferoutesinfo.org

Traffic Calming

Discussion

High vehicle speeds reduce pedestrian comfort and increase injury severity in collisions. Controlling speeds is a critical element to ensure the pedestrian feels comfortable walking on a sidewalk or within a crosswalk. Traffic calming treatments are physical elements that alter the streetscape to manage vehicle speeds. As a result, driver awareness of pedestrians increases, and the improvements may have an effect on slowing speeds.

Design Summary

Speed tables/ raised crosswalk - An elevated surface above the travel lane attracts the attention of the driver and encourages lower speeds. It is useful in areas with high pedestrian activity by essentially raising the road surface over a short crossing distance.

Traffic Circles - Traffic circles are located in the middle of an intersection to slow traffic. Generally 10-20 feet in diameter, they typically have landscaping in the middle that reduces sight length down the street to slow vehicles. Traffic circles also manage speeds by forcing vehicles to drive around them.

Chokers/ Chicanes - These horizontal diversion treatments create "slow points" at mid-block locations by placing physical elements along the street to make vehicles slow down in order to maneuver around them. Chokers draw in the curb on both sides of a street to narrow the right of way, providing less space for vehicles to travel over a short distance, and facilitate a shorter pedestrian crossing. Chicanes are the same concept but the raised curb is offset to force vehicles to slightly turn, thus providing an additional speed reduction measure. It is important that they do not conflict with bicycle facilities.

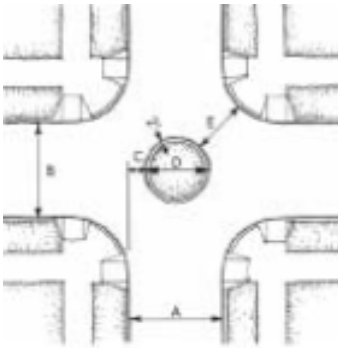
Pedestrian Bulb-outs - Extend sidewalks into the street to create shorter crossing distances for pedestrians and smaller vehicle turning radii at intersections. More detail may be found in the *Intersections Section.*

Refuge Islands - Provide a space in the middle of an intersection for pedestrian to comfortably wait until traffic clears and they can finish crossing the intersection. More detail may be found in *Intersections Section.*

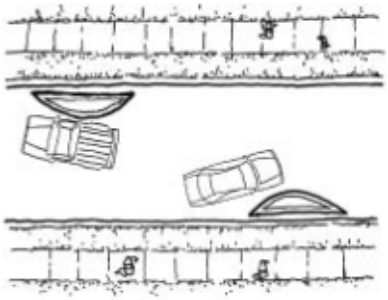
Example

Speed Table

Traffic Circle



Chicane



Source (Top and Bottom): Valley Transportation Authority Pedestrian Technical Guidelines; (middle) San Diego Street Design Manual

Sidewalk Zones

Discussion

The sidewalk zone is the portion of the street right-of-way between the curb and building front or front property line. Within this zone, there are four distinct areas that serve different organizational purposes.

Design Summary

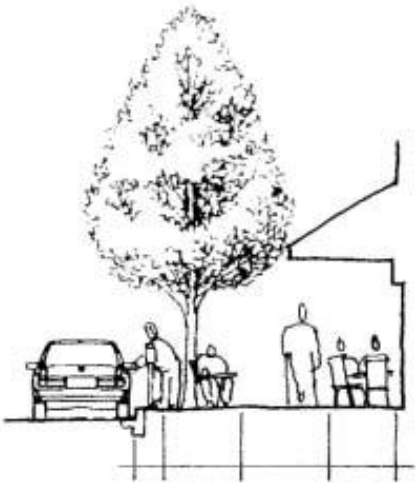
The *Emeryville Design Guidelines* note that at a minimum the sidewalks in the residential neighborhoods should include a six foot wide pedestrian pathway and a three foot landscaped buffer while other streets throughout Emeryville should include a seven and a half foot wide pedestrian pathway and a four foot landscaped buffer. These designs are a minimum for design in Emeryville, and ideally sidewalks should be 16 to 18 feet wide, and can include wider landscaped buffers, a seven and a half to 11 foot wide pedestrian pathway, and / or vegetative strips along the building face. The *Emeryville Design Guidelines* also specify minimum dimensions for sidewalks in various city districts.

- Building Entry / Public Space - This area borders the building façade, fence, or landscaped area. The primary purpose of this zone is to create a buffer between pedestrians walking in the throughway zone from people entering and exiting buildings. It provides opportunities for shops to place signs, planters, or chairs that do not encroach into the throughway zone.

- Pedestrian Pathway - The minimum width of this zone should be at least 6 to 7.5 feet or wider for higher volume areas, as noted in the *Emeryville Design Guidelines*.

- Landscaping / Street Furniture - This area acts as a buffer between the curb and throughway zone. This is the areas where trees should be planted and benches should be located. Any sidewalk amenities should be located within this area and should not interfere with the throughway zone. Streets with higher speeds should have larger furnishing zones. At a minimum, such as in areas with lower pedestrian activity, there should be a 6-inch wide curb. Other areas, such as business districts, should have at least an extra foot to accommodate car doors to not conflict with the sidewalk.

Example



Maintain an unobstructed pedestrian pathway and landscaping area.

Source: Valley Transportation Authority Pedestrian Technical Guidelines; Emeryville Design Guidelines, City of Emeryville, Decemebr 2010

Pedestrian Amenities

Discussion

Providing amenities for pedestrians along their route makes for a more enjoyable and comfortable walking experience, thus encouraging more walking. They are an essential element of street infrastructure which makes pedestrians a priority within the streetscape. These elements enhance the pedestrian realm by serving as functional aspects that serve the needs of walkers while enhancing the character of the street.

Design Summary

- Wayfinding & Signage - Wayfinding signage should cater to both vehicles and pedestrians, particularly in districts where there are high levels of walking activity. Signs and routes that direct pedestrians to specific destinations are key to providing adequate way finding for pedestrians. Wayfinding should be available on smart phones when possible.
- Street Furniture - Street furniture is normally placed on a sidewalk in the Frontage Zone to provide additional comfort for pedestrians and enhance place making within the pedestrian realm. Street furniture can include benches, specially designed newspaper racks, fountains, special garbage/recycling containers, etc. It is important that they do not conflict with the pedestrian travel path.
- Street Trees - *The Emeryville Design Guidelines* addresses the design and incorporation of street trees and stormwater management into transportation infrastructure through the treatment of runoff within different design scenarios. Some examples include vegetated swales, planters, rain gardens, pervious paving, stormwater curb extensions and curb cuts, and green gutters. Street trees are an important aspect to the pedestrian realm as they increase the comfort for pedestrians, providing shade and a buffer from vehicles, ultimately enhancing the streetscape. The *Guidelines* also note that trees should be placed an average of 25 feet apart to provide a continuous street canopy.
- Lighting - Pedestrian scale lighting provides a better-lit environment for pedestrians while improving visibility for motorists. Sidewalks with frequent nighttime pedestrian activity should have pedestrian lighting. Pedestrians tend to observe more details of the street environment since they travel at a slower pace than vehicles, and thus pedestrian scale lighting should have shorter light poles and shorter spacing between posts. A height of 12- 20 feet is common for pedestrian lighting. The level of lighting should reflect the location and existing or desired level of pedestrian activity.

Example

Wayfinding and Signage

High Quality Street Furniture

Pedestrian Scale Lighting

Median Island / Pedestrian Refuge – All Crossings

Discussion

Refuge islands provide a designated space in the middle of a crosswalk to allow pedestrians to wait halfway between crossings. Refuge islands are raised islands in the center of a roadway that separate opposing lanes of traffic with a cutout or ramp for an accessible pedestrian path. They reduce pedestrian exposure to motor vehicles, and allow a pedestrian to cross a roadway in two stages. Their application is most pertinent in higher traffic volume areas that have four-lane or wider streets or when crossing distances exceed 60 feet.

Design Summary

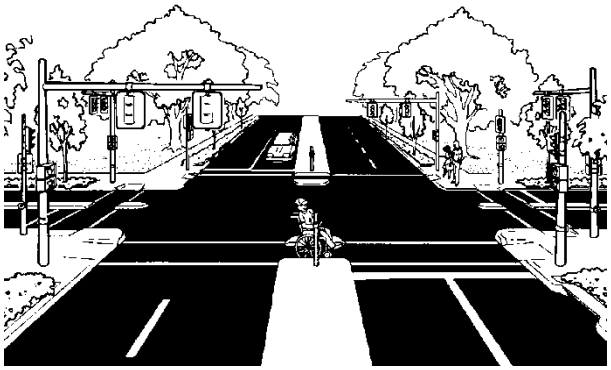
The minimum recommended width for a median island is 5-8 feet based on the average roadway speed, as shown in the table below. This minimum width accommodates bicyclists. In different contexts, the refuge island can be extended if there are higher amounts of pedestrian activity or additional travel lanes.

Recommended Median Widths	
Speed	Width
25-30 MPH	5 Feet
30-35 MPH	6 Feet
35-45 MPH	8 Feet

A special application of the median island is the two-stage crossing where the crosswalk is staggered such that a pedestrian crosses the street halfway and then is directed to walk towards the direction of traffic to reach the second half of the crosswalk. This channelization effect, typically described as a split-pedestrian cross-over, allows for the pedestrian to easily view traffic while completing the second part of the crossing.

Example

Pedestrian Refuge Island



Split Pedestrian Cross-Over

Image Sources: www.tfhrc.gov, www.flickr.com/photos/luton

High Visibility Crosswalk Striping – Level 1

Discussion

In areas with high pedestrian volumes and where land uses may generate significant pedestrian activity (at least 15 pedestrians per hour), high visibility striping is a tool that brings attention to pedestrians crossing typically at an uncontrolled or mid-block location. This highest-visibility markings include the "ladder" and the "continental." It should be used in combination with other design treatments, like refuge islands, bulb-outs, and other active device enhancements for roadways with more than 4 lanes or speeds over 40 mph. They help to direct pedestrian traffic to specific locations.

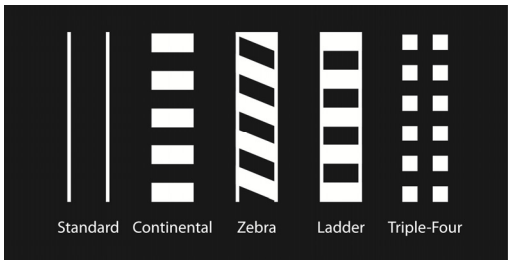
Design Summary

The use of high visibility striping is recommended at uncontrolled crossing locations, and other locations as traffic volumes, speeds, and vehicle-pedestrian conflicts require. There are several treatments for high visibility markings, including the ladder, continental, and zebra designs. Communities should choose a preferred style to use in these circumstances so it is consistently applied. Continental striping is often chosen to communicate sensitive pedestrian crossing areas as the designated high visibility tool.

The City of Sacramento, for example, developed its own standard high visibility striping treatment for uncontrolled locations called the triple-four (shown in the example illustration). The City has implemented this treatment citywide, involving three four-foot segments, two dashed lines on the outside with a clear space in the center to direct pedestrian traffic.

Example

Example Crosswalk Types



Continental Crosswalk in Emeryville

Image Sources: Fehr & Peers

Advance Yield or Stop Lines – Level 1

Discussion

Standard white stop or yield limit lines are placed in advance of marked, uncontrolled crosswalks. In California, yield lines are used, as state law requires drivers to yield, not stop, for pedestrians in crosswalks.

Design Summary

This measure increases the pedestrian's visibility to motorists, reduces the number of vehicles encroaching on the crosswalk, and improves general pedestrian conditions on multi-lane roadways. It is useful in areas where pedestrian visibility is low and in areas with aggressive drivers, as advance limit lines help prevent drivers from encroaching on the crosswalk. It also addresses the multiple-threat collision on multi-lane roads.

Example

Image Sources: Fehr & Peers

High Visibility Signage – Level 1

Discussion

This tool involves two key types of high-visibility signage:

- In-Street Signage – These involve the placement regulatory pedestrian signage in the middle of the roadway centerline, either in front or behind the crosswalk. It is MUTCD-approved and assists to remind road users of laws regarding to the right of way at unsignalized pedestrian crossings.
- Other Warning Signs - High-visibility fluorescent yellow green signs are made of the approved fluorescent yellow-green color and posted at crossings to increase the visibility of a pedestrian crossing.

Design Summary

Signs may be placed on the roadway centerline directly, as in the picture to the right, or on the side of the roadway depending of the type of signage. Careful placement is necessary to avoid maintenance issues with vehicles knocking down the sign. One option for in-street signs is to temporarily place the sign during specific time periods, such as when school is in session. Another option is to put the sign within a raised median or place in-pavement raised markers around the sign. They can be placed either at mid-block locations or intersections with significant pedestrian activity, such as near transit stations or schools.

Example

In-Street Signage

Other Warning Signage

Image Sources: Fehr & Peers

Curb Extensions, Bulb Outs, and Reduced Curb Radii – Level 2

Discussion

At uncontrolled locations, enhanced treatments beyond striping and signing may be needed for candidate marked crosswalk locations under the following conditions:

- Streets with moderate expected motorist compliance; or
- Streets with high expected motorist compliance operating poorly.

Design Summary

The following treatments are methods to enhance Level 2 uncontrolled crossing locations:

Curb Extension / Bulb Outs

Also known as curb extensions, bulb-outs increase driver awareness of pedestrians and help slow traffic. They provide a larger space for pedestrians to wait before crossing an intersection and prevent cars from parking near the crosswalk. Bulb-outs are highly beneficial in business district or transit station areas, which generate significant pedestrian activity. They may also be beneficial in school zones or neighborhood districts, which have vulnerable pedestrians, such as children or older adults who would benefit from an enhanced treatment that reduces crossing distances.

Bulb-outs involve extending the curb space into the street to create a shorter pedestrian crossing. They should not extend into the bicyclist line of travel to avoid impeding bicyclists and motorists. They may require removal of on street parking.

Landscaping within bulb-outs, as depicted at right, can further enhance the character and comfort of the pedestrian realm. Bulb-outs may also create space for pedestrian amenities or bicycle parking.

Reduced Curb Radii

Shorter radii narrow the distance that pedestrians have to cross and reduce traffic speeds. Like curb extensions, they increase driver awareness, but are less difficult and expensive to implement.

This measure would be beneficial on streets with high pedestrian activity, on-street parking, and no curb-edge transit service. It is more suitable for wider roadways and roadways with low volumes of heavy truck traffic.

Example

Curb Extension / Bulb Outs

Reduced Curb Radii

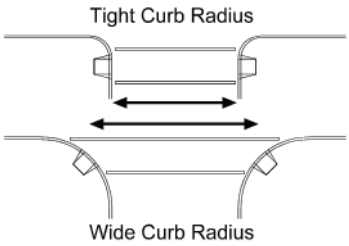


Image Source: Dan Burden (top), www.ci.austin.tx.us *(bottom)*

Enhanced Uncontrolled Crossing Treatments – Level 3+

Discussion

At uncontrolled locations, enhanced treatments beyond striping and signing may be needed for candidate marked crosswalk locations under the following conditions:

- Multi-lane streets (three or more lanes); or
- Two-lane streets with average daily traffic volumes (ADT) greater than 12,000; or
- Posted speed limit exceeding 30 miles per hour.

Design Summary

The following treatments are methods to enhance Level 3 or higher crossings:

In-Pavement flashers – Level 3

This enhanced treatment helps to improve the visibility of pedestrians at uncontrolled crosswalks. In-pavement markers are lined on both sides of a crosswalk, often containing an amber LED strobe light. They can either be actuated by a push-button or using remote pedestrian detection. The benefits of this measure are that it provides a dynamic visual cue, and is effective in bad weather.

The best application for this measure is in locations with low bicycle ridership, as the raised markers present a hazard to bicyclists. First-generation in-roadway warning lights have high maintenance costs. May not be appropriate for locations with bright sunlight (e.g. east-west roads). The lights may cause confusion when pedestrians fail to activate them or if they falsely activate

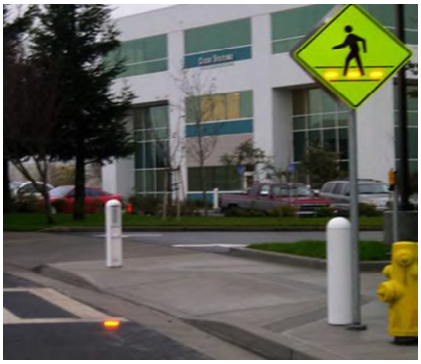
Flashing Beacons – Level 3

This treatment enhances driver visibility of pedestrians by installing flashing amber lights either overhead or on a post-mounted sign before a vehicle approaches the crosswalk or at the crossing. The benefit of this measure is that the blinking lights during pedestrian crossing times increase the number of drivers yielding for pedestrians and reduce pedestrian-vehicle conflicts. This measure can also improve conditions on multi-lane roadways.

The best application for this measure is in places where motorists cannot see a traditional sign due to trees or other barriers.

Example

In-Pavement Flashers



Overhead Flashing Beacon

Enhanced Uncontrolled Crossing Treatments – Level 3+

Rectangular Rapid Flashing Beacon (RRFB)

The RRFB, also known as a stutter flash, enhances the flashing beacon by replacing the slow flashing incandescent lamps with rapid flashing LED lamps. The lights can be activated either by a push-button or with remote pedestrian detection. This treatment is included in the 2009 Federal MUTCD, but has not yet been approved for use in California. There are also versions with LED lights placed within the pedestrian crossing sign.

Initial studies suggest the Rapid Rectangular Flashing Beacon (RRFB) is very effective as measured by increased driver yielding behavior. Solar panels reduce energy costs associated with the device. This device is appropriate for multi-lane roadways.

Rectangular Rapid Flashing Beacon

High- Intensity Activated Crosswalk (HAWK)

This enhanced signal treatment is used in circumstances where there are high vehicle speeds as well as a high demand for pedestrian crossings. It combines the beacon flasher with a traffic control signal to generate a higher driver yield rate. They are pedestrian activated and will display a yellow indication to warn vehicles, then a solid red light. While pedestrians are crossing, the driver sees a flashing red light in a "wig wag" pattern until the pedestrian clearance phase has ended, then returns to a dark signal. The HAWK is included in the 2009 Federal MUTCD, but not yet approved for use in California. This measure has been proven to reduces pedestrian-vehicle conflicts and slows traffic speeds. The most appropriate application for this device is in areas where it is difficult for pedestrians to find gaps in automobile traffic to cross safely, but where conventional signal warrants are not satisfied. This device is appropriate for multi-lane roadways.

HAWK Signal

Mid-Block Pedestrian Signal

A pedestrian signal may be use to provide the strictest right-of-way control at a pedestrian crossing. Warrants for placement are defined within the MUTCD (a new warrant is provided in the 2009 Federal MUTCD).

Mid-Block Pedestrian Signal

Image Sources: Fehr & Peers

Grade Separated Crossing

Discussion

A grade-separated pedestrian crossing provides a complete separation of pedestrians from vehicles through a pedestrian-only overpass or underpass (generally bicycles are permitted as well). Grade separations are a tool to help overcome barriers and help pedestrians connect to sidewalks, off-road trails and paths. It should be used where topography is supportive and no other pedestrian facility is available.

Design Summary

Grade separated crossings should be constructed within the most direct path of a pedestrian. They should have visual appeal and entrances that are visible so pedestrians feel safe and not isolated from others.

Because they can be costly (typically from $2M to $8M or more), it is recommended that grade separated crossings be used in instances where there are unsafe vehicle speeds and volumes or no feasible substitute for the pedestrian.

Example

Image Sources: Fehr & Peers
http://www.walkinginfo.org/library/details.cfm?id=2882
http://www.opacengineers.com/features/BerkeleyPOC

Bicycle and Pedestrian Trail Crossing

See the Appendix B for a detailed description of this treatment.

Controlled Crossing Treatments / Intersection Design

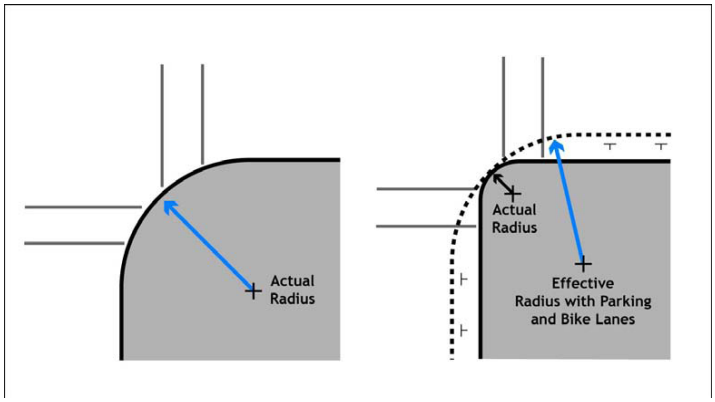
Pedestrian treatments at signalized locations throughout Emeryville may be used to:

- Improve the visibility of pedestrians to motorists and vice-versa
- Communicate to motorists and pedestrians who has the right-of-way
- Accommodate vulnerable populations such as people with disabilities, children, and seniors
- Reduce conflicts between pedestrians and vehicles
- Reduce vehicular speeds at locations with potential pedestrian conflicts

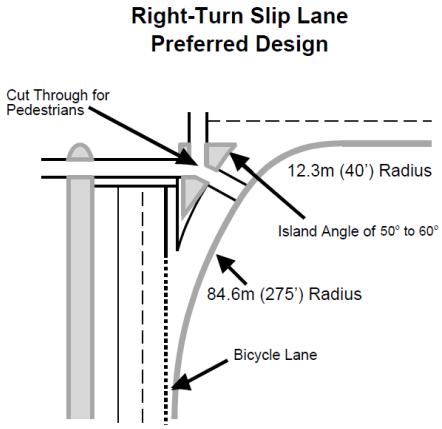
Improving Pedestrian Visibility – Shorten Crossing Distance

Intersections should be as compact as possible to minimize pedestrian crossing distances. Shorter crossing distances ultimately reduce the exposure time of pedestrians within the roadway and are easier to navigate. Consequently, compact intersections are more comfortable for pedestrians and improve visibility between motorists and pedestrians.

Reducing turning radii is one tool to foster compact intersection design and improve sight distance, in which dimensions of the curb at the intersection directly affects the speed of the approaching vehicle. A large turning radius (generally 30 feet or greater) allows vehicles to turn at high speeds. Reducing the radius forces approaching vehicles to slow down while still accommodating larger vehicles, thus reducing the frequency and severity of pedestrian collisions at intersections. As shown below, on-street parking and bicycle lanes can allow for smaller curb radii while maintaining the same effective curb radius. Note that on-street parking should be restricted in at least 30 feet in advance of the intersection, to improve visibility for pedestrians.



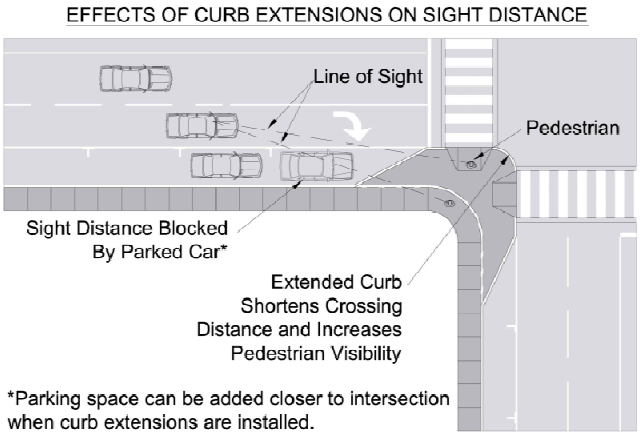
Free right turns should be restricted whenever possible as they encourage fast turning movements and present a challenging uncontrolled crossing for pedestrians. When they are necessary, design strategies can enhance the pedestrian crossing and improve visibility of bicyclists on intersecting streets (illustrated below).



Source: Fehr & Peers

Improving Pedestrian Visibility – Reducing Sight Distance Barriers

Compact intersection design can also improve pedestrian visibility by removing barriers to sight distance, including parked cars, roadway geometry, terrain, vegetation, sun glare, insufficient building setbacks, inadequate roadway lighting, poor signal visibility, signal controller cabinets/poles, and cluttered signage. Improving sight distances gives motorists a clear view of pedestrians, while allowing the pedestrian to observe and react to any hazards. Free vehicle right turns and permitted lefts are two situations that often create conflicts with pedestrians. Ensuring proper sight distances between pedestrians and vehicles can decrease the rate and severity of turning related pedestrian-vehicle collisions.



Source: Sacramento City Pedestrian Master Plan

Removing barriers to sight distance requires careful design when vehicles approach other vehicles and pedestrians. Design elements should be considered at intersections as well as mid-block crossings. Designers must particularly consider the needs of those pedestrians with special needs, including older adults, children, and people with disabilities. For example, children and people using wheelchairs have a lower eye height than standing adults.

Standard Crosswalk Striping

Discussion

Crosswalks should be marked on *all approaches* where feasible to delineate space for pedestrians to cross. While heavy vehicle volumes may present an exception, exceptions are discouraged and should only be considered when all other options to accommodate motor vehicle demand have been considered.

At intersections, crosswalks are essentially an extension of the sidewalk. If the sidewalk provides a path of travel for the pedestrian to the intersection, proper striping should continue to direct the pedestrian to the other side of the intersection.

Advanced stop bars are another standard crosswalk treatment to discourage vehicles from encroaching into the crosswalk. They may be useful at signalized intersections and stop controlled intersections with multiple lanes. A yield line should be used as a replacement at uncontrolled intersections.

Design Summary

Standard dual white lane stripes are recommended for pedestrian crossings at signalized intersections. These bars should be one foot wide and extend from curb ramp to curb ramp.

Advanced stop or yield limit lines are solid white lines extending through the traffic lane to communicate to drivers where they should stop. MUTCD requires they be placed at least 4 feet before the crosswalk, although placement at greater distances can enhance pedestrian visibility and vehicle reaction times.

Example

Standard Crosswalk at Signalized Intersection

Crosswalk with Advance Stop Bar

Sources: Fehr & Peers (above), Sacramento City Pedestrian Plan (below)

Special Paving Treatments

Discussion

Special paving treatments include adding texture to surfaces or coloring pavement to distinguish the sidewalk or crosswalk. This treatment enhances the character of the overall pedestrian environment. The rougher roadway surface may also slow vehicles and draw more attention to the pedestrian realm.

Design Summary

Types of special paving treatments typically include:

- Bricks, pavers, or colored concrete
- Stamped asphalt or concrete that is then painted to resemble bricks.
- Pavement stencils

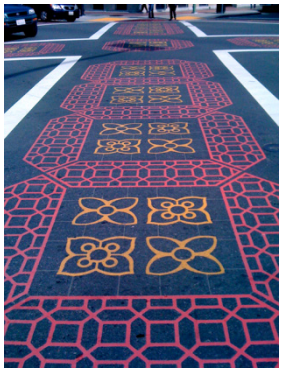
Designers must be careful to not confuse the visually impaired and cause problems for people with disabilities. Surfaces should be adapted to accommodate people using wheelchairs. A standard white stripe is recommended on either side of the crosswalk even when special paving treatments are used to enhance the contrast between the crossing and the roadway.

Example

Brick Paver Streetprint Design

Brick Pavers and Concrete

Decorative Streetprint



Sources: Fehr & Peers, http://www.visualtexture.net/page/2/

Curb Ramps

Discussion

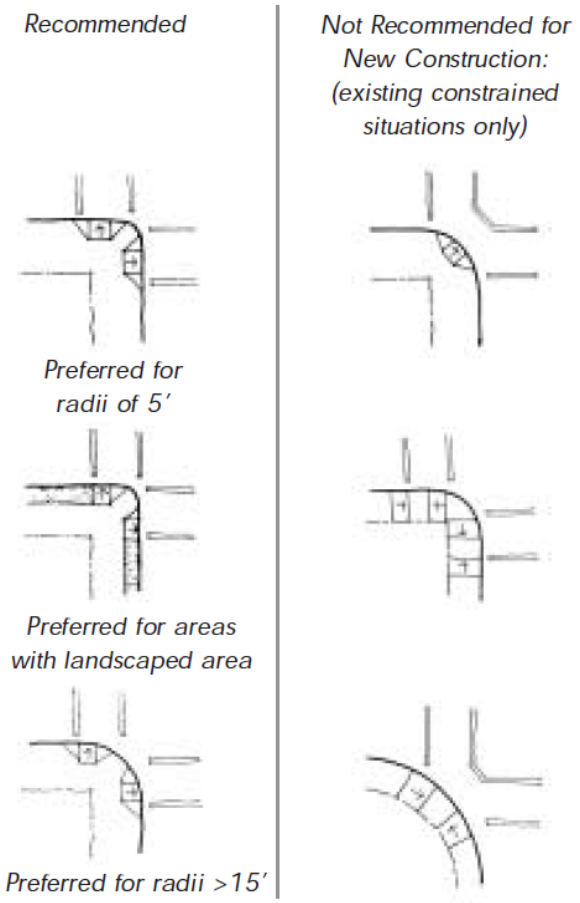
Pedestrians with mobility impairments, such as people using wheelchairs or those with canes, need curb ramps to safely access a sidewalk.

Design Summary

The appropriate curb ramp design depends on the geometry of the intersection. Recommended practices for various sidewalk conditions are shown to the right. As depicted in the illustration, directional ramps are preferred over diagonal ramps as they provide direct access to each crosswalk. Curb ramps should be ADA compliant to accommodate mobility and visually impaired pedestrians. Detectable warnings are required by the ADA Accessibility Guidelines with any new curb ramp or reconstruction. These guidelines call for raised truncated domes of 23 mm diameter and 5mm height. Curb ramps should align in the direction of the crosswalk and have enough clear space beyond the curb line so the pedestrian is not drawn right into the line of traffic.

Pedestrian bulb outs are appropriate to combine with curb ramps as described in the Uncontrolled Crossing section.

Example



Sources: Valley Transportation Authority Technical Pedestrian Guidelines, Fehr & Peers

Pedestrian Friendly Signal Treatments

Discussion

There are several innovative treatments that enhance the visibility and convenience of pedestrian crossings at traffic signals. These treatments can be applied in a variety of contexts depending on the pedestrian demand and vehicle movement within the streetscape.

Design Summary

Leading Pedestrian Intervals

An enhanced pedestrian treatment that gives pedestrians a walk indication while other approaches are red to prevent advancing. Crossing with this "head start" allows pedestrians to be more visible to motorists approaching an intersection.

- Should be used at locations with heavy right turn vehicle volumes as well as frequent pedestrian crossings.
- Vehicles are stopped for 2-4 seconds while pedestrians are allowed to begin crossing.
- May require restricting right-turn on red at some locations.

Countdown signals

Displays a "countdown" of the number of seconds remaining for the pedestrian crossing interval.

- Information about the amount of time left to cross is particularly helpful when crossing multi-lane arterials.
- Can improve pedestrian compliance while reducing the amount of pedestrians "dashing" across an intersection.

Scramble Phasing

This enhanced crossing treatment allows pedestrians to walk in all directions while all vehicle approaches have a red phase. Pedestrians may cross the street orthogonally or diagonally, providing a direct and efficient walking route.

Audible Signal

Pedestrian phases are typically difficult for those with visual impairments to recognize. MUTCD 2003, Section 4A.01 specifies that signals that communicate to pedestrians in a non-visual way can include verbal messages or vibrating surfaces.

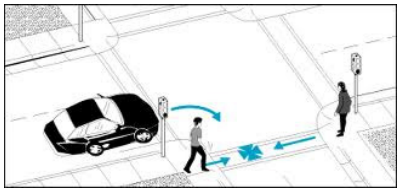
- Should be implemented on a separate pole close to the crosswalk line. If two are placed on the same corner, they should be 10 feet apart to distinguish between directions.
- Speaker on top of the signal can give bell, buzzer, speech message during walk interval or vibrate when walk signal is on. Or a personal individual receiver can communicate by infrared or LED to the signal.

Pedestrian Friendly Signal Timing

See "Pedestrian Friendly Signal Phasing" below.

Example

Leading Pedestrian Interval



Countdown Signal

Scramble Phasing

Sources: http://www.walkinginfo.org, Fehr & Peers, www.streetswiki.wikispaces.com

Pedestrian Friendly Signal Phasing

Discussion

Left- and right-turning vehicles are required to yield to pedestrians in the crosswalk. Different signal phasing sequences accommodate pedestrian crossing intervals differently:

- Protected left turns allow vehicles turning left an exclusive phase, ultimately eliminating conflicts between pedestrians in the crosswalk; left-turning vehicles will never cross at the same time as the pedestrian signal.
- Split phasing allows each intersection approach to receive a dedicated phase. Pedestrian phases for parallel crosswalks will be activated at different times. This phasing can reduce intersection capacity.
- Permitted left turn phasing, where vehicles turning must yield to through traffic and pedestrians, can reduce pedestrian delay and improve traffic operational efficiency by minimizing the impact of pedestrian timing through allowing two pedestrian crossings at once.

Other types of pedestrian signal phasing, including "scramble" phasing and leading pedestrian intervals, are described in the "Pedestrian Friendly Signal Treatments" guideline above.

Design Summary

Where pedestrian volumes are high, using permitted signal phasing is generally preferred because it reduces pedestrian delay. Providing protected left-turn phasing to eliminate pedestrian-vehicle conflicts is recommended where feasible.

At intersections with heavy vehicle traffic volumes, providing convenient and comfortable pedestrian crossings must be balanced with the need to maintain intersection capacity and operations for automobiles. In these instances, it is important to incorporate additional treatments to enhance pedestrian visibility, such as special striping or signage. If a permitted left turn phase is used, the traffic and pedestrian signal should be located next to each other on the corner pole (as depicted in the picture) to attract driver's attention.

Example

Example of a Pedestrian Signal Head Mounted on a Signal Pole

Pedestrian Friendly Signal Timing

Discussion

Signal timing typically favors vehicle travel. However, in areas with high pedestrian activity, there are methods to alter signals to better meet the needs of pedestrians. The walk interval of a pedestrian phase is, at a minimum, four to seven seconds, followed by a pedestrian clearance interval, called the "flash don't walk" (FDW) phase. The FDW phase uses a standard rate to determine the amount of time provided for the pedestrian to clear an intersection. It is determined by dividing the width of an intersection by the pedestrian walking speed. The solid "Don't Walk" sign typically coincides with the yellow vehicle signal. The pedestrian timing is an important element to traffic signals since the green time for cars might not be sufficient for pedestrians to cross an intersection.

Design Summary

The standard for walking speeds at signalized intersections has changed from 4 feet per second to 3.5 feet per second to more accurately reflect the average pedestrian walking speed and aging population. The 2009 Federal MUTCD requires this reduction, although the change has not yet been adopted in California.

A slower walking rate of 2.8 feet per second (MUTCD 4E.10(CA)) is recommended in areas with a high number of children, older adults, or disabled pedestrians crossing. Pre-timed signals may warrant a longer walk phase in order to accommodate pedestrians.

Example

Source: Dan Burden

Roundabouts

See the Appendix B for a detailed description of this treatment.

Implementation Checklists

The purpose of a Implementation Checklist is to ensure that pedestrian needs are being considered in the planning, design, and construction of all transportation projects and new land use development. Also known as "Routine Accommodation" guidelines, these checklists can be used to ensure projects foster pedestrian safety and provide access in all roadways. Routine accommodation policies are included as part of the federal surface transportation act (SAFETEA-LU). Additionally, Caltrans Deputy Directive 64 (DD64-R1) requires the accommodation of pedestrians in all projects. In June 2006, the Metropolitan Transportation Commission (MTC) adopted regional policies to accommodate pedestrians through the Resolution No. 3765, which promotes the routine accommodation of all non-motorized travelers.

Documenting how well a project meets the City's goals to accommodate pedestrians within the transportation network is a valuable process, particularly in future funding applications. The following section includes two resources to adequately consider pedestrian and bicycles as part of the project and land use planning process:

- **Design Summary for Pedestrian Accommodations:** This summary lists pedestrian-supportive treatments identified throughout this document to ensure a broad range of applications are considered within streets, sidewalks, controlled intersections/ crossings, and uncontrolled intersections/ crossings.
- **Emeryville Project Development Review Checklist for Bicycles and Pedestrians:** This checklist for bicycles and pedestrians is a sample set of questions for Emeryville to use with future transportation infrastructure and land use development projects.

Design Summary for Pedestrian Accommodations

Streets and Sidewalks

- Design "complete streets" which accommodate all pedestrians, paying special attention to vulnerable populations such as children, older adults, and the disabled.
- Ensure a continuous network of sidewalks with appropriate widths depending on the pedestrian demand and surrounding land uses.
- Provide pedestrian amenities, including street trees, furniture, and pedestrian-scale lighting within the sidewalk where appropriate.
- Develop a connected and fine-grained street network, providing pedestrian paths where possible.
- Install traffic calming treatments where pedestrian activity is high but vehicle volumes and/or travel speeds are also high.
- Install curb ramps with truncated domes to facilitate a transition from street to sidewalk.
- Place buildings adjacent to the street when possible, avoiding placing large parking lots in front of buildings.

Uncontrolled Intersections

- Incorporate high visibility striping to enhance pedestrian crossings

- Install median islands where feasible, especially where there are long pedestrian crossings
- Installing innovative crossing treatments and special paving techniques in areas with high pedestrian demand
- Install in-street pedestrian crossing signs nears schools and senior center
- Build grade separated crossings where there are no feasible alternatives to directly cross pedestrians on the street
- Install enhanced mid-block crossings at locations where pedestrian demands are supportive

Controlled Intersections

- Design compact intersections with tight curb radii
- Reduce sight barriers
- Install advanced stop bars at intersections
- Install pedestrian friendly signal treatments to accommodate pedestrians at the appropriate level of demand (example: pedestrian scramble at high demand areas)
- Mark crosswalks with standard dual white lines or preferred standard markings at all approaches
- Install countdown signals at signalized intersections and consider slower walking speeds where applicable
- Establish clear right-of-way control for pedestrian crossings to avoid conflicts with vehicle left or free right turns
- Install bulb-outs where there is a need to decrease traffic speeds and create more sidewalk space
- Incorporate ADA-compliant practices at intersections routinely
- Consider installing roundabouts at strategic locations, ensuring safe pedestrian designs

Emeryville Project Development Review Checklist for Bicycles and Pedestrians

Discussion:

Recent federal, state and regional policies call for the routine consideration of bicyclists and pedestrians in the planning, design and construction of all transportation projects. These policies—known as "Routine Accommodation" guidelines—are included in the federal surface transportation act (SAFETEA-LU), Caltrans Deputy Directive 64, and MTC Resolution 3765.

This checklist was developed for project sponsors to document how the needs of bicyclists and pedestrians are being considered in the process of planning and/or designing of their project(s). For projects that do not accommodate bicyclists and pedestrians, project sponsors must document why not. Besides documenting how a project would meet a local jurisdiction's adopted goals for encouraging active, non-motorized transportation (e.g., walking and biking), the checklist can also be used to help develop funding applications for bicycle and pedestrian projects that would benefit a project.

This checklist is intended for use on projects at their earliest conception or design phase; however, some of the responses to questions in this checklist may be included in any transportation impact study prepared for a project. For projects that require substantial design work, this checklist should be completed and submitted to City staff before projects reach later design phases. City transportation engineers and planning staff, Bicycle/Pedestrian Advisory Committees (BPAC) and other relevant commissions should be responsible for reviewing the answers submitted by project sponsors.

Design Summary:

Project sponsors should provide detailed answers to the following questions. Where appropriate, answers should include or reference project plans or design documents that illustrate how a project accommodates bicycles and pedestrians.

1. What existing accommodations for bicycles and pedestrians are provided at the project site and on the adjacent streets? Please include a description of pedestrian and bicycle facilities located within 1,000 feet of the project site.

- *The response to this question should identify any crosswalks, sidewalks, bike lanes, bike routes or shared-use paths.*
- *Describe any pedestrian generating amenities or uses near the project site, including schools, recreational centers, public facilities, parks, job centers, or commercial areas.*
- *Please describe any particular pedestrian or bicycle uses or needs along the project corridor that you have observed or of which you have been informed. Please include any deficiencies, including missing sidewalks or proposed bicycle or pedestrian facilities that have not been constructed.*
- *If there are no existing pedestrian or bicycle facilities, how far from the proposed project are the closest parallel bikeways and walkways?*

2. Describe to what extend the proposed project would generate trips by non-auto modes (e.g., attract walking or bicycling customers, employees, students, visitors or others). If the project is required to prepare a transportation impact study, has the study attempted to estimate the number of new walkers or bikers to the site?

3. Is the project adjacent to any intersections within a quarter mile that have reported collisions involving bicyclists or pedestrians? If so, describe where these collisions have occurred in respect to the project site, and

Emeryville Project Development Review Checklist for Bicycles and Pedestrians

describe whether or not the project would address these locations?

4. Do any adopted City or regional plans call for the development of bicycle or pedestrian facilities on, crossing or adjacent to the proposed project? If yes, list the applicable plan(s). Is the proposed project consistent with these plans? To respond to this question, the project sponsor should reference any regional transportation plan, City plan, and any applicable special area plans.

5. Please describe the public outreach that has been conducted to date for the proposed project, and what comments have been made regarding bicycle and pedestrian accommodations.

6a. What bicycle or pedestrian accommodations are included in the proposed project design?

- *This response should clearly document how pedestrians and bicyclists would access and maneuver on the project site, even if the project site does not propose new bicycle or pedestrian facilities.*
- *Please include a proposed project site plan that identifies on-site bicycle and pedestrian circulation. The plan should identify pedestrian entrances to any structure, bicycle parking areas, pedestrian walkways in parking areas and service loading docks. If the project includes additional elements that serve bicycle commuters, such as employee locker rooms, those areas should also be shown on the site plan.*
- *If the proposed project does not incorporate both bicycle and pedestrian facilities list reasons why the project is being proposed without them.*

6b. What would be the cost of the bicycle and/or pedestrian facilities included in the project description, and what is the cost of these facilities in proportion of the total project cost? If right-of-way acquisition is required, please describe land acquisition separately. If the project does not include bicycle and pedestrian accommodations, identify if cost was a primary factor when they were removed from the project description.

7. If the project includes bicycle or pedestrian facilities, what applicable design standards or guidelines have been followed? If the project designed facilities using standards not identified in the design standards included in the City's plan (where applicable), please describe what design standards where used for these facilities.

8. Will the proposed project remove an existing bicycle or pedestrian facility or block or hinder bicycle or pedestrian movement? If yes, please describe situation in detail. Include a list of reasons why the project is being proposed as designed.

- *If the project is proposing any new driveways (i.e., curb cut), please describe how pedestrians and bicyclists will be accommodated. Discuss whether or not the driveway would result in additional conflicts between drivers and bicyclists in an existing or proposed on-street bicycle facility. If the driveway will cross an existing or proposed sidewalk or pedestrian path, describe whether or not vehicles would need to block the sidewalk in order to exit the site.*

9. How will access around the project site for bicyclists and pedestrians be maintained during project construction? Describe if the project construction will require any temporary sidewalk or lane closures.

10. What agency will be responsible for ongoing maintenance of existing and proposed bicycle and pedestrian facilities at the project site and how will this be budgeted?