



Improvement to Transit Access For Cyclists and Pedestrians

Toolkit of Non-Motorized Infrastructure Best Practices

Submitted to the San Bernardino Associated Governments

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Introduction

This toolkit of non-motorized infrastructure presents best practices is designed to improve the attractiveness of non-motorized transportation within station catchment areas. The elements presented in this toolkit seek to create environments in which bicycling and walking to transit stops and stations are convenient transportation options and where non-motorized transportation is safe and comfortable.

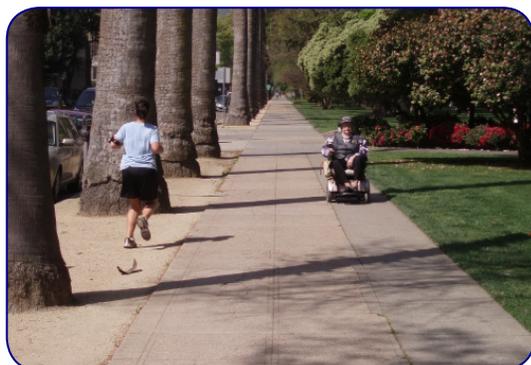
This toolkit is organized into the following chapters:

- ▶ **Chapter 1.0 Sidewalks** - Sidewalk width, street furniture, landscaping, driveways, and street lighting
- ▶ **Chapter 2.0 Intersections** - Crosswalks, curb extensions, curb ramps, median crossing islands, triangular median islands, pedestrian push button, pedestrian countdown signal, bicycle detection, intersection crossing markings, bike box, and advance stop bar / yield line
- ▶ **Chapter 3.0 Traffic Calming** - Curb radii reduction, landscaped medians, speed humps / speed tables, chicanes / chokers, speed feedback signs
- ▶ **Chapter 4.0 Bicycle Facilities** - Bicycle paths, bicycle lanes, bicycle routes, bicycle boulevards, on-street parking, wayfinding signage, bicycles on transit, roadway hazards, undercrossings / overcrossings, and bicycle signals
- ▶ **Chapter 5.0 Transit Stops and Stations** - Shelter, seating, trip information, trash container, bicycle storage, security, and wayfinding signage

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1.0 Sidewalks

The following section presents best practices in sidewalk design and maintenance to improve access to transit stops and stations by walking.



Sidewalk Width and Clear Pathways

A continuous and well-connected sidewalk network creates a safe and more comfortable environment for pedestrians. Sidewalks should be at least four feet wide and wider in areas with high pedestrian volumes. Obstructions such as utility boxes and newspaper racks should be located outside of the path of travel to provide access for persons with disabilities. Sidewalks can be constructed from concrete or decorative pavers, such as bricks, which creates a more aesthetically pleasing streetscape. Concrete sidewalks cost approximately \$90 per linear foot to install and the cost to install sidewalks using decorative pavers varies by material.

◀ Sidewalks should be wider than four feet in areas with high pedestrian volumes.



Street Furniture

Providing street furniture on sidewalks acts as a buffer between pedestrians and vehicular traffic. Benches, water fountains, and bicycle parking racks are recommended types of street furniture because they address needs that a pedestrian may have, such as a place to rest. Street furniture should be placed outside of the walking zone as to not create a hazard to pedestrians. The cost to install street furniture varies by type and among vendors.

◀ Street furniture on sidewalks acts as a buffer between pedestrians and vehicular traffic.



Landscaping

Installing sidewalk landscaping also creates a buffer between pedestrians and vehicular traffic. Landscaping can make a streetscape more visually appealing and street trees can provide shade for people walking and gathering. Costs of sidewalk landscaping include additional water and maintenance, which can be a challenge for implementation. Drought tolerant plants can reduce maintenance costs because they require less water.

◀ Street trees can provide shade for people walking and gathering on the sidewalk.



Driveways

Improving the design and minimizing the frequency of driveways can reduce conflicts between vehicles and pedestrians. Reducing driveway width and tightening curb radii causes motorists to drive more slowly. Converting driveways to a “right-in right-out” design reduces the number of conflict points between automobiles and pedestrians. Providing a level sidewalk across driveways improves access for persons with disabilities.

◀ Driveways with a “right-in right-out” design reduce the number of conflict points between automobiles and pedestrians.



Street Lighting

Street lighting improves streetscapes by increasing security for pedestrians and increasing visibility for both bicyclists and pedestrians. Streetlights should be installed on both sides of the street and the level of lighting should be consistent throughout the segment. Providing pedestrian scale lighting creates a more aesthetically pleasing and comfortable environment to walk in. Intersections often require additional lighting to allow motorists to see pedestrians crossing.

◀ Pedestrian scale lighting creates a more comfortable walking environment.

2.0 Intersections

The following section presents best practices for intersection design to improve safety and convenience in walking and bicycling to transit stops and stations.



Crosswalks

Installing crosswalks helps pedestrians to identify ideal locations at which to cross a street. Marked crosswalks also indicate to motorists where pedestrians have right-of-way and where to yield. Crosswalks should be highly visible to both drivers and pedestrians and can be installed with basic striping or decorative pavers. The cost of striping a typical high visibility crosswalk is approximately \$600 per crosswalk. The cost of installing decorative crosswalks varies by size and materials. Crosswalks can also be supplemented with in-pavement flashing lights or freestanding beacons to increase visibility, which is particularly important for mid-block crossings.

◀ Marked crosswalks indicate to motor vehicles where pedestrians have right-of-way and where to yield.



Curb Extensions

A curb extension is a portion of the sidewalk that is extended into the parking lane at intersections. This reduces the distance that pedestrians need to walk to cross the street, makes pedestrians more visible to motor vehicles, and causes drivers to reduce speeds by narrowing the roadway. Curb extensions must be installed with curb ramps that comply with ADA standards (see following page). Curb extensions are typically constructed with concrete, but can have decorative pavers and landscaping, as well.

◀ Curb extensions can have decorative pavers and landscaping.



Curb Ramps

Curb ramps allow persons in wheelchairs, with walkers, with strollers, and with disabilities convenient access to the sidewalk from the street. The Americans with Disabilities Act (ADA) requires curb ramps to be installed at all locations where pedestrians cross. Curb ramps for each crossing approach are recommended rather than one curb cut per corner so that visually impaired persons have better orientation. Warning strips should be installed on all ramps. Curb ramps cost approximately \$5,000 each to construct.

◀ Curb ramps should be installed at each crossing approach.



Pedestrian Refuge Islands

Medians are elevated barricades that divide the roadway down the center. Pedestrian refuge islands can provide a protected space for pedestrians crossing the street and allow pedestrians to focus on crossing one direction of traffic at a time. They are especially recommended for wide streets and arterials that pedestrians may have trouble crossing before the end of the signal phase. The cost to construct a pedestrian refuge island is approximately \$20,000.

◀ Median crossing islands allow pedestrians to focus on crossing one direction of traffic at a time.



Triangular Median Islands

Installing triangular or “porkchop” median islands provides increased safety and convenience for pedestrians crossing right turn slip lanes. Pedestrians can cross the slip lane and wait in the median until they have the right-of-way to cross the street. Striping crosswalks in combination with triangular median islands increases the visibility of pedestrians to motorists. The cost to construct triangular medians depends on the size of the island.

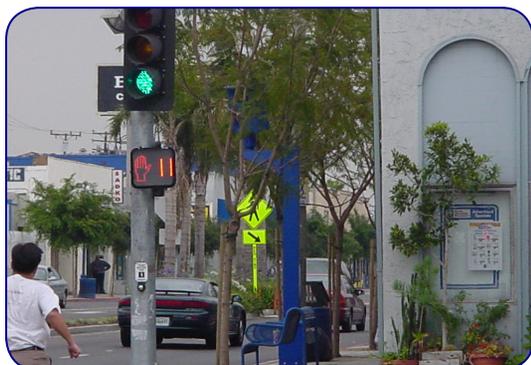
◀ Triangular median islands allow pedestrians to cross right turn slip lanes and wait in the median until they have the right-of-way to cross.



Pedestrian Push Button

Installing pedestrian push buttons at signalized intersections allows pedestrians to trigger the signal when motor vehicles are not present. Push buttons are appropriate for arterial and congested streets because they can allot more time to pedestrians only when they are present and thus reduce vehicular delay. Push buttons can be enhanced with audible messages for visually impaired persons.

◀ Pedestrian push buttons allow pedestrians to trigger the signal when motor vehicles are not present.



Pedestrian Countdown Signal

Pedestrian countdown signals display to pedestrians crossing the street when they have enough time to enter the crosswalk and how much time they have left to cross the street. Countdown signals improve pedestrian safety by helping pedestrians to finish crossing before the end of the signal phase. Countdown signals cost approximately \$10,000 to install.

◀ Pedestrian countdown signals display to pedestrians crossing the street how much time is left until the signal phase changes.



Bicycle Detection

Bicycle detection at signalized intersections allows bicyclists to trigger the signal when motor vehicles are not present. Detection can be in the form of bicycle loop detectors or video detection with higher sensitivity. Bicycle loop detectors cost approximately \$3,000 each to install. If a City already uses video detection for vehicular traffic, increasing the sensitivity may not require additional costs.

◀ Bicycle detection at signalized intersections can be managed using bicycle loop detectors.



Intersection Crossing Markings

Pavement markings through intersections help bicyclists with proper lane positioning and alert motorists to the presence and path of bicyclists. Since intersection crossing markings make bicyclist movements more predictable, they also have the potential to reduce collisions between bicyclists and motorists. The cost to stripe intersection crossing markings is approximately \$3,500 each.

◀ Intersection crossing markings help bicyclists with proper lane positioning.



Bike Box

Bike boxes allow bicyclists to position themselves in front of the traffic queue during red signals. When the signal changes to green, bicyclists can move first into the intersection and thus reduce conflicts with vehicles turning right. The cost to stripe a bike box depends on the size of the box and whether or not the box is painted a “fill color.” Striping costs approximately \$2 per linear foot.

◀ Bike boxes allow bicyclists to position themselves in front of the traffic queue during red signals.



Advance Stop Bar / Yield Line

Advance stop bars or yield lines are installed up to 50 feet prior to marked crosswalks. Striping advance stop bars and yield lines helps show motorists where they should stop in relation to the crosswalk to provide pedestrians with increased safety while crossing the street. They also make pedestrians crossing more visible to drivers. Both treatments should be installed in combination with signage to make motorists more aware of crosswalks. Advance stop bars and yield lines cost approximately \$1,000 to \$2,000 to install.

◀ Advance stop bars should be installed with accompanying signage.



Bicycle Signals

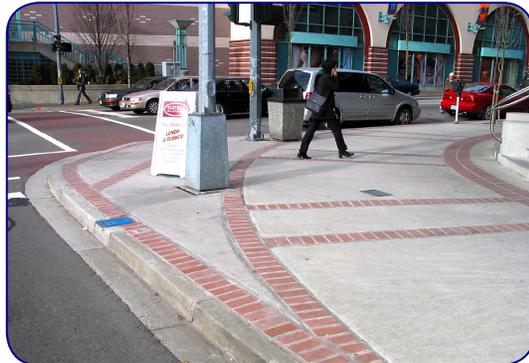
Bicycle signals can be installed where bicycle facilities with high volumes of bicyclists intersect other roadways, such as at the terminus of a bicycle path. Bicycle signals provide a bicycle only signal phase so that bicyclists can enter and exit the bicycle facility without conflicts with motorized vehicles and provide adequate timing for bicyclists to cross an intersection.

- ◀ Bicycle signals provide a bicycle only signal phase for bicyclists to enter and exit bicycle facilities without conflicts with motor vehicles.

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3.0 Traffic Calming

This section provides best practices in traffic calming treatments to create safer environments for bicyclists and pedestrians.



Curb Radii Reduction

Wide curb radii can often result in motorists traveling at high speeds when initiating turns. Reducing the curb radius at intersections causes motorists to slow down, minimizes the distance pedestrians must cross, increases the visibility of pedestrians to drivers, and reduces the risk of right hook collisions between bicyclists and vehicles. Depending on the location's conditions, reconstructing a curb radius can cost between \$5,000 to \$30,000 at each corner.

◀ Reducing the curb radius at intersections causes motorists to lower speeds when initiating a turn.



Landscaped Medians

Medians are elevated barricades that divide the roadway down the center. They have the potential to reduce speeds by narrowing the visual width of the roadway. This effect is enhanced by the addition of landscaping, such as trees and bushes, which also creates a more aesthetically pleasing streetscape. Medians should be constructed without obstructing pedestrian and bicycle access. Costs of landscaping include additional water and maintenance, which can be a challenge for implementation. Drought tolerant plants can reduce maintenance costs because they require less water.

◀ Landscaped medians lead to reduced speeds and create a more aesthetically pleasing streetscape.



Speed Humps / Speed Tables

Speed humps and speed tables are raised, paved portions of the street that extend from curb to curb and are intended to slow vehicle speeds. Speed tables have flat tops and can be used as raised crosswalks, which both slow traffic speeds, make pedestrians more visible to drivers, and remove the need to install curb ramps. Speed humps and speed tables can be constructed with asphalt, concrete, or decorative pavers. The cost to install speed humps and speed tables varies by size and material.

◀ Crosswalks can be installed on speed tables to reduce speeds and make pedestrians more visible to drivers.



Chicanes / Chokers

Chicanes and chokers are curb extensions that alternate from one side of the street to the other. These treatments can reduce vehicle speeds by visually narrowing the roadway and requiring vehicles to shift their positions horizontally. If supplemented with landscaping, chicanes and chokers can also create a more pleasant walking environment and a buffer between the sidewalk and the street. The cost to install chicanes and chokers depends on their size, the site conditions, and the decision to install landscaping.

◀ Chokers can reduce vehicle speeds by visually narrowing the roadway and requiring vehicles to shift their positions horizontally.



Speed Feedback Signs

Speed feedback signs display a driver's speed as compared to the posted speed limit on a particular segment. By showing when motorists are exceeding the posted speed limit, speed feedback signs can cause drivers to slow their speeds. A typical speed feedback sign costs approximately \$10,000 to install.

◀ Speed feedback signs display a driver's speed as compared to the posted speed limit.



Traffic Circles

Traffic circles are circular islands in the center of intersections that control the flow of traffic. Drivers that enter the traffic circle must travel in a counter clockwise direction around the island to get to the other side. Intersections with traffic circles can be signalized, stop-controlled, or yield-controlled. Traffic circles slow the flow of vehicular traffic into intersections, which creates a more safe and comfortable environment for bicyclists and pedestrians. Studies have shown traffic circles improve air quality and roadway circulation by eliminating the stop-and-start movements associated with a four-way stop. The cost to construct a traffic circle varies by size and materials. Landscaped traffic circles are generally more expensive because of maintenance costs.

◀ Traffic circles slow the flow of vehicular traffic into intersections.

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4.0 Bicycle Facilities

The following section presents best practices in bicycle facilities and treatments that enhance safe and convenient bicycle travel.



Bicycle Paths

Bicycle paths provide a completely separated right-of-way for exclusive use by bicyclists and pedestrians with cross-flow traffic minimized. Bicycle paths should provide safe and convenient connections to other existing facilities and to transit stops and stations. Wayfinding at decision points and intersecting facilities can help bicyclists and pedestrians know when to exit the paths and to navigate the network (see page 17). Bicycle paths cost approximately \$800,000 per mile to construct.

◀ Bicycle paths should have safe and convenient connections to transit stops and stations.



Bicycle Lanes

Bicycle lanes are one-way striped travel lanes for exclusive use by bicyclists on a street or highway. Bicycle lanes should be at least five feet wide and can be located adjacent to a curb or on-street parking. Bicycle lanes should be kept clear of debris and well-maintained to increase safety of bicyclists. The cost to install bicycle lanes is approximately \$40,000 per mile.

◀ Bicycle lanes can be located adjacent to a curb or on-street parking.



Bicycle Routes

Bicycle routes are low volume streets that are shared with motor vehicles. Shared lane markings and “Share the Road” signage is recommended to create a safer bicycling environment by alerting motorists to the presence of bicyclists. Shared lane markings also help bicyclists with proper lane positioning when on-street parking is present. Bicycle routes without shared lane markings cost approximately \$15,000 per mile and bicycle routes with shared lane markings cost approximately \$25,000 per mile to install. Additional signage costs approximately \$500 per sign.

◀ Shared lane markings can create a safer bicycling environment by alerting motorists to the presence of bicyclists.



Bicycle Boulevards

Bicycle boulevards are bicycle routes that are enhanced with traffic calming to increase safety for both bicyclists and pedestrians. They are typically located on neighborhood streets that are parallel to an arterial street that provides access to the same destinations. Bicycle boulevards should be well-connected for convenient travel. Bicycle boulevards cost approximately \$30,000 per mile to construct, but can cost significantly more depending on the level of traffic calming treatments applied.

◀ Bicycle boulevards are bicycle routes enhanced with traffic calming to increase safety for both bicyclists and pedestrians.



On-street Parking

Streets with bicycle facilities should be designed to enhance the comfort and safety of bicyclists. On-street parking should be in the form of parallel parking or back-in angled parking to reduce conflicts between bicyclists and motor vehicles. Typical head-in diagonal parking creates potential conflicts as it is challenging for drivers to see bicyclists when backing out of spaces. Converting parking space orientation costs approximately \$2 per linear foot.

◀ On-street parking should be in the form of parallel parking or back-in angled parking.



Wayfinding Signage

Wayfinding signage can help guide bicyclists, pedestrians, and other road users to key destinations, such as transit stops and stations, and can orient bicyclists with the bicycle network. Wayfinding signage should be placed at decision points and intersecting facilities, and should be highly visible and consistent throughout the jurisdiction. To ease navigation at night, wayfinding signage should also be appropriately reflective. The cost to install wayfinding signage is approximately \$500 per sign.

◀ Wayfinding signage can help guide both bicyclists and pedestrians to key destinations.



Bicycles on Transit

Combining bicycling and transit trips can offer a high level of mobility that is comparable to travel by automobile. In order to increase the feasibility of combining trips, transit providers should allow bicycles onboard transit vehicles. Buses often provide bicycle racks on the front of the vehicles and trains can supply bicycle storage areas in specific cars.

◀ Trains can supply bicycle storage areas in specific cars and can maximize space utilization by hanging bicycles vertically.



Roadway Hazards

When trash and debris collect on the roadway, it increases the risk of bicyclists falling and getting injured. In order to minimize hazards to bicyclists, streets should be paved and swept regularly. Sewer grates should be clearly marked so that bicyclists have time to avoid them or be installed with bicycle friendly designs that bicycle tires do not get trapped in. Utility covers should be installed outside of bicyclists' path of travel. Railroad tracks should be enhanced with treatments to allow bicyclists to cross at 90 degree angles.

◀ Sewer grates should be clearly marked so that bicyclists have time to avoid them.



Overcrossings / Undercrossings

Overcrossings and undercrossings can provide separated rights-of-way for bicyclists and pedestrians where roadway widths are constrained or there are barriers to travel, such as railroad tracks. These facilities reduce conflicts with vehicles and provide more direct paths of travel. Both types of crossings must be properly designed to encourage their use. Overpassings should be convenient so that bicyclists and pedestrians utilize them and undercrossings need to be well lit and free of graffiti to create a sense of security. Both facilities are recommended as a last resort due to the high cost of construction, which varies depending on the site conditions.

Implementing Agency: City

- ◀ Overcrossings can provide access over railroad tracks for a more direct path of travel.

5.0 Transit Stop and Station Design

The following section presents best practices in bicycle and pedestrian access to transit stops and stations, including design and circulation considerations.



Shelter

Providing a shelter at all transit stops and stations allows commuters protection from sun and from inclement weather. Shelters should be established outside of the pedestrian walking zone and with sufficient room for bus wheelchair lifts to load and unload passengers. If there is not adequate space to install a dedicated shelter, there should be awnings or overhangings on the surrounding buildings for commuters to stand beneath.

- ◀ Shelter should be provided at all transit stops and stations to protect commuters from sun and inclement weather.

Seating

Benches or seats should be provided at all transit stops and stations for commuters to rest while waiting for the bus or train. Elderly and disabled passengers often have difficulty standing for long periods. Seating should be installed within close proximity of transit stops and stations and under the provided shelter if feasible.

- ◀ Seating should be located within visual range of the transit driver and under the provided shelter.



Trip Information

At a minimum, all transit stops and stations should provide signage displaying the route number. Providing timetables and maps are recommended to increase convenience for commuters with transfers and those that are less familiar with the network, such as a bicyclist with a flat tire in an unfamiliar location. For major transit stations and terminals, providing passengers with real time information on arriving transit vehicles is a valuable customer service improvement.

◀ Transit providers should install timetables and maps at transit stops and stations.



Trash Container

Clean transit stops and stations increase the sense of security that commuters feel when waiting for a bus or train and reduce the likelihood of litter in the area. Providing ample trash containers gives riders and others a place to put their trash to keep waiting areas well-maintained.

◀ Providing trash containers creates a sense of security at transit stops and stations.



Bicycle Storage

Providing bicycle storage at transit stops and stations allows commuters to combine their trips with greater convenience. Short-term bicycle racks are appropriate for bus stops where storage space in the public right-of-way is limited. Long-term storage facilities, such as lockers or enclosed storage rooms, should be provided at train stations in addition to bicycle racks for commuters that require all-day storage. Both short- and long-term parking facilities should be located near loading zones and, when possible, in view of station attendants. Racks cost approximately \$200 per rack and lockers cost approximately \$2000-\$3000 per locker to install.

◀ Short- and long-term bicycle parking should be provided at transit stops and stations to increase convenience of combining trips.



Security

Installing lighting at transit stops and stations can increase the sense of security that commuters feel when waiting for buses and trains. Lighting should be located as close as possible to the waiting areas without blocking pedestrian access. In addition to lighting, video surveillance cameras and emergency phones can also be installed to improve security.

◀ Lighting can increase commuters' sense of security at transit stops and stations.

Wayfinding Signage

Wayfinding signage at transit stops and stations helps users navigate the area and locate amenities, such as bicycle storage areas and passenger loading zones. Providing passengers with this information improves access to transit by removing barriers of potential users.

◀ Wayfinding signage at transit stops and stations can help users locate bicycle storage areas and loading zones.