



## CHAPTER 5

# MULTIMODAL STREETS

Streets are our largest urbanized public open spaces and provide the framework upon which cities are built. Historically, they have served many functions for many users, providing mobility as well as creating spaces in which people meet and interact. As automobiles became more abundant, however, the design of streets shifted to emphasize the movement of cars at high rates of speed. By enabling sprawling land use patterns, the automobile became a necessity as well as an American cultural symbol, and accommodation of pedestrians, bicyclists and transit users became secondary to high “levels of service” for the automobile.

In contrast, a street that provides for all modes of transportation—including pedestrians, bicyclists and transit vehicles as well as automobiles—is known as a complete street, because it serves the needs of everyone. Complete, multimodal streets are important in Smart Growth Areas because they accommodate the variety of transportation choices necessary to support more intensive development, while minimizing the amount of land required for automobile travel and storage. Their design emphasizes balance—the appropriate allocation of often-limited public rights-of-way to share between the multiple functions and users of the street. It also emphasizes sensitivity to the context in which streets exist, so that streets support the surrounding land uses and enhance the character of the community.

## 5.1 Street Networks and Connectivity

Street connectivity refers to the directness of links and the density of connections in the network. A well-connected network has many short links, numerous intersections and minimal cul-de-sacs. As connectivity increases, travel distances decrease and route options increase, creating a more accessible and flexible system.

One way of measuring connectivity is to count the number of street intersections per square mile. Higher densities of intersections, particularly four-leg intersections, indicate a more highly connected street network. Street networks with low connectivity often have intersection densities below 100 per square mile. In contrast, a highly connected network typically has at least 200 intersections per square mile, and may have more than 300.

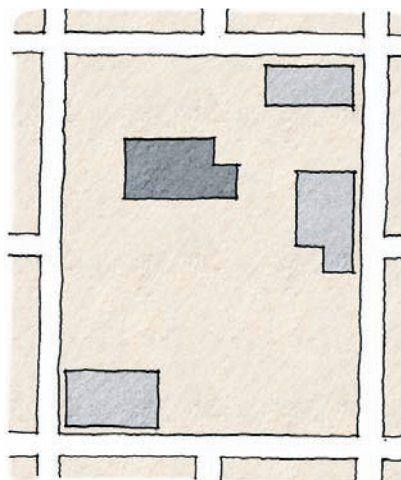


Dedicated bicycle paths increase connectivity in this San Diego neighborhood.

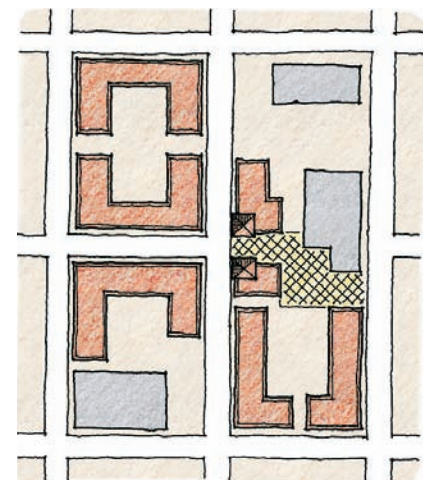
### 5.1.1 Redevelopment of Large Sites

As part of infill redevelopment of very large sites, such as former shopping malls or manufacturing businesses, developers should strive to create a highly-connected network of streets.

- ◆ Redevelop the street network to provide short street segments and walkable block sizes as much as possible. A 200- to 300-foot spacing of streets on average is optimal to support pedestrian activity; up to 400-foot spacing on average is acceptable.
- ◆ Extend surrounding streets through the project where appropriate.
- ◆ Space major thoroughfares no more than 1/4 mile from one another in dense urban areas, and 1/2 mile apart in other places, so that each thoroughfare requires fewer lanes.



In this example, plans to remove an existing building (shaded dark gray) create an opportunity to redevelop a superblock.



The redeveloped site extends surrounding streets through the site where possible and provides a pedestrian connection through the block where a street cannot be extended.

- ◆ Provide a dense network of local streets, with multiple connections to surrounding major thoroughfares.
- ◆ Where possible, use alleys rather than curb cuts to provide access to vehicle parking and loading spaces.
- ◆ At the edges of new development, include street stubs that allow connections to adjacent properties that may develop or redevelop in the future.
- ◆ Connect new streets to the surrounding street network. Where dead-end streets are necessary, provide pedestrian and bicycle connections to adjacent streets.
- ◆ Include a system of bicycle facilities, including on-street bike lanes, separated paths or shared lanes on traffic-calmed streets, with multiple parallel routes.
- ◆ Connect bicycle facilities to major destinations such as schools, retail districts and parks, as well as to existing bicycle facilities on adjacent streets.
- ◆ Provide pedestrian facilities on both sides of all streets, with connections to off-street paths where needed.
- ◆ Provide paseos and other pedestrian and bicycle connections where streets are not continuous.

### 5.1.2 Reconstruction of Existing Streets

Rebuilding an existing street creates an opportunity to redesign the street so it is more compatible with the existing context, or with the community’s vision for its future. The visual simulations in Chapter 2 show examples of how existing streets in the San Diego region could be redesigned to accommodate all modes of travel.

- ◆ When redesigning a street, consider whether traffic lanes could be narrowed for traffic calming or to gain additional width for other uses. In general, narrowing lanes may be appropriate on streets that carry fewer than 20,000 vehicles per day under future design year conditions; where intersections are closely spaced to allow for vehicle queuing; and where speeds are low.
- ◆ When redesigning a street, consider whether traffic lanes could be removed to provide adequate space for pedestrian, bicycle and transit facilities, as well as medians, center turn lanes and on-street parking. In general, removing lanes may be appropriate on four-lane undivided streets that carry fewer than 20,000 vehicles per day under future design year conditions.
- ◆ When redesigning a thoroughfare, consider whether it could be realigned to improve connectivity and accessibility to surrounding properties.
- ◆ Conduct an appropriate environmental assessment when redesigning a street. This assessment should consider impacts to the roadway, but also any beneficial effects on pedestrian and bicycle mobility, as well as modal shifts from automobile traffic to transit service.

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#### See Also

“Transformation of Existing Places”  
on page 20

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This street in Oakland, California, connects to an off-street pedestrian path that leads to a transit station.



## 5.2 Complete Streets



Multimodal streets such as this one in La Jolla are accessible to all users.



A multimodal street in San Diego accommodates pedestrians, bicyclists, motorists and public transit riders.

Complete streets follow the key principles in this section and, as a result, can be safely shared by motorists, pedestrians, bicyclists and transit.

### 5.2.1 Balancing User Needs

A network of complete streets enables safe access for all users. Pedestrians, bicyclists, motorists and transit riders of all ages and abilities can safely move along and across a network of multimodal streets. This form of street design requires that the street be compatible with its context.

In 2008, the State of California enacted AB 1358, the Complete Streets Act, which requires cities and counties to incorporate provisions for multimodal streets into their General Plan Circulation Elements starting in 2011. This legislation creates many new opportunities to plan for multimodal streets in the years to come.

- ◆ Begin the street design process with a long-range vision for the community, district or street. The vision should provide for future and existing needs.
- ◆ Create a design that supports community values and economic development, as well as safe mobility and access for all users.
- ◆ Prioritize multimodal design elements, such as bicycle lanes, wide sidewalks and transit lanes, and implement the highest-priority elements if the right-of-way is constrained. This may involve reducing the number of automobile travel lanes.
- ◆ Ensure that all streets are accessible to people with disabilities, as well as others with limited mobility.
- ◆ Consider special users, especially the elderly and children, depending on the surrounding development context.

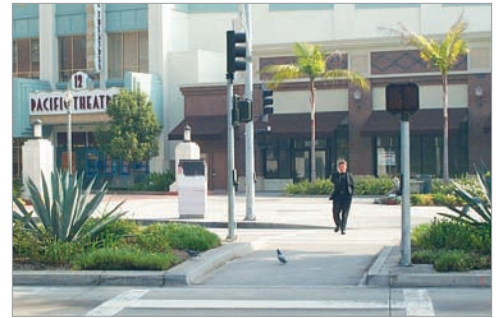
### 5.2.2 Design for Pedestrians

Pedestrians should be accommodated on all streets, even auto-oriented streets. The following guidelines explain how to design a street that meets the basic needs of pedestrians. SANDAG's *Planning and Designing for Pedestrians* provides additional details about how to create pedestrian-oriented streets.

- ◆ Provide continuous pedestrian connections within the public right-of-way, avoiding any gaps or diversions that require significant detours.
- ◆ Design all pedestrian routes to meet the requirements of the Americans with Disabilities Act (ADA).
- ◆ Provide a 6-foot to 12-foot buffer between pedestrians and moving traffic, using a combination of landscaping, street trees, on-street vehicle parking and striped bicycle lanes.

See Also  
*Planning and Designing for Pedestrians*

- ◆ Include pedestrian amenities such as street trees that provide a canopy over the sidewalk, seats where people can rest and pedestrian-scaled lighting.
- ◆ Incorporate public plazas and public art in selected locations.
- ◆ Provide safe street crossings, preferably spaced no more than 300 to 500 feet apart. A signalized intersection with a pedestrian-activated signal is one example of a safe crossing. On some streets, it may also be safe to provide a well-marked unsignalized crossing, with or without a pedestrian refuge.
- ◆ Consider providing a mid-block crossing where crossing distances exceed 600 feet. If a signalized mid-block crossing is not warranted, use a multi-stage crossing, where pedestrians must only cross one direction of travel at a time and have a safe place to wait in the center of the street.
- ◆ Minimize driveways and curb cuts, which create conflicts with pedestrians and bicyclists. Consolidate driveways for adjacent uses where possible, and remove unused driveways.



Well-marked crosswalks and pedestrian refuges in Culver City, California, encourage walking by creating a safer pedestrian environment.

### 5.2.3 Design for Bicyclists

Bicyclists prefer different types of facilities depending on their level of skill and confidence. It is important to provide a variety of facilities and routes to accommodate the spectrum of bicyclist ages, skills and needs, and to ensure that bicyclists can travel wherever they need to go. In addition, it is essential to provide a comprehensive, continuous bicycle network to encourage bicycle mobility. SANDAG’s *Regional Bicycle Plan* provides additional details about how best to design bicycle facilities.

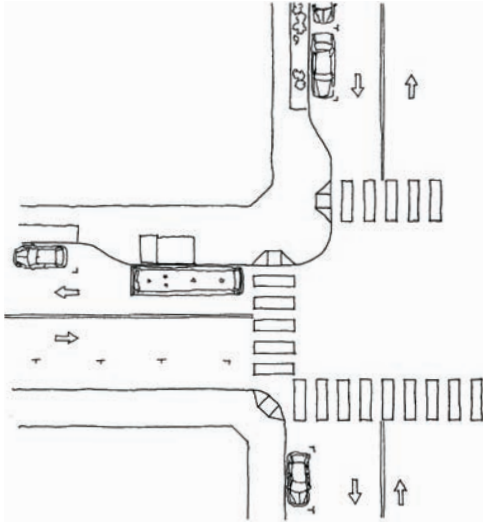
- ◆ Provide an interconnected, continuous network of bicycle facilities, including striped bike lanes, shared lanes, marked bike routes, and off-street bike paths and trails, that allows bicyclists to safely travel to any destination that can be reached by vehicle.
- ◆ Provide bicycle connections to parks and other public open spaces, as well as civic buildings.
- ◆ Designate “bicycle boulevards” on low-volume neighborhood streets as alternatives to traveling on major thoroughfares.
- ◆ Provide alternative routes that can accommodate bicyclists of varying levels of experience.
- ◆ Provide marked bike lanes on designated bike routes with high traffic volumes and speeds of at least 35 miles per hour. Ensure that bike lanes are consistent with the requirements of California’s *Highway Design Manual*.
- ◆ On lower-volume, lower-speed streets, especially where width is limited, consider providing unmarked bike routes within travel lanes that are 14 feet wide, or use shared lane markings on streets that have on-street parallel parking.
- ◆ On four-lane undivided streets with fewer than 20,000 vehicles per day, consider providing space for bicycle lanes by converting the street to three lanes, with center left-turn lanes.
- ◆ Use “back-in angled parking” on streets with angled parking to make bicyclists more visible to drivers.



A shared lane marking in San Francisco, California, denotes a travel lane shared by bicycles and cars.



Back-in angled parking in Solana Beach gives drivers a clear view of vehicle and bicycle traffic as they exit their parking space.



A bus bulbout allows buses to stop in the travel lane.

## 5.2.4 Local Bus and Bus Rapid Transit Stops

Along with convenience, travel time and cost of the transit service, the comfort, safety and attractiveness of transit stops affects mode choice. The design of stops is especially important for a Bus Rapid Transit (BRT) system, since BRT provides greater convenience for passengers as well as faster service.

- ◆ Include signs, seating, lighting, trash cans and ADA-compliant wheelchair lift areas at all bus stops. Provide bicycle parking where demand warrants.
- ◆ At high-volume bus stops, provide additional amenities such as illuminated bus shelters, system maps and schedules, wayfinding signage and bars that passengers can lean on while standing.
- ◆ Consider including public art at bus stops and using unique designs for bus shelters, benches and other street furniture.
- ◆ Provide bus bulbs that allow buses to stop in the travel lane, so they can more quickly re-enter the flow of traffic. Use the bus bulb to provide additional amenities for passengers such as benches, bus shelters and trash cans.
- ◆ At BRT stops, provide a branded, easy-to-identify stop logo and shelter design. Consider providing off-bus fare vending machines on routes with very high ridership, and on routes where it is essential to minimize the amount of time spent at each stop.
- ◆ Allow level boarding by providing low-floor buses in combination with 14-inch-high boarding platforms. A curb height of 9 to 10 inches can accommodate near-level boarding.
- ◆ Display real-time arrival information if available. The first priority should be to provide this information at BRT stops.

## Bicycle Boulevards

A bicycle boulevard is a street that emphasizes bicycle travel and provides bicyclists an alternative to streets with heavy vehicle traffic. Streets that could be designated as bicycle boulevards include residential streets that are parallel to arterial streets, as well as other low-traffic streets with high demand for bicycle facilities. Bicycle boulevards are designed to slow traffic, promote the movement of bicycles, and increase safety and convenience for bicyclists. Characteristics of bicycle boulevards include:

- Shared vehicle/bike travel lanes
- Traffic calming measures that slow traffic and discourage vehicle through traffic
- Limited traffic control along the boulevard to reduce the need for bicyclists to stop
- Distinctive directional signage
- Pavement markings to inform all users that bicyclists share the road with vehicles
- Special traffic control at major streets to help bicyclists cross, such as bicycle loop detectors in the pavement at signalized intersections



Berkeley, California, has a network of bicycle boulevards, where bicyclists and cars share the road.



- ◆ Enhance bus stop security by preserving lines of sight between the bus stop and surrounding areas. Lines of sight can be preserved by using low-trimmed landscaping and by placing the stop away from sound walls or tall fences, which create places where people can be concealed.
- ◆ Keep benches and bus shelters in good condition at all times. Remove evidence of vandalism as quickly as possible.

### 5.2.5 Bus Rapid Transit and Light Rail Lanes

BRT and Light Rail Transit (LRT), including streetcars, require a different design than local bus service. LRT and streetcars can operate in mixed traffic or in dedicated travel lanes. Because LRT and streetcar vehicles are constrained to tracks and are larger than buses, they require larger turning radii, wider clearances and longer stopping distances. They also need to be separated from motor vehicle traffic when turning at intersections.



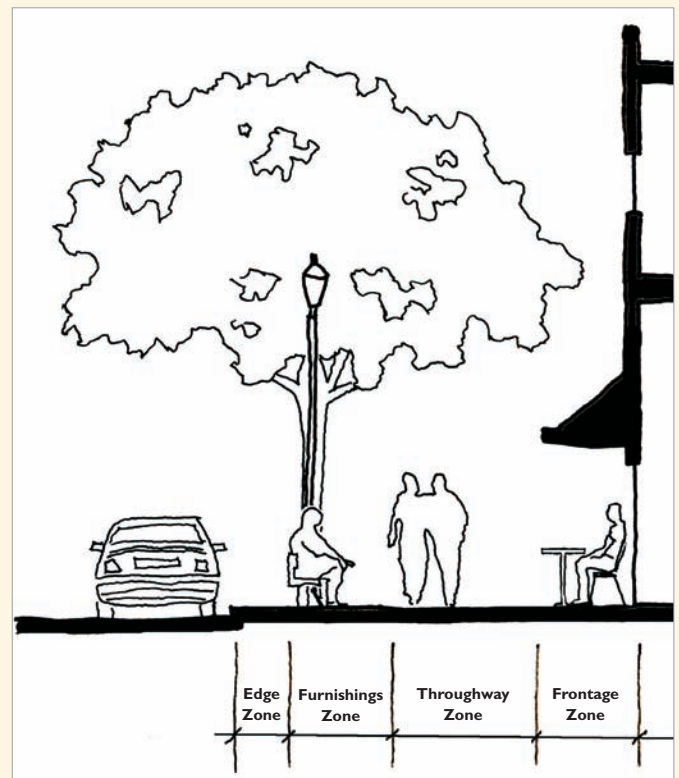
LRT lanes can be physically separated from vehicle lanes to prevent conflicts, as shown in this example from Minneapolis, Minnesota.

- ◆ Provide a minimum lane width of 11 feet for buses in mixed traffic or dedicated lanes, to accommodate the mirror-to-mirror width of modern buses.

### Pedestrian Sidewalk Zones

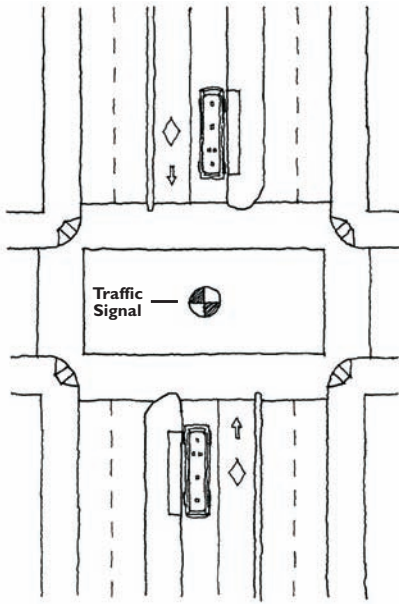
Sidewalks provide space for more than just the movement of pedestrians. They also accommodate outdoor seating and street furniture, and they connect the roadway to the sidewalk. A successful sidewalk design includes space for four distinct zones:

- **Edge Zone.** The interface between the roadway and the sidewalk. This zone provides space for car doors to swing open and for diagonally-parked cars to overhang the sidewalk.
- **Furnishings Zone.** The buffer between the walking area for pedestrians and vehicle traffic. This zone accommodates street trees, utility poles, fire hydrants, bicycle racks, parking meters, bus shelters, street furniture and similar items.
- **Throughway Zone.** The area where pedestrians travel. The preferred width for this zone is at least 6 to 8 feet. It must be entirely clear of obstacles and accessible to people with disabilities.
- **Frontage Zone.** The area adjacent to the property line. This zone provides space for pedestrians to enter and exit buildings, as well as to window-shop. It can also be occupied by outdoor displays, benches or planters.



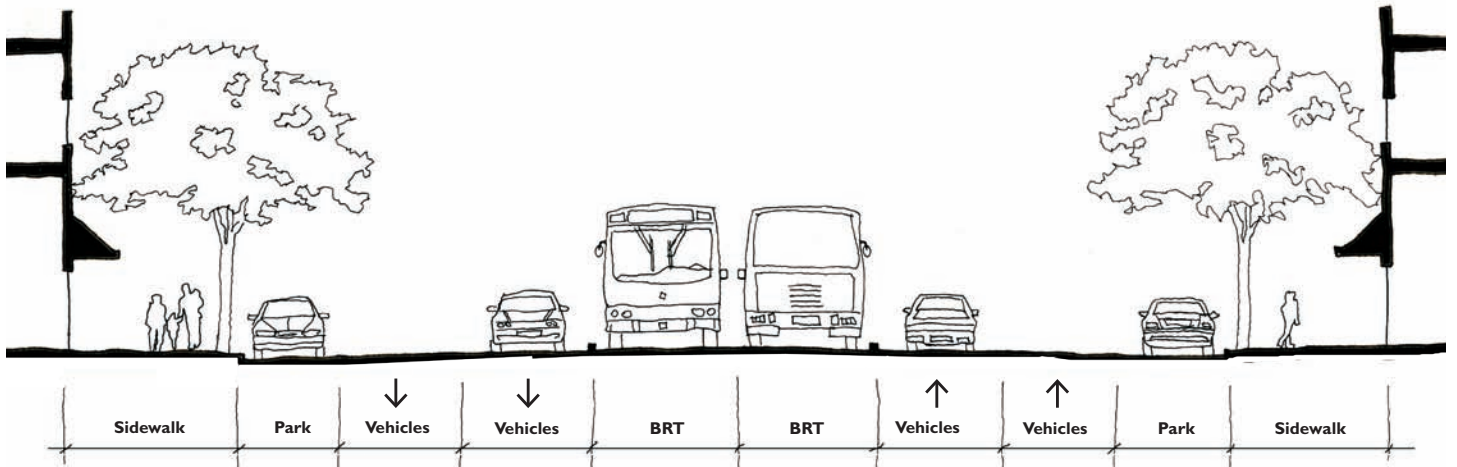
The pedestrian realm includes four distinct sidewalk zones.

SANDAG's *Planning and Designing for Pedestrians* provides more details about design solutions for each pedestrian sidewalk zone and for how the zones should be designed in different contexts.

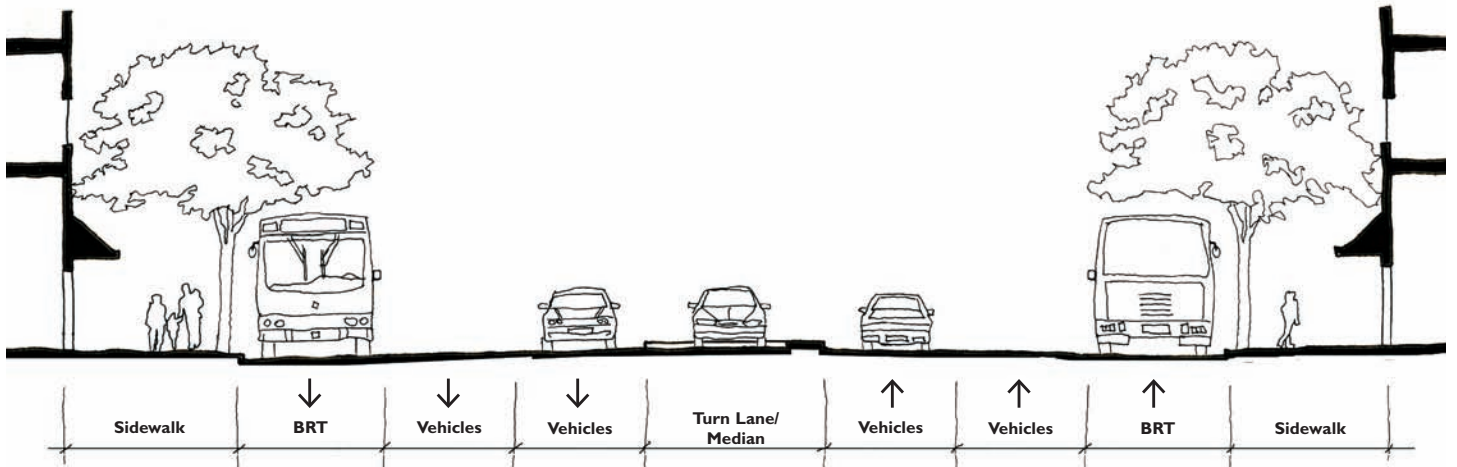


Stops for BRT and LRT vehicles can be provided in the median.

- ◆ Provide dedicated lanes on streets where at least two general traffic lanes can be maintained in each direction, where transit service runs most of the day, and where the travel time savings from dedicated lanes exceed 30 seconds per mile. General traffic lanes can be reduced to one lane in each direction if high-frequency transit service is provided, and if parallel streets provide an alternate route.
- ◆ On streets where BRT and LRT vehicles use the curb lane, consider removing on-street parking if it is determined that the parking will create operational problems for transit vehicles. If on-street parking cannot be removed, provide a 2-foot to 3-foot buffer between the curb lane and on-street parking to allow for the opening of doors on parked vehicles.
- ◆ On streets where BRT and LRT vehicles use the curb lane, allow bicyclists to share the curb lane with transit vehicles; provide bike lanes with a width of at least 5 to 7 feet; or provide bicycle facilities on a parallel route.
- ◆ On streets where BRT and LRT vehicles use median lanes, address potential issues with restricting vehicle crossings of the center lanes, as well as restricting left turns at intersections.
- ◆ On streets where BRT and LRT vehicles use median lanes, physically separate the lanes from other traffic lanes by providing raised curbs.



Median lanes provide the most efficient operation for BRT vehicles.



BRT vehicles can also operate effectively in curb lanes.



- ◆ At intersections with recurring backups, consider queue jump lanes for BRT vehicles, which provide a dedicated bus lane from the back of the recurring queue to the intersection. A queue jump lane can also be provided in a right-turn lane that is shared between through buses and right-turning traffic, but this requires special traffic signalization.

## 5.2.6 Multimodal Intersection Design

Intersections on a multimodal street must accommodate pedestrians, bicycles, cars, buses, trucks and, in some cases, trains. When street designers attempt to avoid conflicts between modes, they may inadvertently favor one mode at the expense of others. Appropriate designs manage these conflicts and integrate design features that safely accommodate all users. Table 5-1 provides a list of potential design features that help to achieve the following guidelines.

- ◆ Clearly indicate pedestrian crossings and bicycle facilities so that pedestrians and bicyclists understand how to use the street and drivers know where to focus their attention.
- ◆ Provide appropriate sight distances and lighting so that pedestrians can clearly view oncoming traffic and be seen by approaching motorists.
- ◆ At unsignalized intersections, limit pedestrian wait times to cross the street by creating gaps in traffic using signal timing at upstream intersections. This can be accomplished by modifying signal change intervals to create gaps of a few seconds—for example, through the addition of an all-red phase. Alternatively, provide two-stage crossings that include a generous pedestrian refuge in the median, so pedestrians can cross each direction of travel separately.
- ◆ At signalized intersections, limit pedestrian wait times by providing a shorter signal cycle length. Ensure that the pedestrian cycle is long enough for all pedestrians to cross the street, including people with limited mobility.



This intersection in Redwood City, California, includes highly visible crosswalks as well as bollards that protect pedestrians from turning vehicles.

Table 5-1 **Features of Multimodal Intersections**

Design Goal	Potential Features
Short and visible crosswalks	<ul style="list-style-type: none"> <li>• Crosswalks on all approaches</li> <li>• Longitudinal (“Continental” or “piano key”) crosswalk markings</li> <li>• Reduced overall street widths</li> <li>• Curb extensions with pedestrian push buttons on extensions</li> <li>• Median refuges on wide streets, with pedestrian-activated pushbuttons in the median</li> <li>• Pedestrian countdown signals</li> <li>• Signalized mid-block crossings on long blocks</li> </ul>
Accessibility for all users	<ul style="list-style-type: none"> <li>• Longer pedestrian clearance times (based on 3.5 ft/sec)</li> <li>• Audible signals</li> <li>• Two curb ramps per corner</li> <li>• ADA-compliant, pedestrian-activated pushbuttons</li> <li>• Clear pedestrian paths, clearances and access to crosswalks</li> </ul>
Bicycle features	<ul style="list-style-type: none"> <li>• Bike lanes continuous to stop line, with dashed line allowing vehicles to enter the bike lane for right turns</li> <li>• Bicycle-sensitive in-street detectors or video detection</li> <li>• Adequate length of green signal for bicyclists to cross signalized intersections</li> </ul>
Reduced conflicts between pedestrians and turning vehicles	<ul style="list-style-type: none"> <li>• Traffic signals that allow pedestrians to cross before allowing vehicles to enter the intersection</li> <li>• Traffic signals that allow pedestrians to cross in all directions (a “scramble phase”) in high pedestrian volume locations</li> <li>• Traffic signals that include protected left turns for vehicles and prohibit pedestrians from crossing during the left-turn phase (“protected left turn signal phasing”)</li> <li>• Adequate sized islands for pedestrian refuge</li> </ul>
Design elements for high-priority transit routes	<ul style="list-style-type: none"> <li>• Bus Rapid Transit signal priority</li> <li>• Queue jump lanes and associated signal phasing</li> <li>• Bus bulbs</li> </ul>
Low vehicle speeds	<ul style="list-style-type: none"> <li>• Target operating speeds of 25 to 35 mph</li> <li>• Signal progression timed for target speed</li> <li>• Small curb return radius</li> <li>• Roundabouts</li> </ul>

## Roundabout Design

Modern roundabouts are circular intersections that guide traffic in a counter-clockwise direction around a central island, with a gentle turn that slows traffic to speeds of 15 to 20 miles per hour. Roundabouts reduce the frequency and severity of collisions by slowing vehicle traffic and moving all vehicles in the same direction. As a result, they are increasingly being used to control intersections on streets ranging from local residential streets to major arterials.

Roundabouts have several design attributes that distinguish them from “traffic circles,” which are often stop- or signal-controlled:

- Vehicle entries in a roundabout are yield-controlled. Vehicles that are entering must yield to vehicles in the center of the roundabout.

- Vehicles are “deflected” with splitter islands as they enter, which also creates crosswalk refuges for pedestrians.
- Crosswalks are set back from the center of the roundabout.
- The radius of the central island is large enough to deflect circulating traffic and often has a mountable “apron” to accommodate the turning radius of large vehicles.

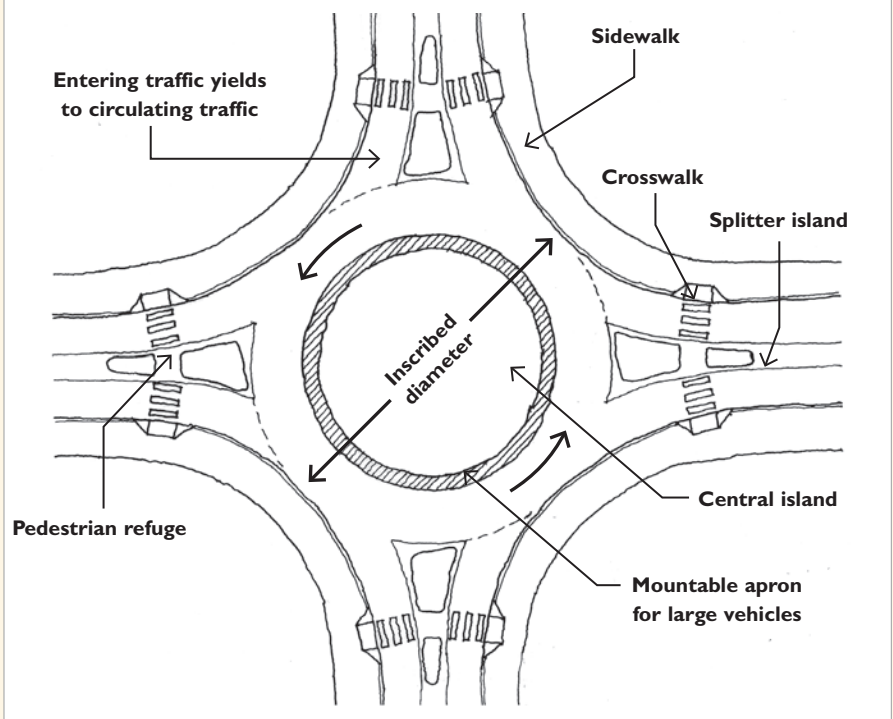
Single-lane roundabouts, such as the one shown on this page, can handle 10,000 to 20,000 entering vehicles per day. Double-lane roundabouts can be used on four-lane streets that carry more than 20,000 vehicles per day and accommodate many large vehicles. In many circumstances, roundabouts can accommodate vehicular capacities that are equal to or greater than a conventional signalized intersection.

Roundabouts may require more right-of-way than conventional four-leg intersections, especially at corners. The “inscribed diameter” of a roundabout ranges from 100 to 150 feet for single-lane roundabouts, and from 150 to 230 feet for double-lane roundabouts.

Roundabouts have both advantages and disadvantages for pedestrians. The pedestrian crossings at splitter islands result in shorter crossing distances and improve drivers’ view of pedestrians. In addition, the slower vehicle speeds in a roundabout improve pedestrian safety, and traffic can only come from one direction at any given point on the crosswalk. However, pedestrians must wait for gaps in traffic before they cross. Roundabouts also cannot provide the visual and audible guidance that is offered by signalized intersections, which is especially important for the elderly as well as people with visual impairments.

Similarly, roundabouts have both benefits and drawbacks for bicyclists. While bicyclists benefit from the roundabout’s slower vehicle speeds, they may experience conflicts with entering and exiting vehicles. Some roundabouts direct bicyclists onto a wide sidewalk where they can avoid riding within traffic.

Typical Design Characteristics of a Modern Roundabout



A modern roundabout includes several distinct features that improve operating efficiency and safety. Redrawn from FHWA, 2000, *Roundabouts: An Informational Guide*.



## 5.3 Solutions to Street Design Issues

This section explains how to address some common challenges that arise when designing multimodal streets.

See Also  
 “Transformation of Existing Places”  
 on page 20



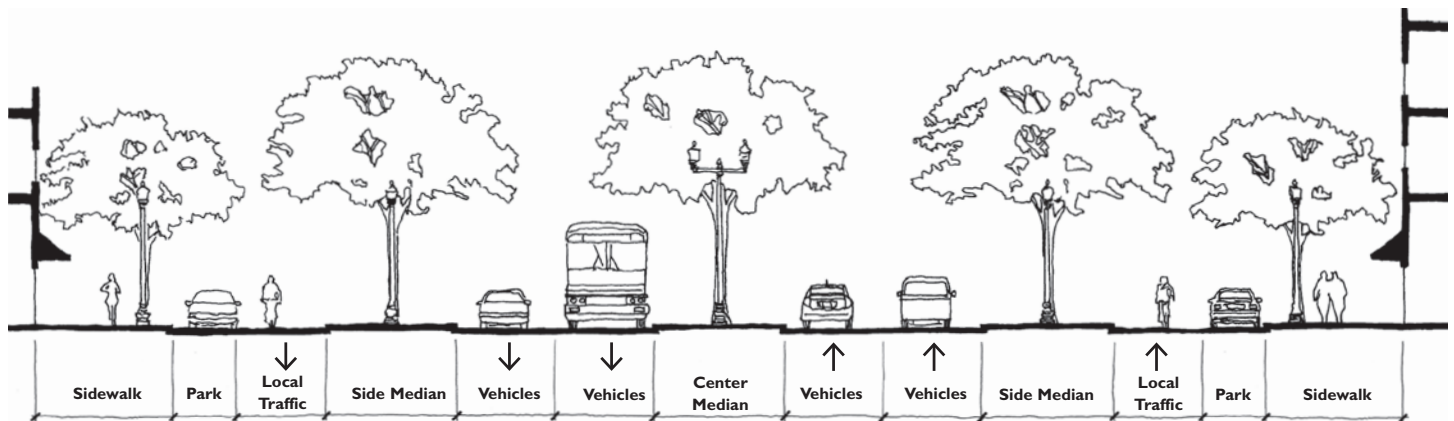
Multiway boulevards, such as this portion of Octavia Boulevard in San Francisco, California, provide room for through and local traffic, as well as space for bicyclists and pedestrians.

### 5.3.1 Multimodal Design of Wide Arterial Streets

Communities may want to provide high vehicular mobility and a pedestrian-friendly environment on the same major arterial street, or they may be faced with excessively wide streets. The solution to these challenges is the multiway boulevard, which combines a high-capacity central roadway with slower, low-volume, pedestrian-oriented access lanes on each side of the street. The central roadway accommodates through movement. The access lanes accommodate on-street parking, loading, bicycle travel and access to abutting properties, as well as wide sidewalks that are separated from the central roadway by tree-lined medians. Pedestrians cross multiway boulevards in stages, using pedestrian refuges on the medians.

Chapter 2 includes a visual simulation showing how part of Palm Avenue in Imperial Beach could be transformed into a multiway boulevard.

- ◆ Use traffic signals to control through traffic on the central roadway and major cross streets. Use stop signs to control traffic on the access lanes.
- ◆ At signalized intersections with high traffic volumes, assign vehicular right-of-way from cross streets and access lanes using separate signal phases. Alternatively, restrict vehicles and bikes to stop-controlled through movement on the access lanes, rather than allowing them to turn across the central roadway.
- ◆ Use a multiway boulevard’s central roadway for transit service, with bus stops located on the medians between the access lane and the through lanes.



A multiway boulevard provides center lanes for through traffic, as well as sidewalks and side access lanes for local traffic, pedestrians and bicyclists.

- ◆ Direct bicyclists to the local access lanes, using shared lane markers where adjacent to on-street parking.
- ◆ Design buildings adjacent to a multiway boulevard so that they front directly onto the access lanes.
- ◆ Keep access lanes narrow, and require frequent stops to discourage speeding.

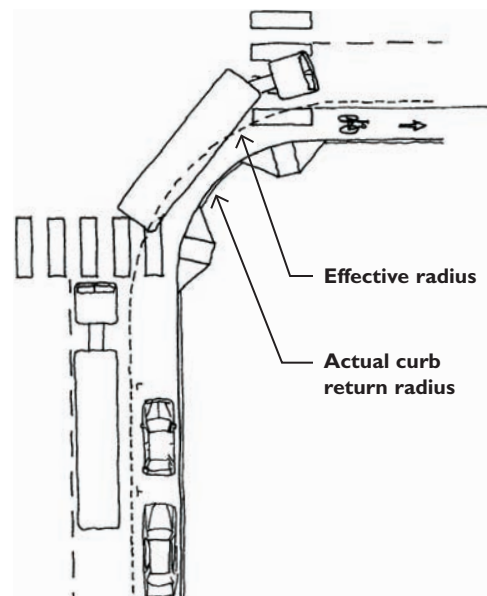
### 5.3.2 Large Vehicles and Emergency Access

Delivery trucks and emergency vehicles are critical to a community’s economic vitality and safety, and these types of vehicles must be accommodated in a multimodal street network. Some streets must also be designed for the safe operation of large buses.

In pedestrian-oriented areas, street designers must consider both a “design vehicle” and a “control vehicle.” A design vehicle must be accommodated without encroachment into opposing lanes, because it uses the street frequently. Examples include buses on routes that frequently turn a corner. Control vehicles, such as fire trucks responding to an emergency or delivery trucks that arrive once or twice a week, use the street less frequently. Streets can be designed so that control vehicles encroach into opposing travel lanes, which allows for narrower lanes and a smaller, pedestrian-friendly curb return radius.

In addition, the national fire code requires a minimum 20-foot clear distance on streets, and some local fire codes require a 24-foot clear distance. This clearance is relatively easy to provide on major thoroughfares. It can also be provided on narrow local streets through creative design.

- ◆ Consider the “effective” turning radius on streets with on-street parking and bike lanes.
- ◆ On narrow streets with small curb return radii, accommodate the turning movements of large vehicles by installing flush curbs at corners, potentially using bollards to demarcate the pedestrian waiting area and protect above-ground utility equipment.
- ◆ Set back stop lines in opposing travel lanes, so that control vehicles can safely encroach upon the lane.
- ◆ Increase street connectivity so that emergency access vehicles have alternative routes.
- ◆ Consider providing alleys to create a secondary approach to structure fires. As secondary approaches, alleys need not be designed for the largest fire vehicle.
- ◆ On narrow streets with long blocks, provide “no parking” zones that allow drivers to pull out of the way of emergency vehicles and provide space for emergency vehicles to stage their operations.
- ◆ Use computer modeling or field demonstrations to ensure that emergency vehicles can turn corners with encroachment into opposing lanes.



Street designers must consider the effective turning radius of vehicles that will use the street.

## Context Sensitive Solutions

Context Sensitive Solutions (CSS) refers to the practice of designing streets that serve all users and are compatible with the surroundings through which they pass, including the built environment as well as the natural environment. These solutions are developed within a collaborative, interdisciplinary process that involves all stakeholders starting early in planning and carried through design. The application of CSS results in a street that:

- Meets the needs of all users and stakeholders
- Fits with its setting and preserves scenic, aesthetic, historic and environmental resources
- Respects design objectives for safety, efficiency, multimodal mobility, capacity and maintenance
- Integrates community objectives and values relating to compatibility, livability, sense of place, urban design, cost and environmental impacts

The use of CSS in the design of a street considers a broad range of objectives and competing interests. It attempts to balance these objectives and interests based on the needs and conditions specific to the street and its surroundings. In essence, CSS recognizes that “one size does not fit all” and strives to develop solutions that best meet everyone’s needs.

Source: Adapted from Institute of Transportation Engineers, 2006, *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities: An ITE Proposed Recommended Practice*.

- ◆ On major thoroughfares with medians and recurring congestion, provide breaks in the median with mountable curbs, so emergency vehicles can cross into opposing travel lanes.
- ◆ Explore various street width and parking combinations to achieve the proper clearance. For example, alternating parking from one side of the street to the other, or providing space for vehicle pullouts, allows for a 28-foot-wide residential street.
- ◆ Encourage fire departments to acquire smaller, more navigable equipment designed for narrower streets.
- ◆ Identify streets with greater width requirements, such as streets adjacent to mid- and high-rise buildings and streets where fire stations are located. Require a larger clear traveled way on these streets.

### 5.3.3 Multimodal Street Design on State Highways

A number of the San Diego region’s surface streets are State highways under the jurisdiction of the California Department of Transportation (Caltrans). The design of these streets is controlled by Caltrans and is subject to the State’s design standards. During redevelopment projects, and during the planning of improvements to State highways, the community may request street design features that conflict with State standards. Caltrans’ “design exception” process provides flexibility in the application of these standards.

Some desired design features may not be acceptable to Caltrans even if the local jurisdiction regularly includes these features on their streets. However, Caltrans has a policy to integrate Context Sensitive Solutions into their transportation projects, as well as special “Main Street” guidelines for local streets that are also State highways. Caltrans will work with municipalities and the community to find mutually acceptable solutions. The following guidelines explain how to work effectively with Caltrans throughout the design process.

- ◆ Involve the State in the earliest stages of planning projects located adjacent to a state highway.
- ◆ Include Caltrans as a key stakeholder in all stages of the project, but especially when proposing any change to a State highway or connecting street.
- ◆ Work collaboratively with the State and all other stakeholders to define a vision, goals and objectives, and a purpose and need statement for the project.
- ◆ Identify potential disagreements early in the process, and resolve them quickly to avoid delaying the project in its last stages of planning.
- ◆ Understand Caltrans’ Project Development and design exception process, since these are the mechanisms through which any changes to standards will be accepted.
- ◆ Before creating street designs, discuss design flexibility with the State’s design engineers and establish the range of acceptable options.



## Alternative Transportation Performance Measures

Automobile levels of service are a useful tool for understanding vehicle flows but ignore other criteria. A full evaluation of a multimodal transportation system requires a variety of performance measures. Some examples include:

### Traffic Measures

- Corridor travel times
- Duration of congestion
- Vehicle miles traveled (VMT) or passenger miles of travel (PMT)
- Average vehicle occupancy

### Alternate Modes

- Share of travel by various modes
- Percentage of automobile trips shifted to other modes
- Pedestrian and bicycle level of service (LOS)

### Street Connectivity and Walkability

- Number of intersections per square mile
- Ratio of street segments to intersections
- Ratio of direct travel distance to actual travel distance
- Percentage of streets with sidewalks on both sides
- Percentage of major destinations within 15-minute walk

### Bike Travel

- Continuity of bicycle facilities throughout community
- Linear feet of bike lanes or multi-use paths
- Direct access to major activities/key destinations
- Number of bicycle parking facilities
- Number of intersections with enhanced treatments for bicycles such as detectors, bike lanes and bike boxes

### Public Transit

- Transit travel speed, relative to driving the same trip by car
- Number of jobs/residences within walking distance of bus stops
- Transit demand

## 5.4 Traffic Calming

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Traffic calming involves a combination of public education, enforcement and engineering measures that encourage safer speeds, alter driver behavior and improve conditions for non-motorized street users. Traditionally, traffic calming measures were restricted to low-volume residential or commercial streets, and most measures are best suited to this context. While major thoroughfares must move large amounts of traffic efficiently, there are also traffic calming measures that can manage vehicle speeds on these streets, which improves safety and comfort for pedestrians and bicyclists.

### 5.4.1 Program Design

Traffic calming involves context sensitive design practices, requiring flexibility in the application of design standards so that the program reflects community values and a balance among objectives.

- ◆ Understand the problem and its root causes. Determine if the problem is real or only perceived.
- ◆ Involve the community in the process of understanding the problem and developing a solution. Use the process as an educational opportunity.
- ◆ Develop guidelines for working with the community, evaluating potential solutions, obtaining community consensus, and monitoring effectiveness of traffic calming plans.
- ◆ Involve representatives from local jurisdictions' departments and service providers, including planning, public works, fire, police, maintenance and refuse collection.
- ◆ Plan comprehensively and develop solutions for the broader neighborhood, to avoid pushing problems from one street to another.
- ◆ Consider a variety of traffic calming solutions, rather than relying on a single measure. The most successful solutions are a combination of measures.
- ◆ Look beyond simply slowing or diverting traffic. Solutions should support multiple objectives, including enhanced street aesthetics, improved walking and cycling conditions, and controlling speeds.

## 5.4.2 Traffic Calming for Local Streets

Many different engineering solutions can be used to calm traffic on local streets. SANDAG's *Planning and Designing for Pedestrians* includes a toolkit of traffic calming measures.

- ◆ To reduce vehicle speeds, consider vertical deflections such as speed humps, speed cushions, speed tables and raised intersections; horizontal shifts, such as traffic circles, roundabouts and chicanes; and street narrowing, by providing a “choker” or a center island.
- ◆ To reduce or eliminate cut-through traffic, consider closing streets or installing diverters that create dead ends. Provide for bicycle access through traffic diverters.

## 5.4.3 Traffic Calming for Major Thoroughfares

Major thoroughfares, such as arterial streets, are intended to carry greater volumes of traffic and large vehicles on a frequent basis. They are primary emergency response routes and are intended to accommodate through traffic. While traditional traffic calming measures are not appropriate on these streets, a variety of “speed management” measures can be used so that drivers travel at the posted speed limit.

- ◆ Narrow the street physically, using medians and curb bulbouts; perceptually, using lateral lane striping and different paving treatments; or using landscaping and buildings to better define the edge condition for the street.
- ◆ Time the progression of traffic signals along an arterial to the desired speed, so that speeding vehicles will arrive at the signal before it turns green.
- ◆ Post radar feedback signs or trailers that inform motorists of their speed.
- ◆ Consider using roundabouts at intersections, which require drivers to travel at a safe speed.

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### See Also

*Planning and Designing for Pedestrians*

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Bulbouts such as this one in Oakland, California, narrow streets and provide space for pedestrian amenities.



Street trees can contribute to traffic calming by defining a strong edge for the street, as shown in this example from San Jose, California.



## 5.5 Stormwater Runoff

Streets make up about 60 to 70 percent of impervious surfaces in urban areas and have direct connections to underground stormwater systems. Runoff from impervious surfaces can overwhelm stormwater systems, causing flooding and erosion, increased sedimentation and damage to natural habitats. The pollutants in runoff can also degrade water quality. When streets are redesigned, Best Management Practices (BMPs) can be used to accommodate stormwater runoff through infiltration, retention or detention, biofiltration, or mechanical filtering, screening and de-sedimentation. These measures help to delay or prevent the movement of runoff into the storm drain system, as well as filter sediment and pollutants from runoff.

- ◆ Minimize street widths to reduce impervious surfaces.
- ◆ Where possible, use permeable planting strips, swales or permeable paving to allow infiltration of runoff from sidewalks.
- ◆ In more rural areas, direct runoff into biofilters or swales rather than underground storm drains.
- ◆ In more urban areas, design curb and gutter systems that allow stormwater to drain into swales running behind the curb, or into biofiltration units or rain gardens.
- ◆ Consider using biofiltration systems within median islands or bulbouts.
- ◆ Install commercially available traps, filters, and detention or retention devices that capture pollutants, as well as particulate matter such as dirt and leaves.



Permeable surfaces, such as this landscaped bulbout in La Jolla, reduce stormwater runoff.