

Chapter 16

Traffic Calming & Traffic Management



Traffic Calming and Traffic Management

16.1 Introduction

This chapter describes a variety of measures that can be used to lower vehicle speeds, and redirect traffic flows. *Traffic calming* measures are physical road design elements intended to reduce vehicle speeds and improve driver attentiveness. *Traffic management* measures are the application of turn restrictions and other measures to redirect or restrict traffic flows. This chapter places a greater emphasis on traffic calming measures; however, traffic management strategies are also discussed.

Traffic calming incorporates three major categories of design measures:

- Narrowing the real or apparent width of the street.
- Deflecting (introducing curvature to) the vehicle path.
- Altering the vertical profile of the vehicle path.

These measures are used to reduce operating speeds on a roadway and to increase driver attentiveness. A major objective of traffic calming is to reinforce the desired operating speed through design of the facility, thereby self-enforcing the desired speed. The goal is to:

- Reduce the number of motorists exceeding the posted speed limit;
- Reduce the speed of all motorists to the desired operating speed; and
- In some cases, to support the reduction of posted speed limits.

Desirable operating speeds, regularly requested by those affected by traffic calming measures (typically residents, business owners/operators, employees, and business patrons), range from 15 to 30 miles per hour in residential settings and 20 to 35 miles per hour in commercial or institutional settings. The selection of appropriate design speeds is discussed further in Chapter 3 and needs to be informed by existing operating speeds and applicable speed limits.

Traffic calming should reduce the operating speed of the street (i.e. the speed which most motorists intuitively choose) to the target speed. In many cases, traffic calming is also used to increase the attentiveness of drivers by signaling a change from the prevailing roadway conditions. Additional attentiveness is achieved through:

- Reduction of operating speeds;
- Increase in noticing other important users of the street, specifically, pedestrians, bicyclists and motorists using on-street parking;
- Heightened awareness of a need for safe driving behavior; and
- Elimination of inducements to aggressive and dangerous behavior (for example, reducing pavement width to stop vehicle overtaking).

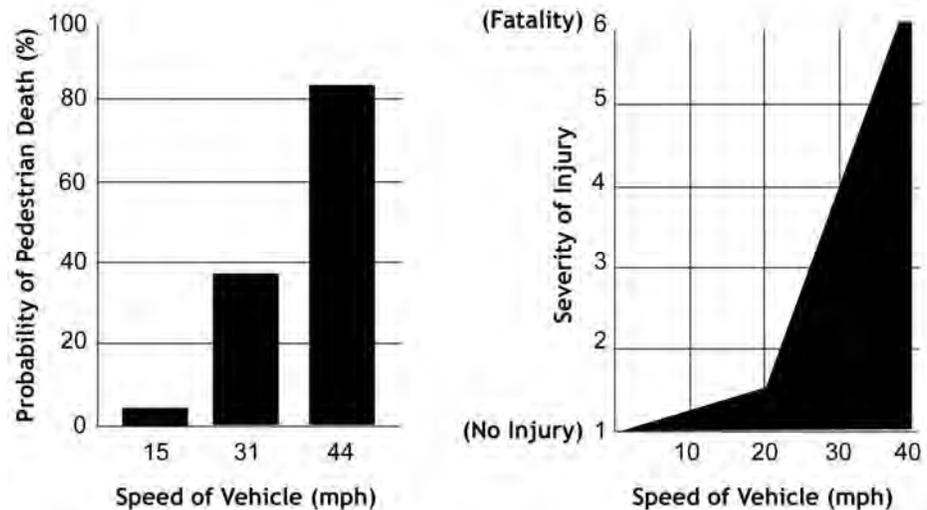
16.2 Potential Benefits and Impacts

When used in appropriate settings, the reduction in vehicle speeds obtained through traffic calming measures reduces both the frequency and severity of collisions. Further, traffic calming measures are also intended to increase driver attentiveness so that vehicles are less likely to collide. A number of studies support the correlation between reduced motor vehicle speed and reduced severity of collisions. For vehicle/pedestrian collisions, the severity of injuries increases sharply as vehicle speed increases, as illustrated in Exhibit 16-1. Traffic calming measures can improve pedestrian accommodation by:

- Reducing crosswalk distances, and the extent of pedestrian/motor vehicle conflict;
- Reducing motor vehicle speeds, their stopping distances, and the severity of pedestrian/motor vehicle conflicts;
- Increasing the attentiveness of motor vehicle drivers to the presence of pedestrians;
- Reducing the number of lanes of vehicular traffic, at least for short segments of streets;
- Increasing sidewalk space;
- Shielding sidewalks from moving motor vehicles with parked vehicles, trees, curbs, bicycle lanes and added sidewalk width; and

- Improving yielding to pedestrians due to the reduced sense of “lost” time for slowing and resuming speed when compared with higher speed environments.

Exhibit 16-1 Vehicle Speed and Pedestrian Fatality Rate



Source: Adapted from the Guide for the Planning Design and Operation of Pedestrian Facilities, AASHTO, 2004

The impact on safety for pedestrians is compounded since there are more suitable gaps for pedestrian crossings, complemented by improved yielding by drivers. The result is an increase in the ability for pedestrians to cross a traffic stream of any vehicular volume. The safety improvement is further compounded by the reduced probability and severity of injuries resulting from those collisions that do occur.

Traffic calming measures can improve bicycle accommodation by:

- Reducing motor vehicle speeds, reducing motor vehicle stopping distance, and the probability of bicycle/motor vehicle conflicts;
- Providing an opportunity to consider installation of bicycle lanes;
- Increasing the awareness of bicyclists;
- Reducing the severity of motor vehicle/bicycle collisions; and
- Reducing intersection size and the probability of motor vehicle/bicycle conflicts.

Traffic calming measures can improve motor vehicle accommodation by:

- Reducing motor vehicle speed, thus reducing the probability and severity of crashes;
- Reducing the frequency of vehicle overtaking on urban and neighborhood streets;
- Providing design features (for example, roundabouts) that self-enforce lower vehicular speeds; and
- Providing motor vehicle drivers with multiple reminders of safe and appropriate operating speed.

Although there are numerous possible benefits of traffic calming, there are several potential disadvantages that must be considered when developing a traffic calming design. Many of these potential disadvantages can be mitigated as described below.

- Traffic calming measures do not improve safety for motorists who fail to heed the indications of reduced design speed and operate a vehicle at speeds in excess of a road's design speed. Advance signage can help to inform drivers of changes in proper operating speed when approaching traffic calming areas.
- Traffic calming and traffic management measures can slow emergency response since they often require slower operating speeds or diversions. It is important to coordinate traffic calming plans with local emergency response departments so that these impacts are minimized.
- Inappropriately designed or placed traffic calming and traffic management measures can impede transit vehicles. It is important to coordinate traffic calming plans with local transit agencies to avoid these impacts.
- Inappropriately designed or placed traffic calming and traffic management measures can impede large truck traffic. It is important to understand regional and local truck routes when developing traffic calming programs to avoid these impacts.
- Some traffic calming measures (particularly those involving horizontal and vertical deflection) can result in increased noise and headlight impacts to adjacent properties. Traffic calming design needs to be sensitive to these potential impacts.

16.3 Applicability to Settings and Roadways

Traffic calming measures are usually deployed in response to community concerns about high motor vehicle operating speeds and volumes. As a result, traffic calming measures are more often applied in developed settings such as urban areas, suburban town centers and villages, suburban high density areas, and rural villages. Typical characteristics of settings associated with traffic calming are:

- Concentrated generators of pedestrian activity; for example, school campuses, elderly housing, downtown retail districts, “Main Street” shopping areas, public assembly venues (stadiums, auditoriums), recreation destinations (parks, playgrounds), health care complexes, and large employers;
- Pedestrian activity, either constant or in surges, along and across the street;
- Neighborhood streets where the street serves both as a transportation facility and a community space;
- Sensitive land uses (historical, tourist, retail, civic, institutional) abutting the street; and
- Transition zones, from higher to lower speed, e.g., when approaching a rural village.

Traffic calming is most often applied to existing streets where vehicle operating speeds are in conflict with pedestrian activity and other aspects of the setting as described above. Some traffic calming measures (such as crossing islands and curb extensions) used as retrofit measures on existing streets can also be used as regular design elements on new or rebuilt streets.

The needs of the setting must be balanced with the regional mobility function of the roadway when considering traffic calming measures, similar to many other aspects of roadway design. Traffic calming measures discussed in this chapter are most appropriate for local roads and minor collectors. Additional measures suitable for local streets (but too restrictive for other types of streets) are not discussed in this chapter, but may be found in the references listed at the end of the chapter.

Traffic calming must strike a balance between local needs and local mobility.

In some circumstances, such as in a town center environment, where both high vehicular and high pedestrian volumes are present, traffic calming measures can be suitable for use on arterials. In some cases, these elements, such as crossing islands and curb extensions, can be

incorporated directly as elements of good design for new roadways. However, intensive traffic calming programs are usually not applied to suburban and rural arterials since they primarily provide for regional travel and the settings for which traffic calming is desired are not usually found along arterials.

Traffic calming measures are not appropriate for freeways and expressways. The settings associated with traffic calming are not present along freeways and expressways. Exhibit 16-2 summarizes the applicability of various traffic calming measures to various roadway types under typical conditions. The specific measures are described in more detail in the following sections.

Exhibit 16-2
Traffic Calming and Traffic Management Applicability by Roadway Type

	Arterials	Major Collectors	Minor Collectors	Local Roads
Street Narrowing				
Narrow Lanes		Δ	■	■
Raised Curbs	■	■	■	■
Street Furniture	■	■	■	■
Street Trees	■	■	■	■
Street Lighting	■	■	■	■
Spot Narrowing	Δ	■	■	■
Medians and Crossing Islands	■	■	■	■
Curb Extensions	■	■	■	■
Road Diets	Δ	Δ	■	■
Building Siting	■	■	■	■
Horizontal Deflection				
Chicanes			■	■
Crossing Islands/Short Medians	■	■	■	■
Mid-Block Traffic Circles			Δ	■
Roundabouts	■	■	■	■
Lane Offsets		Δ	Δ	■
Profile Alterations				
Speed Humps		Δ	Δ	■
Raised Crosswalks		Δ	■	■
Raised Intersections		Δ	■	■
Textured Pavement	■	■	■	■
Traffic Management	Δ	Δ	Δ	Δ

■ Often used for new design or retrofit programs in traffic calming settings
 Δ May be suitable

16.4 Spacing and Frequency of Measures

Traffic calming measures which alter the cross section of the street (for example, on-street parking for a block or more, continuous planting of street trees) are appropriate for extended lengths. Drivers are more likely to regard such features as an inherent characteristic of the street and not as measures “aimed” at their driving practices.

On the other hand, “spot” traffic calming measures, applicable to only a small segment of street (for example, roadway narrowing or speed humps) should be spaced so that the desired operating speed is maintained along the roadway segment in question. If measures are placed more frequently and require excessive slowing and accelerating or maneuvering, they can become annoying and less effective in controlling speeds. The particular spacing of elements depends greatly upon the context in which they are used. For example, with speed humps, the driver should be cued to their spacing so that a consistent speed is maintained. Often, speed humps should be visible from one to the next along a continuous segment of roadway to encourage a flat speed profile rather than rapid acceleration and deceleration at the speed humps.

In a comprehensive traffic calming plan, continuous street-length measures (on-street parking, tree planting) are used on streets, such as the major spine of the area. On other streets within the district, a spacing of one to two traffic calming measures per block is appropriate.

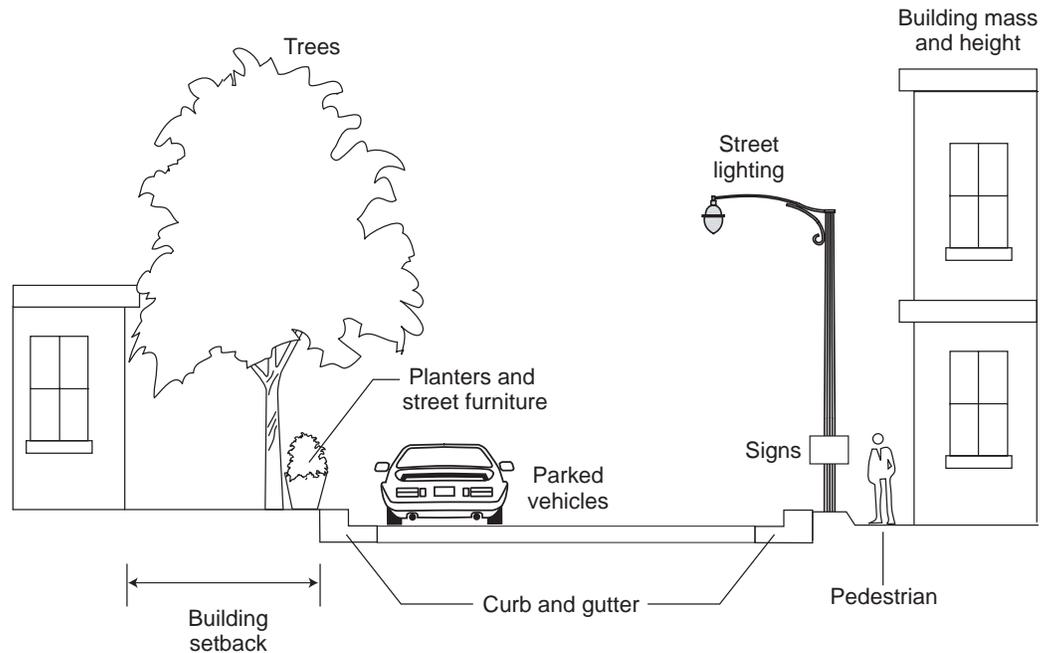
16.5 Measures to Narrow the Apparent Width

Reduction of the apparent street width can be an important traffic calming element. Elements that influence the apparent width of a street are illustrated in Exhibit 16-3, listed below, and discussed in the subsequent sections.

- Building placement along the street;
- The presence or placement of trees along the street;
- Street furniture including lights, benches, and other elements;
- Edge treatment of the pavement; and
- Pavement cross-section including on-street parking, spot narrowing, bike lanes, travel lanes, auxiliary lanes, medians, and islands.

An additional tool for narrowing the apparent width is the use of gateways, which are also described later in this section.

**Exhibit 16-3
Elements of Apparent Street Width**



Source: MassHighway

16.5.1 Building Placement

In commercial settings, the placement of buildings directly along the street (i.e., with no setbacks from the right-of-way) is a highly effective traffic calming measure. Building sites are, by definition, outside the public right-of-way. Their regulation is usually the prerogative of local government jurisdictions (city or town). Regulatory changes, by local governments, to encourage building placement adjacent to streets, particularly in commercial areas, are effective complements to traffic calming design.

Placing buildings directly on the street involves no loss in vehicular service. The quantity, but not the placement, of off-street parking can remain the same for development, although in practice the improved walking atmosphere and the availability of on-street spaces reduces the demand for off-street parking. Drive-through windows can be placed to the rear of buildings, with no loss in vehicle access. In many instances, drive-through operations function better when serviced by

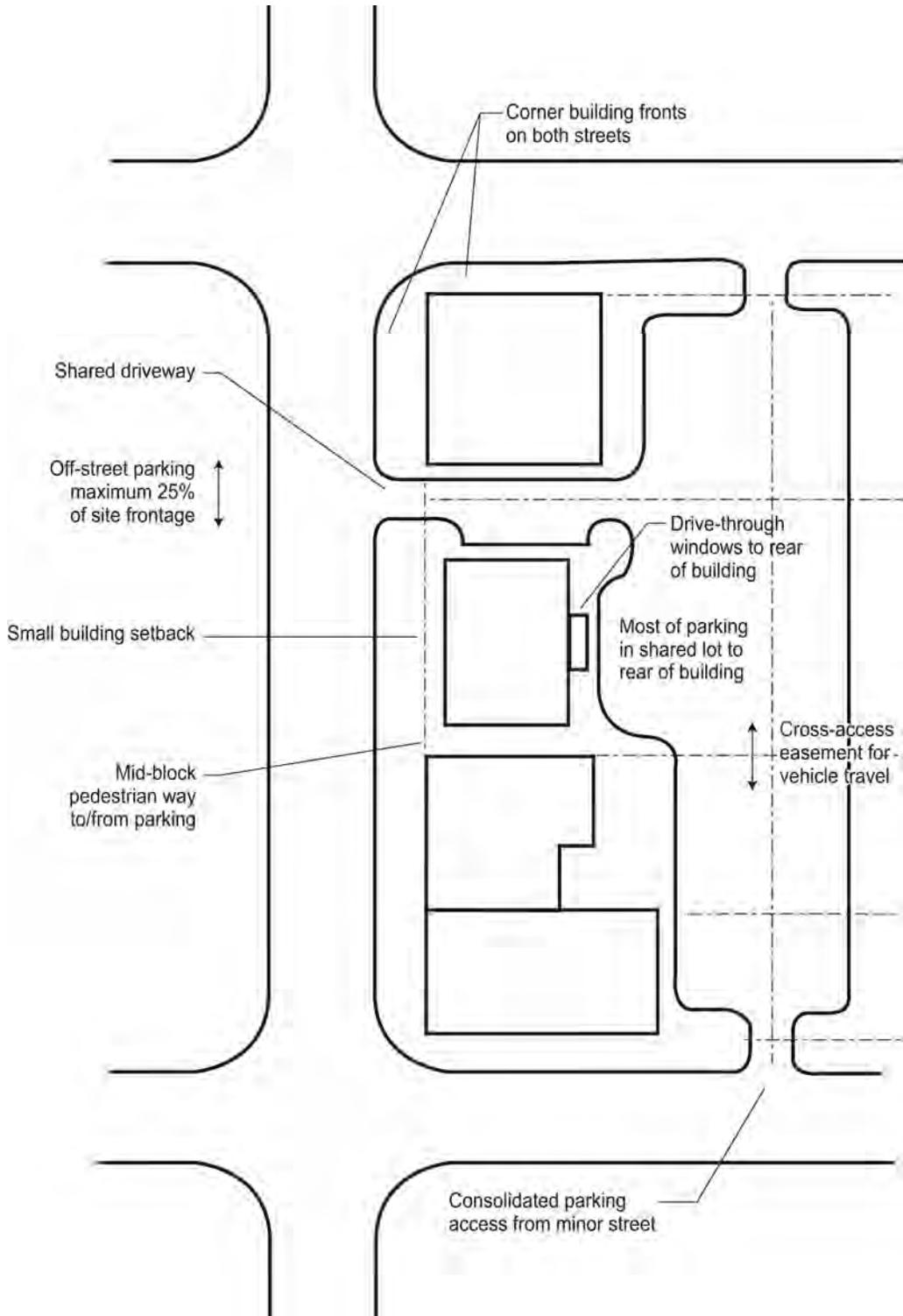
the long drive aisles of joint parking areas located behind the building, rather than in small parking areas on individual parcels.

To properly support traffic calming in commercial settings, commercial buildings should be sited along the street as shown in Exhibit 16-4. Parking lots in front of buildings (i.e., along the street frontage) should be prohibited. On corner parcels, the building should occupy the corner itself, with visible off-street parking (if any) at parcel boundaries, as far from the corner as possible.

Features of building placement that contribute to traffic calming include:

- **Sense of enclosure** – With buildings fronting the street, typical street-side building mass (two story building or equivalent) encloses the street, from the driver's eye point, to a height of about 30 degrees from horizontal. This visual enclosure is always greater than that produced by buildings of the same height, but set back from the street.
- **Urban Characteristics** – Buildings sited along the street convey a broad set of signals signifying that the area is a setting requiring lower vehicle operating speeds. Some elements associated with a town or village center environment are the detailing of the building faces, signs and symbols on the buildings, merchandise visible in the building or displayed on the sidewalk, and on-street parking.
- **Pedestrians or expectation of pedestrians** – Building placement directly along the street puts multiple possible origins and destinations along the street edge. Front doors along a street, served by on-street parking, assure some level of pedestrian travel on the sidewalk. The presence of pedestrians, or the expectation that pedestrians might be present, is an important factor in reducing vehicle speeds and heightening attentiveness of drivers.

Exhibit 16-4 Building Siting Guidelines

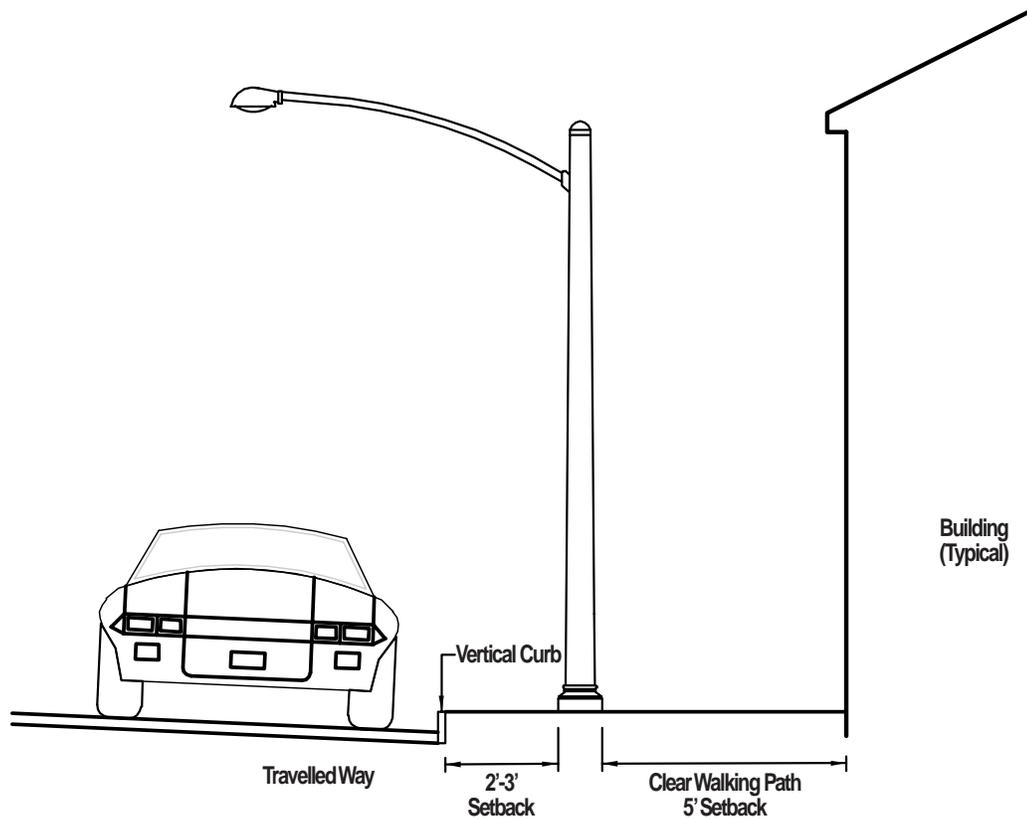


Source: Adapted from Congress for New Urbanism

16.5.2 Street Furniture

Street furniture elements include signs, signals, street lights, walls, fencing, and pedestrian furnishings such as benches, shelters and trash receptacles. In traffic calmed settings, it is desirable for street furniture to border the street and provide a separation between the pedestrian pathway and traffic. Poles and planters are normally located 2-3 feet from the back of curb, leaving room for the opening of car doors or for movement of pedestrians to/from parked automobiles, as shown in Exhibit 16-5. Benches, kiosks and shelters should allow sufficient space (6-8 feet from curb) for the comfort of their users.

Exhibit 16-5
Desirable Street Furniture Setbacks



Source: MassHighway

16.5.3 Street Lighting

Common street furniture elements are street lights, which affect the apparent width of the roadway in several ways:



Street lights in a town center setting

- By the size and placement of the street lights,
- By the height and pattern of light when illuminated, and
- Through the sense of enclosure created by overhead street lights.

A street lamp height of 12-15 feet supports a traffic calmed environment by signaling an area of special concern where pedestrians are present. Where street trees are present, the lamp height should be beneath the tree canopy, or between trees.

For the street lamp heights suggested above and desirable illumination levels, a longitudinal spacing of 50-75 feet is appropriate. Lighting fixtures should be appropriately shielded to minimize undesirable light pollution and the color emitted (white light is often preferred in developed areas) should be consistent with the setting.

In addition to possible traffic calming influences, street lights are an important feature of the urban design for a district. In many cases, municipal or district standards apply to the selection and placement of street light fixtures.

16.5.4 Street Trees

Tree trunks lining the roadside create a sense of enclosure and contribute to a reduced apparent width. The overhead tree canopy further adds to the perception of a narrowed road since the light/shade patterns on the pavement created by the trees contribute to a sense of texture on the pavement. Guidance for the planting of street trees is provided in Chapter 13.

16.5.5 Raised Curbs

Curbs are important in traffic calmed settings because they signal a lower design speed to motorists. Curbing is not normally paired with clear zones typical of rural areas and high speed environments. Further, a raised curb permits a placement of roadside objects (trees and street furniture) close enough to the travel lanes to have a pronounced traffic calming effect.

Short segments of streets with no curb within longer segments of curbed streets can also be a traffic calming measure. In such instances, the edge of the traveled way is delineated by pavement markings, change in pavement texture, or paving bands of a contrasting color and texture. The edge of the traveled way can be further delineated by bollards, planters or other street furniture. Curbless sections can also serve as “shared streets” which are designed to be fully part of the public realm and are integrated into the surrounding context. Examples of such shared streets are plazas in a town center, market places with street vending, streets regularly used for festivals, and places (e.g., in front of churches or city halls) of unusual civic interest.

16.5.6 Curbside Parking

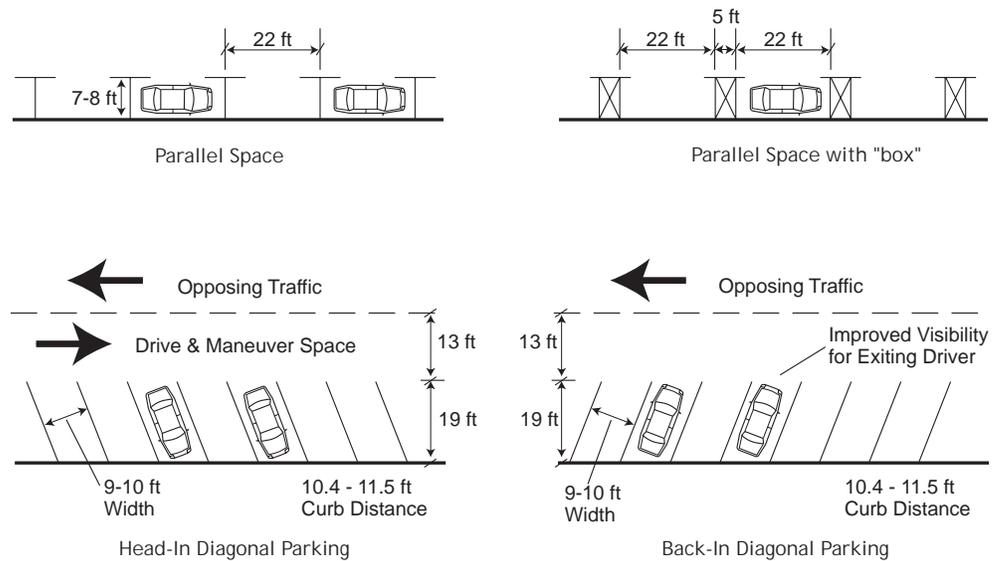
The sense of enclosure resulting from parked cars, the articulated appearance of parked cars, the entry/exit vehicular maneuvers, and the pedestrian traffic generated by occupants of parking/departing vehicles, all contribute to traffic calming on streets with parking. Curbside parking of all types should be considered in the context of bicycle use of the street since parking maneuvers and door openings are obstacles to bicyclists.

The dimensions for on-street parking, in contrast to those for moving vehicles, are not intended to change behavior, but rather are intended to make parking safe and efficient. Although spaces do not need to be striped, the typical dimensions for on-street parallel spaces are a width of 8 feet, and a length of 20-22 feet. In many locations, particularly with short sections of curb face interrupted by driveways or hydrants, the length of parking spaces can be increased without reducing the number of spaces. The selected width should also take into consideration whether bicycle lanes are present and the volume and composition of traffic on the street.

The parallel parking maneuver can be expedited and made more convenient to drivers by marking a “box” at one or both ends of the parking space, as illustrated in Exhibit 16-6. If parking is allowed, this treatment is particularly suited to roadways with higher traffic volumes. The box striping plan can help minimize the delays caused by the parking maneuver. With these boxes in place, the entering or exiting motorist has available the marked dimensions of the space (typically 22 feet, although smaller spaces are possible with this treatment) and also the length of both of the attached boxes (a total of 8-10 feet) to enter and exit the parking space.

Diagonal parking is not commonly used because of limitations in roadway width, but can be an element of traffic calming in areas with a high demand for parking and sufficient pavement width. The allocation of pavement (parking versus travel lanes) and the “friction” of parking maneuvers contribute to traffic calming.

**Exhibit 16-6
Curbside Parking**



Source: Adapted from Back-In Angle Parking in the Central Business District, John A. Nawn, 2003

“Back-in” diagonal parking, shown in Exhibit 16-6 has recently been suggested as another approach to angle parking. Parking dimensions are the same as head-in diagonal parking. However, the back-in layout permits exiting drivers to have a clear view of on-coming traffic, bicyclists, and pedestrians in the street as they exit the space. Visibility leaving the space is superior to head-in parking, where exiting drivers are likely to have their view of on-coming traffic obscured by the adjacent vehicle. An additional advantage of back-in parking is that the open doors of the parked vehicles block passenger access to the street, and instead channel passengers toward the sidewalk, a safety benefit for all users and particularly for children. Finally, back-in parking places the cargo area (trunk, hatchback, truck bed) for almost all vehicles on the curb, and not in the street adjacent to traffic lanes.

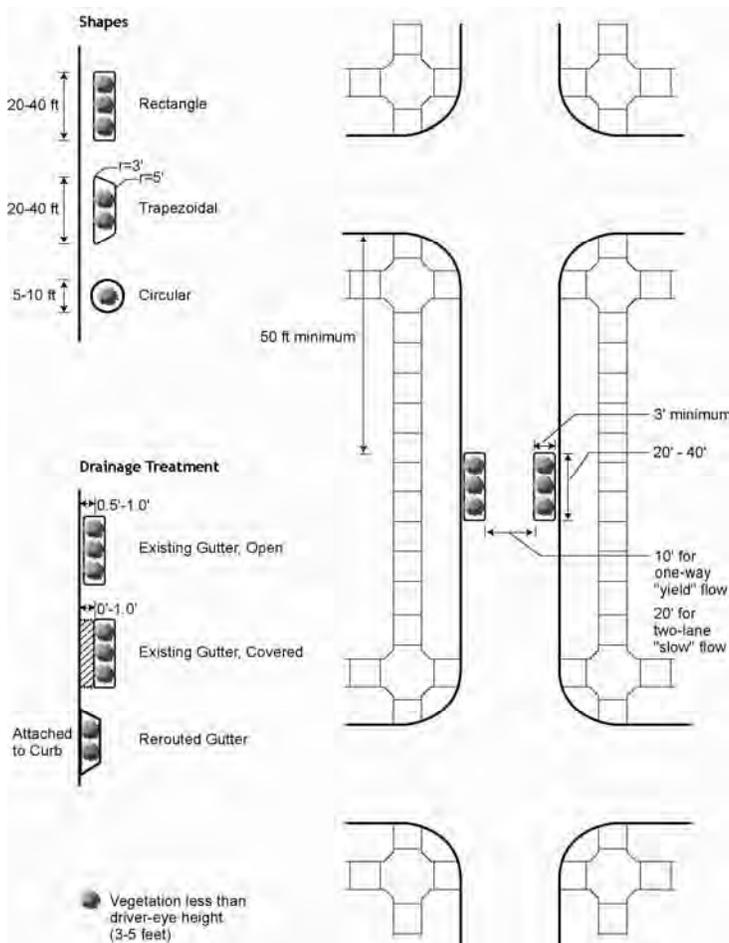
The principal drawbacks of back-in parking, when compared with head-in parking are the need for a motorist to stop in the travel lane before backing

into a space and increased potential for vehicle overhang on sidewalks. The overhang is a significant concern if the sidewalks are narrow. The provision of wheel stops can help address the overhang issues, although the rear-wheel overhang dimension varies widely across the motor vehicle fleet. Wheel stops can also pose a challenge for maintenance operations such as street sweeping and snow plowing.

16.5.7 Spot Narrowing of Pavement

Narrowing a street at mid-block locations, as illustrated in Exhibit 16-7, can capture much of the benefit of a far more extensive narrowing. Narrowing the street at mid-block locations serves to reduce the speed of vehicles not only at the narrowing itself, but also for the adjacent street segments, where motorists decelerate and return to normal running speed.

Exhibit 16-7
Mid-block Street Narrowing



16.5.8 Medians and Crossing Islands

Traversable medians, typically built of textured or contrasting materials such as stamped concrete, bricks, pavers, or cobblestones can be effective traffic calming devices particularly where periodic segments of raised median are included, as shown in Exhibit 16-8. These medians are flush with the travel lanes but are notably different, both in appearance and in feel to the driver. Traversable medians narrow the real and apparent width of the street, and provide deflection at end points, while still permitting unlimited driveway access across them. They can serve as left-turn lanes, and allow for passing of double-parked cars. Further, traversable medians offer opportunities for emergency vehicles to bypass stopped traffic. At intersections, the ends of the traversable medians can extend all the way through the crosswalk, thereby providing some pedestrian refuge.

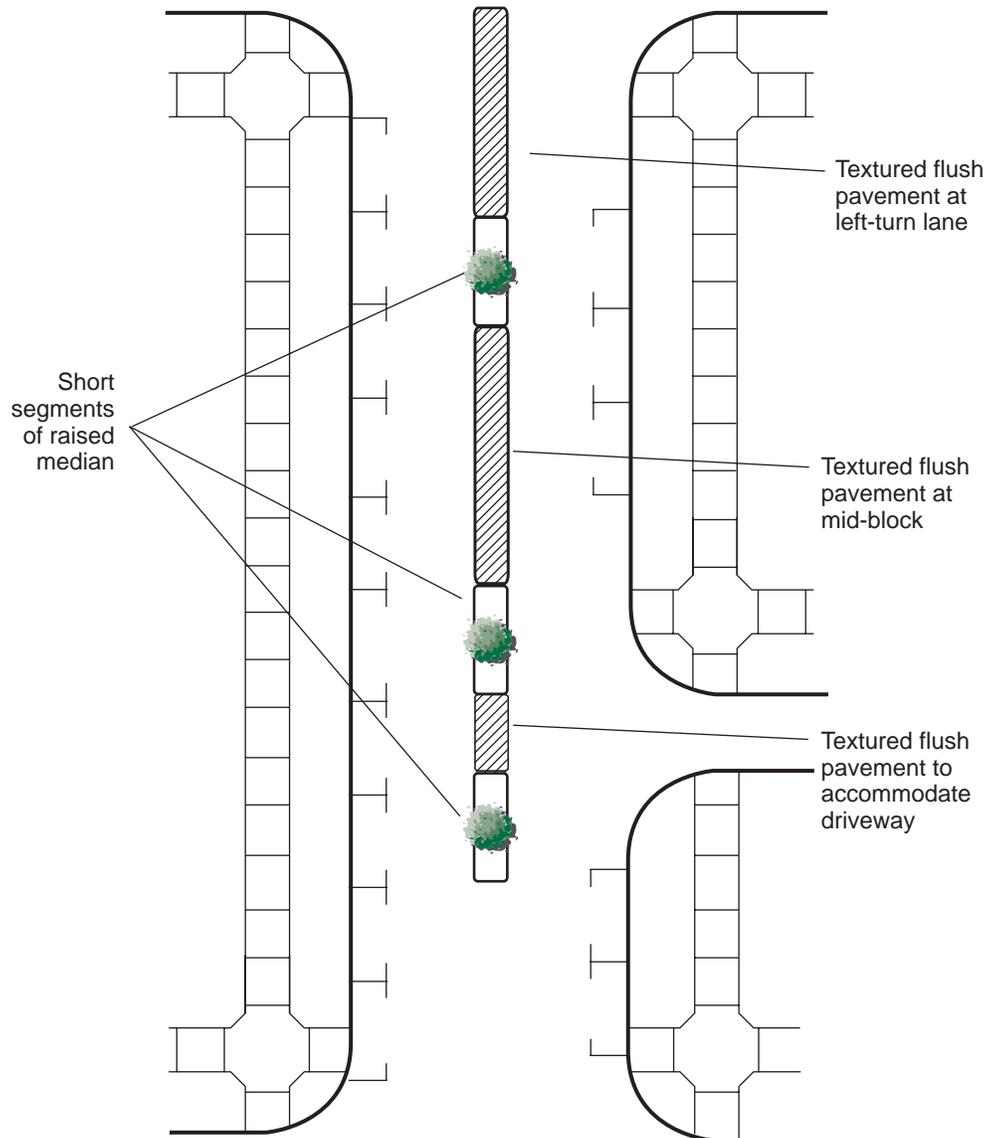
Pedestrian crossing islands are short divisional islands located at crosswalks. Pedestrian crossing islands may be located at intersection or midblock locations. These islands allow pedestrians and bicyclists to cross only one traffic stream at a time and provide some degree of protection from the vehicular traffic while waiting for a gap to finish their crossing.

These islands should include raised curbs with a cut-through at the pavement level for wheelchair users. The cut-through should be graded to drain quickly and should also have special provisions to assist the visually impaired in identifying the refuge island. The pedestrian crossing island should be at least 6 feet wide from the face of the curb to the face of the curb. The island should not be less than 12 feet long or the width of the crosswalk, whichever is greater.

Raised mid-block islands should be short in length, typically less than 70-90 feet. Longer islands are likely to cut off access to too many properties and do not add to the deflection. Ideally, these short segments of median are sited to avoid blocking property access, although confining the occasional driveway to right-in/right-out access may be reasonable. The minimum island size should be 50 square feet. Larger islands can sometimes support plantings if adequate soil volumes and irrigation are provided. See Chapter 3 for additional planting guidance.

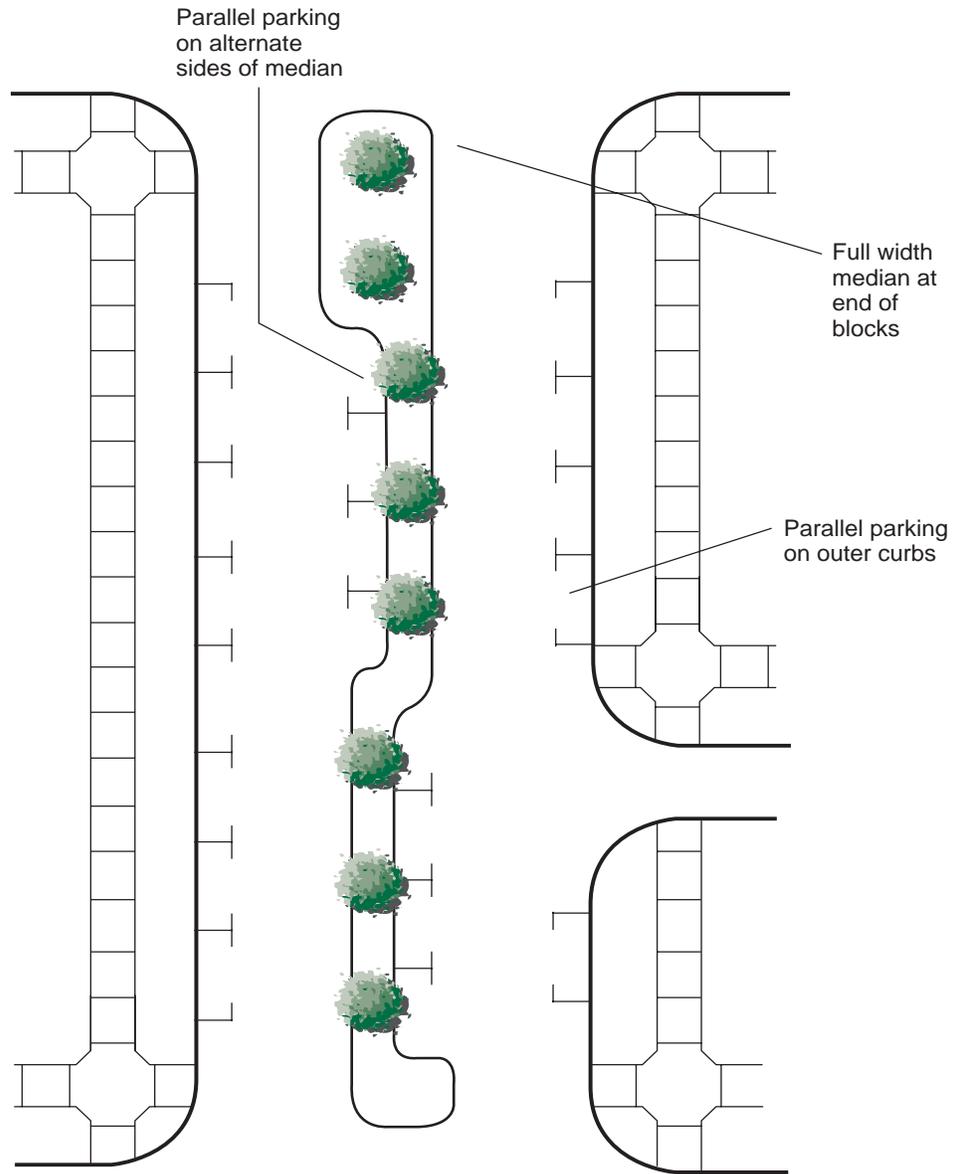
All raised islands should also include an approach nose, offset from the edge of the traffic lane and appropriately treated to provide motorists with sufficient warning of the island's presence. This can be achieved in various ways, such as illumination, reflectorization, marking, signage, and/or by the size of the island.

Exhibit 16-8 Median Islands



On divided streets, parking can be added along the median. Where the total street width permits only one lane of parking along the median, that parking lane can be alternated, as shown in Exhibit 16-9. With this approach a planted median can give the appearance of a double row of trees, although only a single row is present at any point along the street. The designer should refer to Chapter 13 for additional guidance on tree planting in the medians.

Exhibit 16-9 Parking on Median Islands



16.5.9 Allocation of Pavement Width and Road Diets

The pavement width of the street can be allocated in a manner that gives more space to pedestrians, bicycles, and parking, reducing the width of the motor vehicle traveled way. In some instances, the elimination of a travel lane on a four-lane roadway and conversion of another lane to a median with turning pockets can improve conditions for pedestrian and bicycle users without adversely affecting roadway capacity since the left-turns are accommodated within the median. Allocation of pavement width could also provide wider sidewalks if conditions suggest that additional space could better accommodate the existing or anticipated pedestrian activity. These types of measures have recently been referred to as “road diets” when applied to existing streets.

16.5.9.1 Bicycle Lanes

Adding an on-street bicycle lane, as shown in Exhibit 16-10, reduces the pavement width for motor vehicles, while at the same time providing for bicycle travel. The typical dimensions and placement of bicycle lanes are discussed in Chapter 5.

16.5.9.2 Travel Lane Width

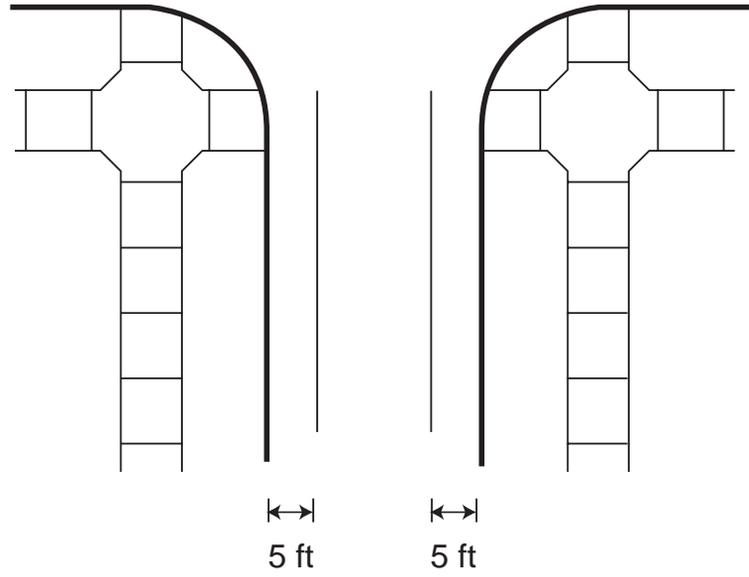
Minimal lane widths can reduce vehicle speeds, reduce pedestrian crosswalk distances, and maximize the space available for bicycle lanes and sidewalks.

Where traffic calming is intended, driving lane widths should be 10 feet, a width widely accepted as appropriate for residential and minor collector streets. A larger lane width (11 feet) is appropriate for outer (curb) lanes on streets where on-street parking is not present and on arterials or other roadways that carry large numbers of trucks and buses.

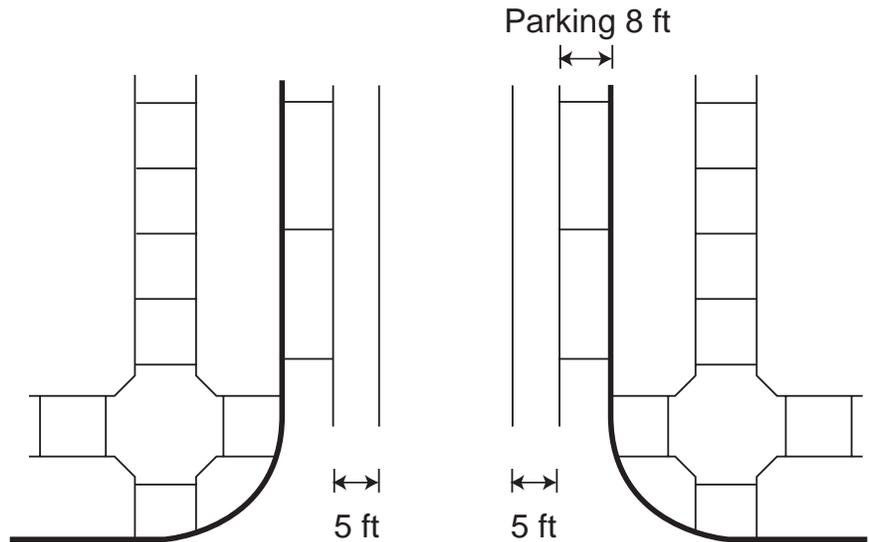
Lane layouts should also take into consideration space for bicycles, as described in Chapter 5. Traffic calming measures that reduce the travel lane width may reduce or eliminate the opportunities for motor vehicles drivers to overtake bicycles sharing the same lane. Where such overtaking is impossible, motor vehicle speed is likely to be determined by bicyclist speed. Thus, the presence of bicyclists becomes a significant element of traffic calming.

**Exhibit 16-10
Bicycle Lanes**

A. Streets without On-Street Parking



B. Streets with On-Street Parking



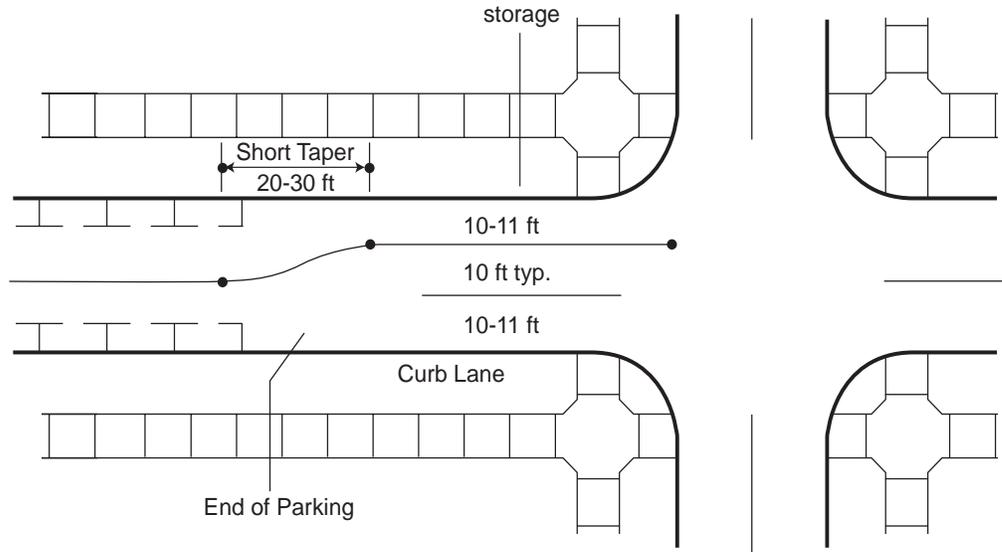
16.5.9.3 Auxiliary Lanes

Auxiliary (left turn and right turn) lanes should be used sparingly with traffic calming. Typically, rear-end collisions between a left-turning and at-speed following vehicle are less frequent and less severe due to the lower speeds of traffic in traffic-calmed settings. Further, the occasional blockage of through traffic by a left-turning vehicle should not be considered a detriment in a traffic calmed setting. Occasional and irregularly timed variations in traffic flow are an intended consequence of traffic calming.

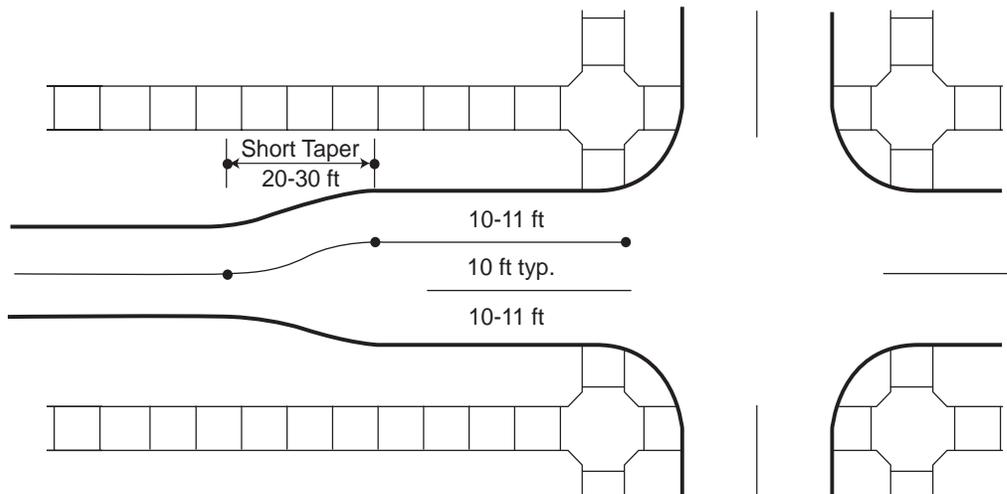
When on-street parking is present, as shown in Exhibit 16-11, left-turn lanes can generally be accommodated (when necessary) within the existing pavement width on the intersection approach leg by removing parking spaces on both sides of the street at the intersection. On streets without parking, the existing pavement width may not be adequate to accommodate a left-turn lane, and the approach may therefore have to be flared to accommodate the left turn lanes. Auxiliary lanes (typically left-turn lanes) should typically be 10 feet wide in traffic calmed areas.

Right-turn lanes are inadvisable in most traffic calmed settings. Their emphasis on vehicular accommodation, the additional crossing distance they create for pedestrians, and the increased possibility of vehicle conflicts with pedestrians are all likely to negate the goals for the traffic calmed street.

Exhibit 16-11 Left-turn Lanes, Traffic Calming Values



A. Within existing pavement width



B. Pavement width flared to accommodate left-turn lane

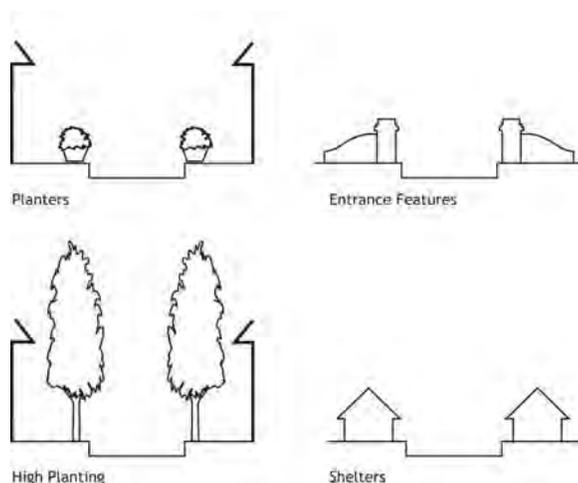
16.5.10 Gateways

Closure of a street (through gates, barricades, pavement removal) should not be considered as part of a traffic calming program. The unintended consequences of street closure – moving traffic problems to a new location, increasing vehicle miles of travel, contentiousness, and degrading emergency services – argue strongly against street closure as a remedy for neighborhood traffic problems.

However, street-side features that function as gates or portals are an effective traffic calming device. Gateway features, located close to the pavement edge, appear to narrow the road and therefore reduce the operating speed of approaching motorists. Gateways are usually interpreted as indicative of a special area, requiring increased attentiveness. Gateways are often associated with dead-end street systems, and can therefore be a signal to unfamiliar motorists that a route is not a likely cut-through route. In addition to their traffic calming function, gateway features can serve as transit waiting areas, information kiosks and mountings for signs and lighting.

As shown in Exhibit 16-12, it is appropriate for gateway features to be placed within the street right-of-way. Minimum clearance from the street is 2-feet from back of curb. When placed near or at an intersection, gateway designs should be checked to assure that an adequate intersection sight triangle is preserved as described in Chapter 3.

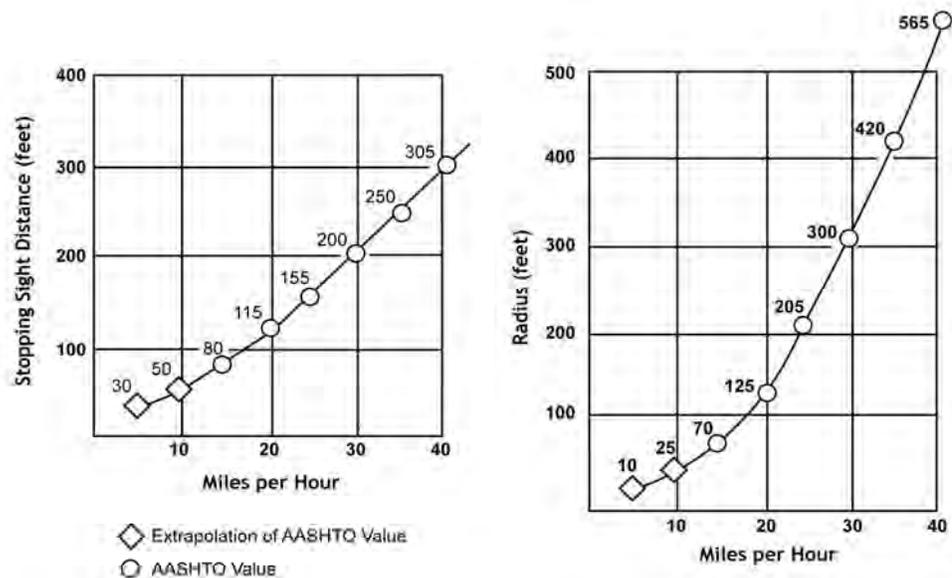
Exhibit 16-12
Gateways



16.6 Traffic Calming Measures Incorporating Deflection

Deflecting the vehicle from an otherwise straight path is an important traffic calming action that reduces vehicle speed. The relationship of sight distance and curvature to operating speed is a basic relationship for road design at all speeds as described in Chapter 3. For the lowest design speeds associated with traffic calming (5-15 miles per hour), it is necessary to extend the ranges of stopping sight distance and minimum radius, by extrapolating the values adopted for higher speeds, illustrated in Exhibit 16-13.

Exhibit 16-13
Low-speed Design Parameters



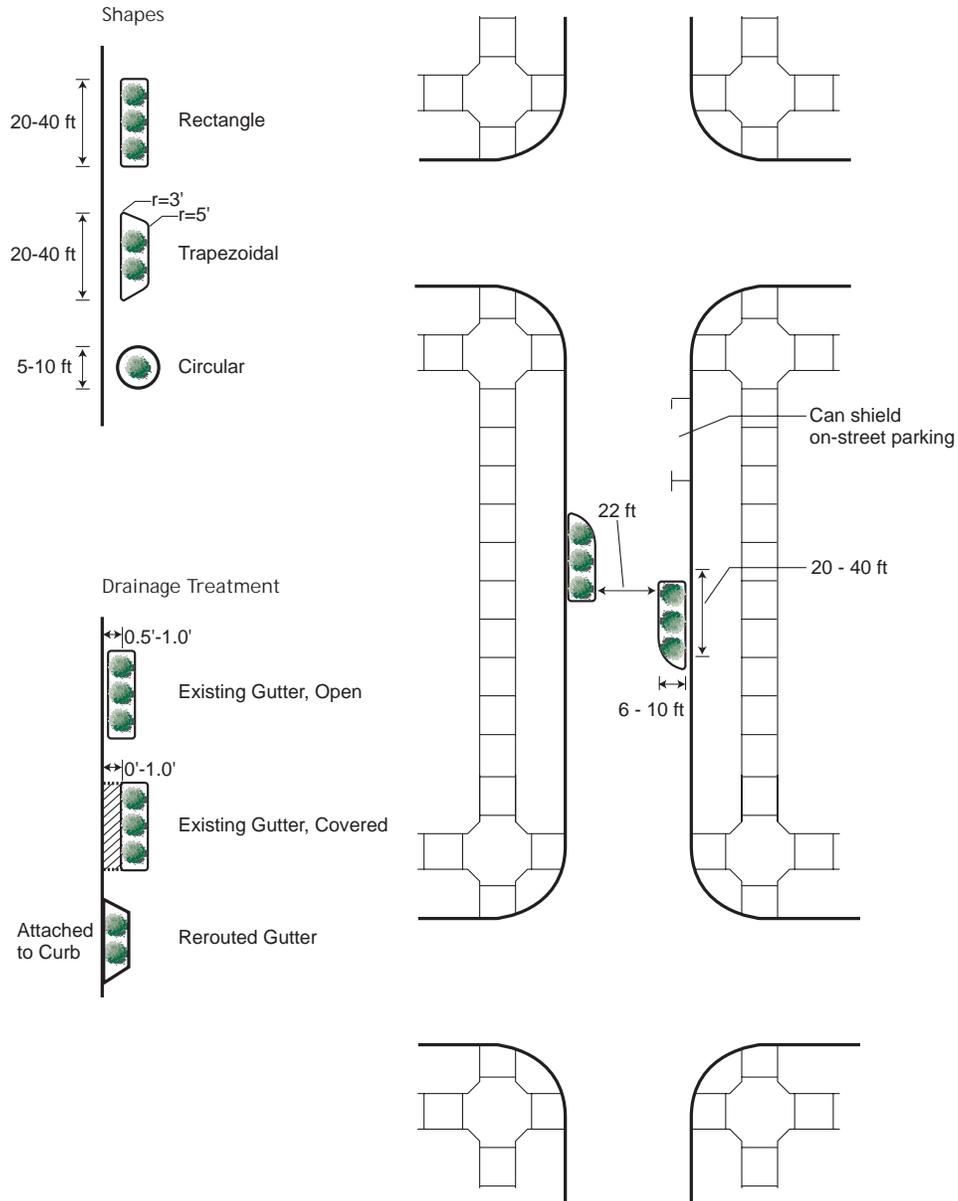
16.6.1 Mid-Block Deflection Measures

There are several possible approaches to introducing mid-block deflection to a vehicle path, as described below:

16.6.1.1 Chicanes and Lane Offsets

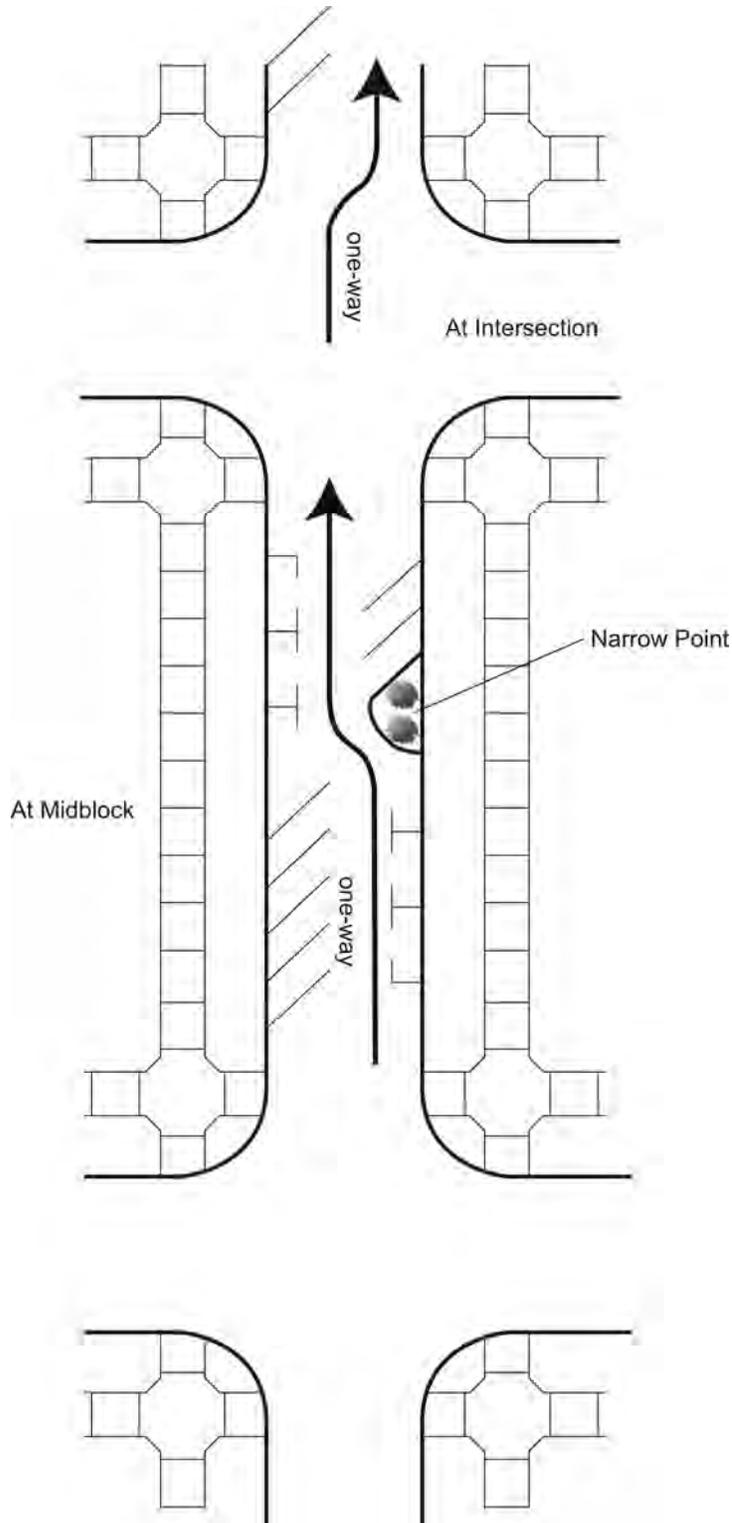
The simplest measure for deflecting traffic is the narrowing of one side of the street by an amount that requires the through traffic to deflect from its previously straight path, as shown in Exhibit 16-14. A series of such deflections, typically called chicanes, multiplies in effectiveness as it extends throughout the entire length of the block.

Exhibit 16-14 Mid-block Deflection



Mid-block deflection can also be obtained by alternating the parking (or type of parking) along the block faces as shown in Exhibit 16-15.

Exhibit 16-15
Lane Offsets from Parking



16.6.1.2 Short Medians/Crossing Islands

Measures to deflect traffic, such as medians and crossing islands, can also be centered in the street, as discussed previously in Section 16.5.8. Horizontal deflection can be achieved with crossing islands where there is on street parking by eliminating parking near the island. Curb lines can also be adjusted to accommodate the crossing islands.

16.6.1.3 Mid-Block Traffic Circles

Mid-block traffic circles are a traffic calming measure that assures a great deal of deflection in the vehicle path, and therefore a significant reduction in vehicle speeds. Unlike the roundabout intersection, the mid-block circle has no traffic control function, since there is no cross street traffic to be controlled. Beyond its traffic calming value, the highly visible central island of the mid-block circle can serve as a major demarcation point at a neighborhood boundary, as a setting for a monument or other display, or to deliberately terminate the view down the street in order to hide the scene beyond.

16.6.2 Intersection Measures

The principle of deflecting traffic in order to reduce its speed can be applied to intersections as well as non-intersection locations. Roundabouts provide a central island, which requires deflection for all movements. Deflection through intersections can also be provided by offsetting the through traffic lanes or through the use of crossing islands.

16.6.2.1 Lane Offsets at Intersections

Traffic lanes can be offset at an intersection, reducing speed through the intersection, as shown previously in Exhibit 16-15. On streets with parking on one side, the offset results from alternating the side of the street containing the parking. At "T" intersections with a left-turn bay provided, the left-turn lane requires an offset for through traffic in at least one direction of travel. On streets with diagonal parking on one side and parallel on the other, the offset at the intersection results from alternating the sides on which each type of parking is provided.

16.6.2.2 Crossing Islands

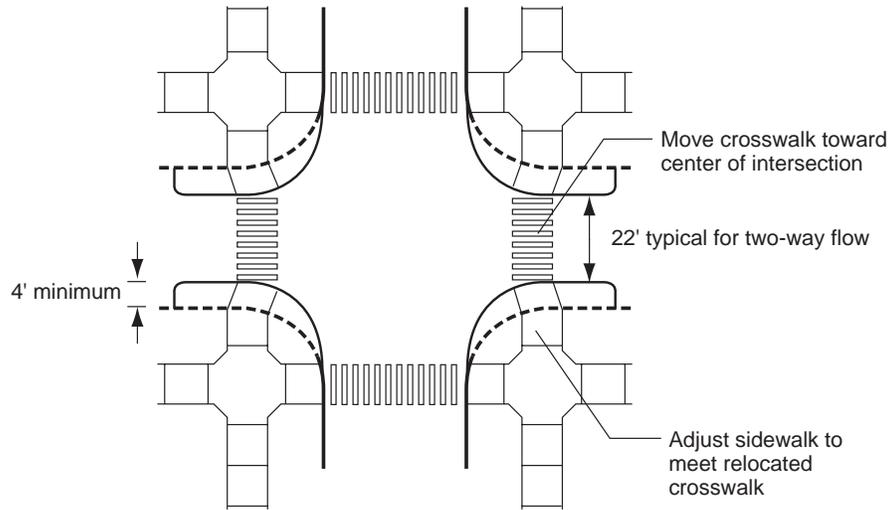
Crossing islands, as described in Section 16.5.8, can also be used at intersection locations.

16.6.2.3 Curb Extensions

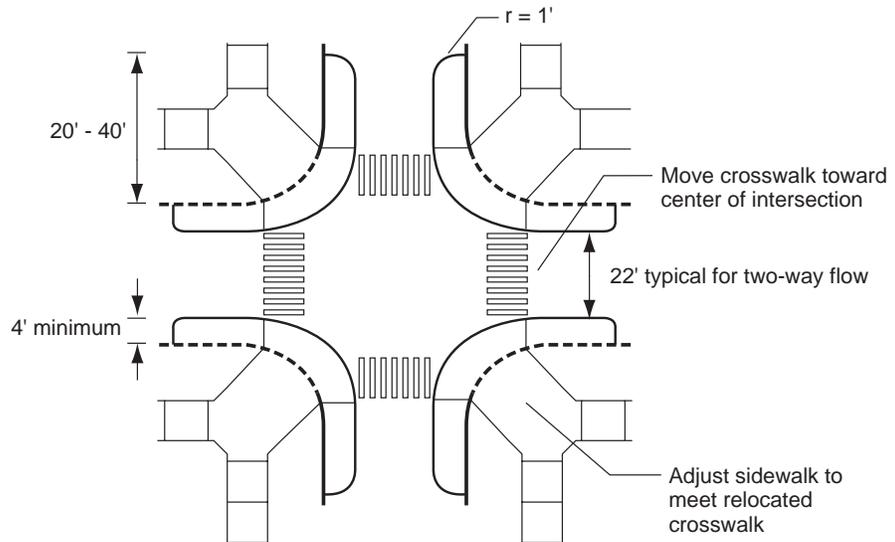
Narrowing the street at an intersection, through the use of curb extensions, is a versatile and widely used traffic calming measure, as shown in Exhibit 16-16.

**Exhibit 16-16
Intersection Curb Extensions**

A. Bulbouts on Both Streets



B. Bulbouts on One Street



In addition to slowing traffic due to reduced pavement widths, curb extensions delineate on-street parking, shield the ends of the parking lane from moving traffic, and discourage drivers from using an empty parking lane for overtaking other vehicles. They also prevent illegal parking at corners, thereby improving sight lines for all users.

Curb extension substantially reduce the pedestrian crossing distance while increasing the pedestrian space on the intersection's corners. Curb extensions can also benefit vehicular traffic, by moving the stop bar on the approach lanes further into the intersection, thereby reducing the intersection size and signal clearance intervals. The reduced intersection size can, in some instances, solve sight-distance deficiencies on the intersection approaches. Curb extensions can prevent parking close to intersections, and thus improve sight distance from cross streets. Also, curb extensions frequently reduce the "wasted" pavement at intersections (i.e., areas of pavement unusable by either vehicles or pedestrians near the corners). Fire hydrants are often located near intersections so that curb extensions result in no loss of legal parking.

Curb extensions can be used on one or both of the intersecting streets, or on any combination of approaches. The width of the roadway at the curb extension is typically no wider than necessary to accommodate the through lanes, providing 10 to 12 feet per lane plus additional offset of 1 to 2 feet from the edge of the traveled way. Curb extensions should only be used in conjunction with on-street parking so that they do not pose an unexpected hazard to bicyclists and motor vehicles.

With curb extensions, the increase in sidewalk area provides space for street furniture such as fire hydrants, information kiosks, benches and plantings. The additional sidewalk space is particularly useful where local regulations require buildings to be located adjacent to the sidewalk, thereby putting a premium on sidewalk space.

Typically, curb extensions are cost effective, since a single intersection treatment affects traffic in all directions on both intersecting streets. Because of their high visibility, curb extensions can be an important entrance feature for a neighborhood or a district of special interest.

16.6.2.4 Roundabouts and Mini-Traffic Circles

Two characteristic features of roundabouts—splitter islands on approaches and the central circle—provide a significant reduction in vehicle speeds and corresponding increases in driver attentiveness. The deflection provided by the splitter islands encourages a decrease in speed as drivers approach the intersection. Within the roundabout, the radius of the central island reinforces the low operating speed. At some roundabouts landscaping or man-made features within the central island terminate the view on approaching roadways, thereby contributing to reduction of the operating speed of approaching traffic. Guidelines for the design of roundabouts are given in Chapter 6 of this Guidebook.



Roundabouts are intersection control measures that provide speed reduction.
(Photo Credit: Jan Conklin)

Because of its circular central island, the mini-traffic circle is frequently confused with roundabouts. However, the mini-traffic circle differs from a roundabout in important ways. Mini-traffic circles are typically smaller than roundabouts and do not merge traffic into a stream around a circulating roadway. Unlike the roundabout, the mini-traffic circle is not a traffic control device. Rather, at the mini-traffic circle, right-of-way is assigned by stop control (often all-way stop control). Mini-traffic circles usually do not have splitter islands on their approaches, although these are sometimes provided to absorb excess pavement width on approaches or to provide pedestrian refuge. For automobiles,

operations at the mini-traffic circle are similar to those at a roundabout, with vehicles proceeding around in a counterclockwise direction. Large trucks (single unit (SU) trucks or larger) make right turns and through movements by entering the circle and proceeding counterclockwise. However, they make left turns by turning in front of the mini-traffic circle, after yielding right-of-way.

This pattern of movement can be hazardous where truck and buses are present on a regular basis. Mini-traffic circles can also pose significant challenges for emergency vehicles. As a result, mini-traffic circles are not recommended for most locations. Roundabouts and mini-roundabouts (designed using the same principles as a roundabout, but will a small central island) should be considered in lieu of mini-traffic circles.

16.6.2.5 Stop Control

Stop control, considered to be a traffic calming measure by many neighborhood groups, can be an appropriate traffic control decision under special circumstances. However, stop signs are traffic control devices that help to assign who has the operational right-of-way movement through an intersection and should not normally be considered a traffic calming tool. Warrants supporting the use of two-way and all-way stop are provided in the MUTCD. Some factors that may suggest use of all-way stop control include a lack of an obvious major and minor street, large volumes of turning movements, nearby pedestrian generators (park, school), and single through lanes in all directions.

Advocates of neighborhood traffic calming tend to overrate the effectiveness of stop control, and often request it at inappropriate locations. Excessive numbers of stops are difficult to enforce, and can be annoying to even careful motorists. Over the longer run misuse of stop control contributes to the erosion of motorist respect for traffic control devices in general, and is likely to decrease safety.

16.7 Measures to Alter the Street Profile or Texture

Traffic calming measures involving the profile and surface of the street include alterations to the profile of the street (humps and elevated segments of streets) and placing a textured pavement surface in parts of the street.

16.7.1 Speed Humps

Speed humps are intended to let vehicles operating at intended speeds pass with little discomfort to the driver, no bouncing of loads in trucks, and little noticeable stress (for example, bottoming out) of the vehicles. Because driver discomfort at humps rises rapidly as their design speed is exceeded, humps are an effective measure for controlling speeds.



Vehicle crossing a speed hump

Speed humps can be appropriate for minor collectors and local roads. On higher-classified streets (major collectors or arterials), the target design speed of 15-20 miles per hour for humps is likely to be inappropriate and inconsistent with the function of such streets.

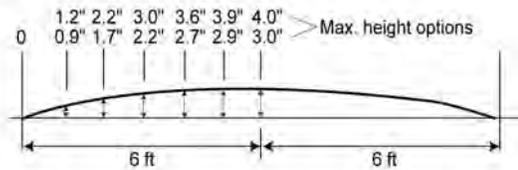
Speed humps may generate noise from vehicles braking and accelerating. Noise impacts on nearby residents can be mitigated through careful locating of the speed humps, or by spacing humps closely to encourage constant speeds.

16.7.1.1 Round-Top Speed Humps

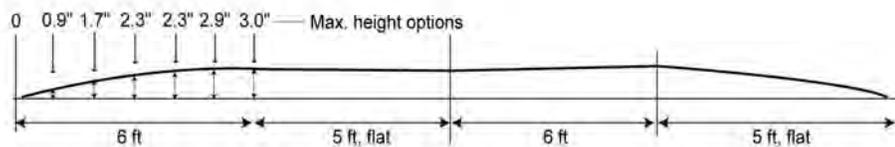
Round-top speed humps are 12-14 feet in length, and rise to a height of 3-4 inches. A common profile, the parabolic crown, illustrated in Exhibit 16-17, permits comfortable crossing at design speed, but makes crossings increasingly uncomfortable as design speed is exceeded.

**Exhibit 16-17
Speed Humps and Speed Tables**

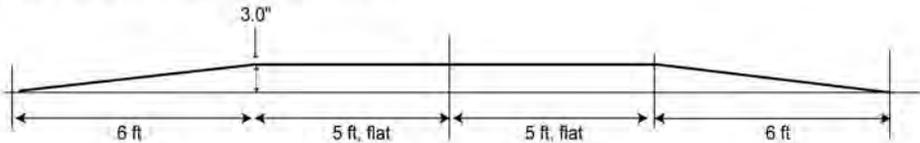
A. 12-Foot Parabolic Crown Hump



B. 22 Foot Parabolic Ramp Speed Table



C. 22 Foot Straight Ramp Speed Table



Round-top humps may be constructed from a wide variety of materials: asphalt, textured or colored asphalt, and poured and stamped concrete. Typically, the space between the end of the hump and the curb is left open, allowing the gutter drainage to continue functioning unhampered.

16.7.1.2 Speed Cushions

The speed cushion is a variety of flat-top hump that does not extend fully across the street, but rather affects only one side of the vehicle. Speed cushions provide much of the traffic calming impact of a flat-top hump, and also allow bicycle lanes and storm drainage to continue unhindered at the original street grade.

16.7.2 Raised Crosswalks (Flat-Top Speed Humps)

Flat-top speed humps, shown in Exhibit 16-17, are frequently used to complement pedestrian crossings, particularly where curb extensions are in place. When constructed of a pavement material differing from the adjacent street, flat-top speed humps are conspicuous to both drivers and pedestrians, thereby improving the pedestrian crossing safety. Flat-top humps at crosswalk locations also serve to protect the pedestrian crossing from intrusion by on-street parking. For flat-top humps, typical ramp lengths are 6 feet, and the typical length of the flat top is 10 feet, giving a total length of 22 feet. A simple straight ramp is typically used.

16.7.3 Raised Intersections

The concept of the flat-top hump can be extended to an entire intersection, raising the entire intersection to sidewalk height or nearly so. The raised intersection provides benefits to all crosswalks. Raised intersections employ many of the same design elements as raised crosswalks; however, the designer needs to pay special consideration to drainage issues and the demarcation of intersection corners through pavement changes, markings, or bollards.

16.7.4 Textured Pavement

Textured pavement encourages motorists to be aware of an area of special concern due to the appearance of the texture, vibration, more noticeable motion of the vehicle and tire noise. Pavement texture alone, at isolated locations, is not an effective traffic calming measure. Rather, textured pavement is more appropriate in support of other traffic calming measures such as mid-block narrowing, intersection curb extensions, or roundabouts.

Flexible pavement materials (i.e., asphalt) can be colored or stamped with patterns, and are often the material of choice for speed humps and crosswalks. Rigid pavement (i.e., concrete and stamped concrete) is regularly used for flat-top humps, and for crosswalks. Rigid materials, such as concrete pavers, are frequently used for full-

intersection designs, raised intersections, crosswalks, and in connection with mid-block traffic calming measures such as narrowing and splitter islands. Paver-insets need to be constructed so that their long-term serviceability is ensured given the freeze-thaw cycles common in this region.

16.7.5 Rumble Strips

The use of rumble strips as a traffic calming measure is inappropriate, since these are typically used as a warning device at high-hazard locations, such as isolated, high-volume, rural intersections. Further, rumble strips are hazardous to bicyclists, and the noise generated by them is likely to be problematical in neighborhoods. A further reason to avoid rumble strips as a traffic calming measure is that they do not compel a reduced speed as do other traffic control measures, and drivers eventually learn to ignore them.

16.8 Traffic Management Measures

Traffic calming measures are intended to reduce operating speeds and increase driver attentiveness. On the other hand, *traffic management* measures are intended to reduce and redirect traffic movements, but are unlikely to have a significant influence on operating speeds.

Traffic management measures fall into two categories:

- (1) Movements physically restricted by street design features, and
- (2) Regulatory restrictions, conveyed primarily through signs.

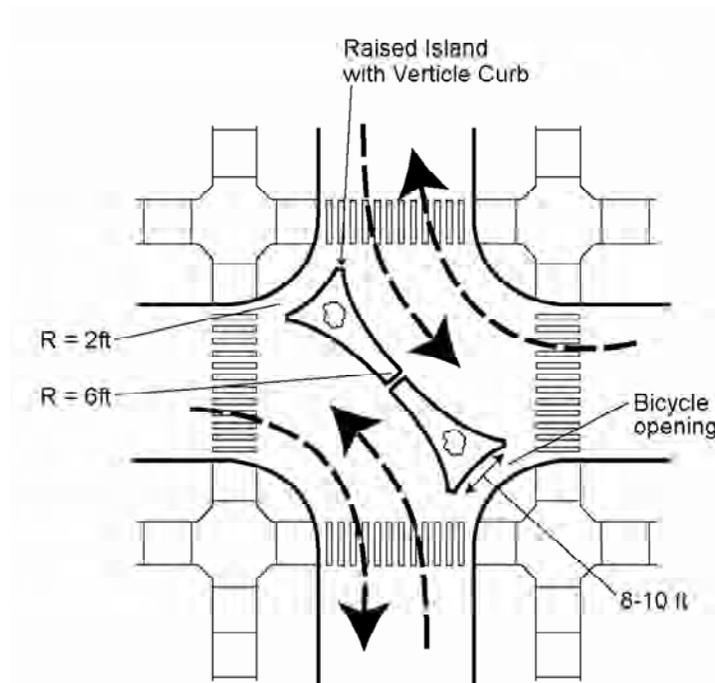
16.8.1 Restriction of Vehicle Movements through Street Design

Several design measures are available to restrict specific movements at an intersection. For example, a segment of median extending across an intersection limits turning movements, from all approaches, to a right turn only. Further, a median eliminates the possibility of through trips on the cross street. This type of cross-street access restriction by medians could be appropriate where sight distance is inadequate for safe turning movements at the intersection, or where through traffic on the cross street is being discouraged. Other techniques such as the use of channelizing islands for particular movements can be used to restrict traffic movements at intersections.

On local streets, the diagonal street closure, shown in Exhibit 16-18, prevents through movement on both of the intersecting streets, but allows

either a right or left turn from all approaches. Diagonal through-movement closure may be appropriate to discourage cut-through trips in neighborhood districts with a dense, well-connected network of streets. Diagonal street closures should also maintain connectivity for bicycle travel.

Exhibit 16-18 Diagonal Street Closure



Source: Traffic Calming State of the Practice, ITE, 1999

Completely blockading (i.e., completely closing) a street should not be considered as a traffic management measure. Street closures should be considered only in instances where such closure is vital for a public purpose (for example, major park or public institution) and then only when an ample, well-connected network remains. Restriction of vehicle movements at town lines is not permitted without the consent of the adjacent community.

16.8.2 Regulatory Measures to Restrict Vehicle Movements

Turn restrictions, on both right turns and left turns, have long been used at intersections to improve pedestrian or traffic flow, and such measures can be used as traffic management actions. Restrictions on turning movements ("no left turn" or "no right turn"), are commonly used to expedite traffic flow. Turning movement restrictions can be more efficiently policed than speed or stop control violations. The

drawback of traffic management measures that rely on regulation is less for turn restrictions than most other types of regulatory action.

The all-way turn restriction, with neither right nor left turns permitted from any approach, is sometimes used at downtown intersections, where large volumes of pedestrians are present on all crosswalks. When used as a traffic management measure, an all-way turn restriction has the further impact of redirecting traffic away from areas of special concern, and channeling it toward intended routes.

Turn restrictions have value in traffic management when used to discourage the use of inappropriate routes. Turn restrictions that apply only during the peak hour, intended to prevent peak hour commuter cut-through traffic in neighborhoods, can also be effective.

16.9 Administering a Traffic Calming Program

Requests for traffic calming often come from neighborhood groups. Traffic calming programs should be planned in a design dialogue, conducted on-scene in the subject area, involving residents, property owners, and business operators in intensive hands-on work sessions. A successful program of traffic calming measures requires skilled gathering and interpretation of input and applying a large measure of judgment in developing the measures.

Formal traffic survey techniques are often ineffective in forming traffic calming programs. Requiring petitions from residents, business or property owners as a prerequisite for installing traffic calming measures is inadvisable. Petitions voluntarily submitted by stakeholder groups can be one of a number of useable inputs to the design of any traffic calming program and can be a measure of the community's perceived need for improvement and their willingness to fund it. However, such petitions should not be required. They are expensive, both in terms of funding and managerial attention required by the traffic calming program. Further, the petition process is often divisive, with the outcome likely to vary greatly depending on the wording of the petition and the outlook of the person collecting signatures.

Attempting to plan a program of traffic calming based on numerical scores or quotas is not advisable. Numerical scoring schemes will focus on those traffic characteristics that are easily measured (specifically, speeds, traffic volumes and collisions), thereby furnishing an

incomplete and often misleading analysis of the need for traffic calming. Factors that are important to the community may not register in this type of numerical analysis. These important factors include the character of residential neighborhoods, historical value, type and value of retail business, neighborhood institutions and aesthetic character.

It is important to determine and discuss the benefits and impacts of various traffic calming measures with community members so that a well-founded traffic calming program can be prioritized and implemented. In some cases, gathering numerical data is expensive and time consuming, and can drain the traffic calming program of funds needed for producing the measures themselves. However, before-and-after studies and the use of low-cost, temporary measures (such as carefully arranged construction barrels) can be used to identify the effectiveness of existing or proposed traffic calming measures to build consensus around a traffic calming plan.

16.10 Traffic Calming and Tort Liability

Traffic calming measures are simply low-speed street design elements, following accepted design guidelines or reasonable extrapolations of them, as discussed earlier in this Chapter. Therefore, traffic calming measures can be defended against tort liability in the same manner as road design in general. The design should document the design decisions and their rationale by following the recommendations listed below:

- Provide a reasonable, written rationale for the traffic calming measure or program of measures. Typical rationales include neighborhood safety, historical preservation, retail viability, and proximity of important institutions (schools, for example).
- Observe good practice in designing the traffic calming measures.
- Monitor the safety performance of installed measures. Ongoing crash record systems are suitable for this monitoring.
- Address observed safety problems in a cost-effective manner, making prudent use of available funding. The “prudent use” test has long been a defense against tort liability at known or suspected safety problem locations, and can be extended to modifications needed at traffic calming measures.

16.11 For Further Information

- *Traffic Calming Guidelines*, Devon County Council, Exeter, England, 1991.
- *Traffic Calming – State of the Practice*, Institute of Transportation Engineers, Washington, D.C., August, 1999.
- *Traffic Calming, Planning Advisory Service Report Number 456*, American Planning Association, Chicago, IL, 1995.
- *Guidelines for the Design and Application of Speed Humps – A Recommended Practice*, Institute of Transportation Engineers Speed Humps Task Force, Washington, D.C., 1997.
- *Traffic Calming Guidelines*, FHWA, 2002
(www.fhwa.dot.gov/environment/tcalm)