

Exclusive Pedestrian Facilities

16

Various alternatives have been implemented to restrict motor vehicles from the pedestrian environment, including residential yards, play streets, pedestrian malls, and transit malls. While pedestrian malls and other auto-free areas are usually developed as part of an urban renewal or downtown revitalization effort, they have the effect of improving pedestrian safety and facilitating pedestrian movement.

Pedestrian malls are streets which have been closed to all vehicular traffic and are reserved for the exclusive use of pedestrians, with few exceptions. Delivery and refuse collection access may be permitted during specified times of the day, and emergency service access must be permitted at all times.

Transit malls are streets where pedestrians share the space with transit buses or light rail vehicles (and sometimes bicycles, delivery and refuse collection vehicles, and taxis), but other vehicles are not allowed, except for emergency and maintenance vehicles. Transit vehicles operate on a narrow right-of-way within the mall space. Pedestrian malls can be developed in each of the following manners:

- a. Modified Street - One block of a conventional street is closed to vehicular traffic for the exclusive use of pedestrians.
- b. Plaza or Interrupted Mall - Several blocks of a retail street are exclusively designated for pedestrian use, with cross streets left open to vehicular traffic.
- c. Continuous or Exclusive Mall - A multiblock area, which may include more than one street, is exclusively designated for pedestrians, with the exception of emergency, maintenance, and delivery vehicles. The area extends the full length of the shopping area, through intersecting streets, without interruption.
- d. Displaced Sidewalk Grid - A pedestrian walkway is developed away from the regular sidewalk grid through alleys and laneways, arcades, and/or lobbies within buildings.

For urban street malls to be successful, they must provide a viable and attractive alternative to regional shopping malls.

Planning Considerations

For urban street malls to be successful, they must provide a viable and attractive alternative to regional shopping malls. This can be difficult when it is considered that street malls must necessarily be planned and

designed around existing roadway configurations, traffic patterns, parking, retail mix and other constraints. Street widths can be too wide, walking distances too long, and retail development poorly located to encourage the patterns and volume of pedestrian activity needed to support a successful urban mall. In order to succeed, the street mall must, therefore, capitalize on its primary advantage as an outdoor activity space by promoting parades, street fairs, bicycle and track races, antique car rallies, marching band competitions, concerts, and other similar public events to encourage pedestrian activity and establish an area identity.

The primary objectives of the pedestrian mall should be to reestablish or fortify an urban area's economic viability while simultaneously creating a social setting capable of responding to a variety of needs. The success or failure of an urban pedestrian mall is dependent upon many factors, some of which are directly controlled during the planning process. The following considerations identify elements of planning essential to the effective realization of pedestrian malls.

Relationship of Mall to Central Area Development

Pedestrian malls succeed or fail according to their degree of accessibility either by public transit or by private automobile. The success of a pedestrian zone is directly related to its ability to create a range of activities to suit a variety of users. For example, Albany's government mall in New York State has suffered a loss of vitality because it is only able to attract patrons during lunch break hours and is practically deserted at other times. A more balanced use of the area's resources over extended periods of time, a high level of urban vitality, and an increased feeling of safety can be achieved by attracting a full spectrum of users through mixed use zoning.

Cooperation and Support

Progress in implementing the planned improvements can be much more rapid when commercial and public interests coincide. Many proposals meet opposition from shop owners who believe that their business will suffer if vehicular access is restricted along their premises. In reality, they often get more business after the parking (often used by employees, not the customers) is removed. Shopkeepers are often resistant to the mall concept until they are made aware of the potential benefits. It is important to obtain the cooperation of commercial interests at the initial planning stages in order to ensure viability of the proposals.

Eliciting public support during the course of the pedestrian mall development is important in guaranteeing the success of the mall. The creation of a pedestrian mall affects a wide range of user groups whose participation is vital. These groups should be consulted and involved during the early planning stages of project implementation.

Existing Vehicle Traffic Patterns

Some cities have radically altered circulation patterns in order to decrease traffic congestion and redistribute vehicular traffic flow in the area of the pedestrian mall. This can be accomplished by developing one-way streets, restricting turning movements, limiting access to certain categories of vehicles, redesigning intersections, and retiming traffic signals.

Public Transit Services

Most cities with successful pedestrian malls have introduced policies that encourage the use of public transport. The success of these policies has varied depending on the extent of traffic congestion and the efficiency of the public transportation system. As always, public transit should be inexpensive, fast, comfortable, safe and enjoyable to ride. Other tactics that can be successful are reserved lanes for public vehicles, low

fares, convenient pickup and drop-off locations within the mall, and better security. Those pedestrian malls that are built as transit ways can provide increased mobility to pedestrians by dropping them at major department stores or activity centers within the mall itself.

Parking Supply

Effective parking policies have a significant impact on both the regulation of parking density and the attractiveness of parking spaces to mall users. Some cities use different strategies to meet the demands of employees seeking day-long parking and visitors looking for short-term parking. Some cities offer park-and-ride systems to allow downtown or mall employees to park their cars at the periphery of the city limit and ride to work via rapid transit or special buses. On-street parking meters and multilevel parking facilities at the edge of the pedestrian mall areas can provide short-term parking needs; time can be charged in incremental rates to promote a quick turnover.

Delivery of Goods

The opposition of many merchants to the idea of a pedestrian mall results from the problem of delivering merchandise to stores and making it possible for customers on foot to handle the purchases easily. One of the most common strategies has been to allow structural changes in the street pattern to make possible store deliveries from courtyards and alleys as well as using time restrictions on the use of pedestrian mall space by commercial trucks. Some downtown merchants have introduced free pushcarts in order to meet customer demand for assistance in delivering their goods to either the central transportation terminal or to where their car is parked. Establishments that sell bulk goods, such as grocery stores, should be relocated to the periphery of the mall where ready access to parked vehicles is available.



Figure 16-1. Pedestrian malls provide for pedestrian safety and mobility.

Essential Services

Essential services such as emergency fire, police, medical, refuse removal, taxis, vehicle pickup and drop-off, truck delivery and pickup, and mall cleaning must also be considered. Provisions must be made to allow emergency service vehicles quick access within the pedestrian mall. Additional amenities within the pedestrian mall such as canopies and covered ways will need to be sufficiently high in order to enable emergency vehicles to pass underneath. There are also certain types of businesses that require such access for other vehicle types. For example, a hotel located on the street to be made into a pedestrian mall will need to provide continuous access to taxis for its viability. Similarly, security vehicles will need to reach banks and



Figure 16-2. Crosswalks should be provided for pedestrians to cross streets in interrupted malls.

businesses located within the pedestrian mall during nighttime hours.

Accessibility Needs

Care must be taken that the paving system used does not impede the safe and easy movement of wheelchairs. Planters, benches and other amenities should be placed in a straight line to satisfy the expectancy of the visually impaired.

Design Considerations

Quality of design and durability of construction materials have proven to be essential elements in the success of pedestrian malls. The ideal pedestrian mall

is designed in a relatively narrow street right-of-way, with concentrated shopping and commercial land uses within the normally accepted walking distance limit of 0.4 km (0.25 mi), and larger traffic generators (“anchors”) located at opposite ends of the mall to encourage walking along the mall. Excessively wide streets dilute pedestrian activity, making a mall appear dull and uninteresting, and also reduce exposure to retail edges due to the increased sight distances.

To be successful, the pedestrian mall must be interesting, safe, convenient and appealing to the shopper. Some successful street malls are located in areas such as historical districts where there is an established pattern of tourist and visitor activity. When this pattern exists, it can be enhanced by designing storefronts and street furniture to keep with the local “theme.” Otherwise, it is necessary to develop design and marketing strategies which will encourage downtown activities and use of the mall. The primary advantage of a street mall is the ability to conduct large-scale outdoor events. Event spaces for setting up concerts, grandstands, and other activities should be considered in the mall design. Access to electrical outlets should also be considered.

Street furniture, paving treatments, lighting, and landscaping are important design considerations. Street furniture elements should be of modular design incorporating several components in a single unit. Other amenities such as benches arranged in groups in small rest areas, local street maps and points of interest displays, programs of future events, transit stop enclosures, and transit system information displays will improve the convenience and attractiveness of the mall.

Pavers are a popular surface treatment in malls, but the pavers must be placed on a substantial subbase to avoid settlement or “frost-heaving” and dislodgment, which can result in tripping. Since emergency vehicles require access to all parts of the pedestrian



Figure 16-3. Pedestrian malls enhance the aesthetics of the downtown area.

mall, the paved areas need to be designed to take the weight of service and emergency vehicles and allow them to move around easily. Pedestrian oriented lighting, with control of overhead illumination so as not to overpower shop window lighting, is preferred to restore a more intimate and natural scale to the converted street. Landscaping should be carefully chosen, not only for appearance, but for maintenance and growing characteristics. Plants or trees that interrupt sight lines and potentially provide concealment can reduce perceived security and discourage pedestrian activity at night.

Crosswalks should be provided for pedestrians in transit malls, interrupted malls, and plazas where pedestrian-vehicle conflicts are present. Such conflicts may be minimized through: 1) one-way cross streets, and 2) signals and warnings to the motorists, such as signs or contrasting pavements at the mall crossings. The mall should be designed to keep transit vehicles

and other service vehicles to a slow (pedestrian) speed, and there should be ample visibility between pedestrians and other vehicles in the mall.

Implementation Considerations

Feasibility studies which determine the levels of political, business, and general public support are essential. Included in these evaluations should be potential effects on traffic, area economics, and the social environment. Temporary pedestrian malls or street closures can be set up as part of a feasibility study to determine a more permanent need.

Successful implementation requires a great deal of cooperation and organization. A primary leadership group and working committees must coordinate and administer the process. Public and private interest should be developed through the media, informational meetings, pamphlets and

displays. Management, financial and scheduling plans should be developed and followed. In addition, periodic review sessions should be held to: 1) consider and develop alternative concepts, and 2) ensure that all concerned parties have adequate opportunity to contribute as they see fit.

Several advantages exist from the design and implementation of pedestrian malls, including:

- ◆ A reduction in pedestrian delays and/or pedestrian congestion.
- ◆ Enhancement of the aesthetic and social environment of the downtown area.
- ◆ Greater pedestrian accessibility to retail merchants.
- ◆ An increase in the use of public transportation.
- ◆ A decrease in noise and air pollution on affected streets.
- ◆ A potential increase in revenues, sales, and land values.
- ◆ Increase in the efficiency and time savings of mass transit in transit malls.

Along with the advantages of pedestrian malls, there also exist several disadvantages, including:

- ◆ A potentially high cost of installation, maintenance and operation.
- ◆ Rerouting of vehicle traffic to other streets.
- ◆ Potential reduction in retail activity and an increase in noise and air pollution on nearby streets.
- ◆ Disruption of utility and emergency services.
- ◆ Disruption of bus routes and delivery of goods.
- ◆ Placement problems with street furniture for visually handicapped pedestrians.
- ◆ Potential parking problems for visitors

and employees. Potential security and policing problems if poorly lit and designed with numerous “hidden” spaces.

- ◆ Potential maintenance problems.
- ◆ Conflicts between pedestrians and transit vehicles in transit malls.
- ◆ Pedestrian-vehicle conflicts at cross streets in a plaza or interrupted mall.

Conflicts between pedestrians and vehicles at midblock locations where displaced sidewalk grids are used.

Summary

In summary, the conversion of streets to full pedestrian malls is an ideal way to provide for safe and free-flow movement of pedestrians in a desired area, such as for retail shopping. Although the conversion of streets to pedestrian malls is usually the result of efforts to revitalize downtown areas, improved pedestrian safety can be a beneficial result of such malls.

Bibliography

Bartholomew, W.M., “Pedestrian Accidents in Service Areas of Selected City Recreation Facilities,” *Traffic Safety Research Review*, Vol. II, No. 4, December 1967.

Bowman, B.L., J.J. Fruin, and C.V. Zegeer, *Handbook on Planning, Design, and Maintenance of Pedestrian Facilities*, Report No. FHWA-IP-88-019, Federal Highway Administration, Washington, DC, March 1989.

Brambilla, R. and G. Longo, *Banning the Car Downtown-Selected American Cities*, Columbia University/Housing and Urban Development (USGPO Stock No. 023-000-00375-9), U.S. Government Printing Office, Washington, DC, 1977.

Brambilla, R. and G. Longo, *A Handbook for Pedestrian Action*, Columbia University/Housing and Urban Development, U.S. Government Printing Office, Washington, DC, 1977.

Brambilla, R. and G. Longo, *The Rediscovery of the Pedestrian - 12 European Cities*, Columbia University/Housing and Urban Development (USGPO - Stock No. 023-000-00375-9), U.S. Government Printing Office, Washington, DC, 1977.

Edminster, R. and D. Koffman, *Streets For Pedestrians And Transit - An Evaluation of Three Transit Malls in the United States*, UMTA-MA-06-0049-79-1, Urban Mass Transportation Administration, Washington, DC, February 1979.

Institute of Transportation Engineers, *Traffic Planning and Other Considerations for Pedestrian Malls*, Informational Report, Washington, DC, October 1966.

Kraay, J.H., "Strategies in Pedestrian Road Safety Research", reprinted in *Voice of the Pedestrian*, International Federation of Pedestrians, Autumn 1976.

Model Pedestrian Safety Program, User's Guide Supplement, Report No. FHWA/RD-87/040, Federal Highway Administration, Washington, DC, July 1987.

Pfefer, R.C., A. Sorton, J. Fegan, and M.J. Rosenbaum, *Synthesis of Safety Research Related to Traffic Control and Roadway Elements*, Volume 2, Report No. FHWA-TS-82-233, Federal Highway Administration, Washington, DC, December 1982.

Zegeer, C.V. and S. Zegeer, *Pedestrians and Traffic Control Measures*, National Cooperative Highway Research Program, Synthesis of Highway Practice Report 139, Transportation Research Board, Washington, DC, November 1988.

Work Zone Pedestrian Safety



17

Proper planning for pedestrians through and along construction areas is as important as planning for vehicle traffic, especially in urban and suburban areas. Pedestrian considerations, including access to bus stops and crosswalks, must be an integral part of each construction project. There are three considerations for pedestrian safety in highway and street work zones:

- ◆ Pedestrians must be separated from conflicts with work site vehicles, equipment and operations.
- ◆ Pedestrians must be separated from conflicts with mainline traffic moving through or around the work site.
- ◆ Pedestrians must be provided with a safe, accessible and convenient travel path that duplicates as nearly as possible the most desirable characteristics of sidewalks or footpaths.

When construction requires closing existing crosswalks and walkways, contractors and other work crews must provide temporary walkways and direct pedestrians to the safest, most convenient route possible. Walkways must be clearly identified and wheelchair accessible, protected from motor vehicle traffic and free from pedestrian hazards such as holes, debris, dust and mud.

When a parking lane exists next to a work site that closes a sidewalk, the parking lane may be used for the pedestrian detour route. Consideration may also be given to closing a moving lane on a multilane street to provide a continuous pedestrian path. When there is no available parking or curb lane, pedestrians must be diverted from a direct encounter with the work site by using advance signing as approved in the *Manual on Uniform Traffic Control Devices*.¹

Good engineering judgment in each work zone situation should readily determine the extent of pedestrian needs.

If required, safe crossings must be provided to the opposite sides of the street. Signing for these crossings should be placed at intersections so that pedestrians are not confronted with midblock work sites that will induce them to attempt skirting the work zone or making a midblock crossing. Pedestrians will infrequently retrace their steps to a prior intersection for a safe crossing. Therefore, ample advance notification is needed. Two approaches to accommodate pedestrians in a midblock work zone are shown in Figure 17-1.²

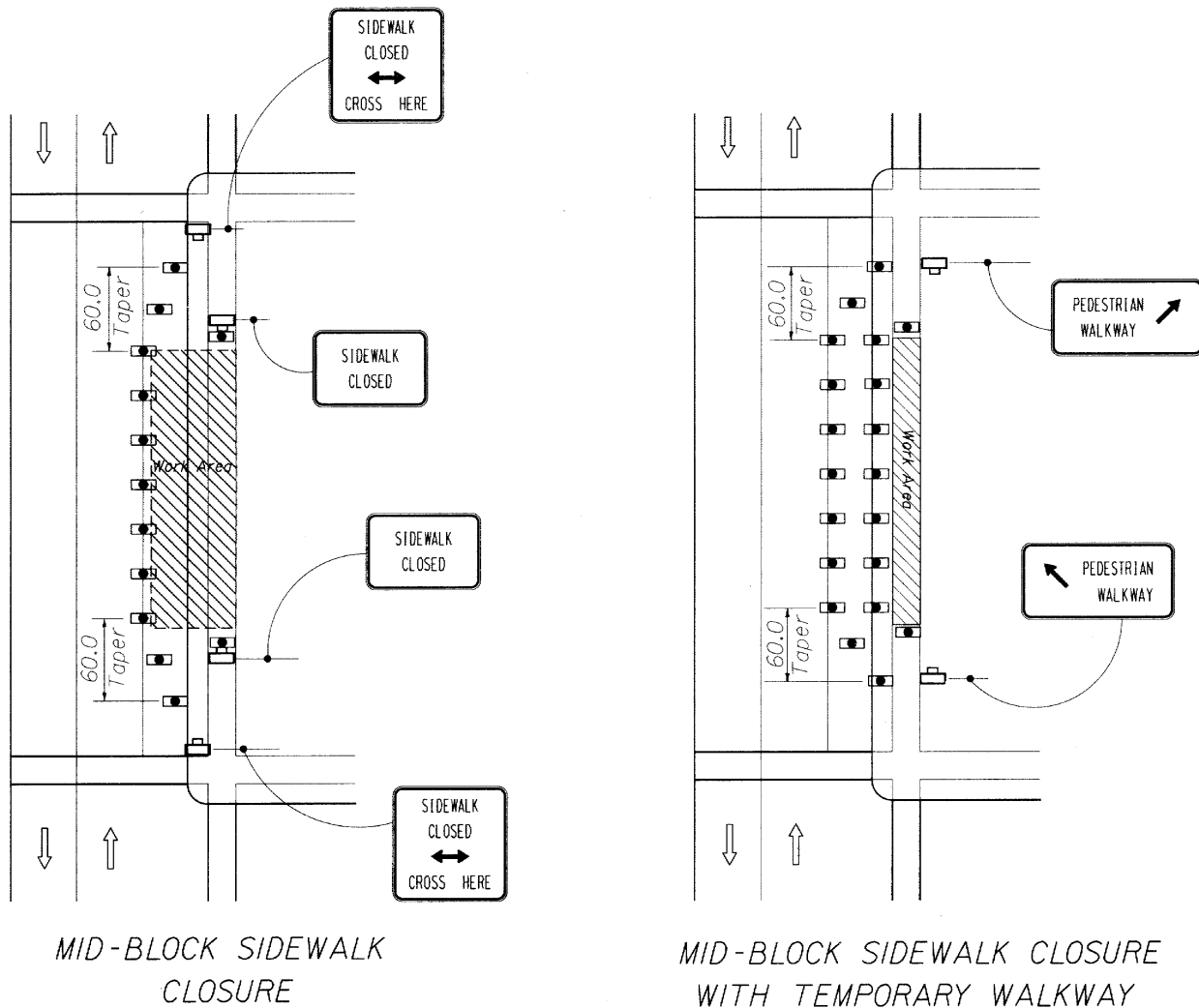


Figure 17-1. Two approaches to accommodate pedestrians in a midblock workzone.²

For temporary work zones of short duration, and under low speed conditions, it is acceptable to use traffic barricades and traffic signs to separate pedestrian traffic from work zone and vehicle traffic, if approved by the local engineer. Barrier walls are recommended.

At fixed work sites of significant duration, especially in urban areas with high

pedestrian volumes, pedestrian fences or other protective barriers may be needed to prevent pedestrian access into a construction site. This is particularly important near school areas. When used, pedestrian fences should be 2.4 m (8 feet) high to discourage people from climbing the fences.

For construction or demolition of buildings adjacent to sidewalks, a covered walkway may be needed to protect foot traffic from falling debris. These covered walkways should be sturdily constructed and adequately lit for nighttime use. External lighting and diagonal white and orange stripes on the exterior of the pedestrian walkway may be needed when placed next to traffic.

Covered walkways and pedestrian fences and other barriers must be designed to provide ample sight distance at intersections and crosswalks. Solid construction fences must be angled at corners or be replaced with chain link fencing to provide adequate visibility.

When pedestrians are judged especially vulnerable to impact by errant vehicles along moderate to high speed streets, foot traffic should be separated and protected by longitudinal barrier systems. Where a positive barrier is clearly needed, it must be of sufficient strength to avoid intrusion by an impacting vehicle into the pedestrian space. Short intermittent segments of longitudinal systems should be avoided. Upstream ends of the system must be flared or protected with impact attenuators properly fastened to the longitudinal barrier. For work zones adjacent to high speed traffic, wooden railings, chain link fencing with horizontal pipe railing and other similar systems are not acceptable.

Construction work zones should be inspected daily and monitored continuously for vehicle and pedestrian needs. Security guards or flagmen may be needed to monitor work sites and help control pedestrian traffic. Where construction vehicles and equipment need to cross pedestrian paths, flagmen, police officers or traffic signals should be used during crossing times.

Good engineering judgment in each work zone situation should readily determine the extent of pedestrian needs. Particular attention should be paid to nearby

pedestrian generators, particularly schools, parks and community centers. Officials should be contacted at these facilities to alert them of upcoming traffic control changes and accommodate special pedestrian needs, particularly for long-term and major construction activities. Use temporary crossing guards for construction in or near school zones.

References

1. *Manual on Uniform Traffic Control Devices for Streets and Highways*, Report No. FHWA-SA-89-006, Federal Highway Administration, Washington, DC, 1988.
2. *Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System*, Florida Department of Transportation, 1988.

Bibliography

- Bowman, B.L., J.J. Fruin, and C.V. Zegeer, *Handbook on Planning, Design, and Maintenance of Pedestrian Facilities*, Report No. FHWA IP-88-019, Federal Highway Administration, Washington, DC, March 1989.
- Humphries, J. and T.D. Sullivan, "Guidelines for the Use of Truck-Mounted Attenuators in Work Zones," *Transportation Research Record 1304*, Transportation Research Board, Washington, DC, 1991.
- Roadside Design Guide*, American Association of State Highway and Transportation Officials, Washington, DC, October 1988.

On-Street Parking

18

On-street parking has an important relationship to vehicle and pedestrian safety, the capacity and level of congestion on a street, the economic vitality of adjacent businesses and providing a service to nearby residences. It can create an effective buffer separating pedestrians on the sidewalk from motor vehicle traffic on the adjacent roadway. The presence of on-street parking reduces motorists' speed, further enhancing pedestrian safety and comfort. On the other hand, the presence of on-street parking results in less visibility between the motorist and pedestrians, especially for children.

The pedestrian dartout, often involving children, is one of the most common types of midblock pedestrian collisions in residential areas. Intersection and midblock bulbouts can reduce these problems. Since a large proportion of pedestrian collisions occur midblock, the restriction of on-street parking in areas with high levels of pedestrians may improve pedestrian safety. However, this is often not practical. Parking restrictions near intersections also play an important role in pedestrian safety. Florida state law states that "No person shall:

1. Stop, stand or park a vehicle:
 - a. on a sidewalk;
 - b. within an intersection;
 - c. on a crosswalk;

2. Stand or park a vehicle, whether occupied or not, except momentarily to pick up or discharge a passenger or passengers:
 - a. within 20 ft (6.1 m) of a crosswalk at an intersection;
 - b. within 30 ft (9.1 m) upon the approach to any flashing signal, STOP sign, YIELD sign, or traffic-control signal located at the side of a roadway."

The presence of on-street parking results in less visibility between the motorists and pedestrians.

The Manual on Uniform Traffic Control Devices (MUTCD) also recommends prohibiting parking within 30.5 m (100 ft) on the approach to a signalized midblock crosswalk, and 6.1 m (20 ft) beyond the crosswalk. Many local jurisdictions provide other ordinances to further manage on-street parking. On-street parking is generally not an issue in rural areas due to the sparse or undeveloped land use and the low numbers of pedestrians. Parking in urban and suburban areas may pose a problem to pedestrians and should be reviewed and managed to create an optimal balance between serving the adjacent land uses and serving pedestrians and other traffic needs.

Figure 18-1. On-street parking in commercial areas provides convenient parking and minimizes the negative impacts of off-street parking.



Urban Area Characteristics

The urban area where curb parking is typically present is in the central business district (CBD), the central city and in the suburbs. Each has unique characteristics related to the parking on various types of streets in each area.

Central Business District

The CBD normally has slower moving vehicles (typically 40 to 48 km/h (25 to 30 mph)), closely spaced traffic signals, marked crosswalks at most intersections, and a high demand for on-street parking and high parking turnover. Parking spaces are often governed by parking meters and, on occasion, the spaces may be marked on the pavement to better organize parked vehicles and to prevent vehicles from encroaching intersections and marked crosswalks. Red curb markings along with NO PARKING signs are often used to prevent cars from parking too close to intersections.

Loading zones and bus stops are often an issue in CBD areas due to the high

competition for limited curb space. Placing these zones adjacent to intersections often facilitates buses (or trucks using the loading zone) by providing a maneuvering area and minimizing the space needed for the zone. Bus stops should be placed downstream from a traffic signal or intersection (when practical) to encourage pedestrians to cross *behind* the bus. Downstream locations for commercial loading zones at intersections are also more practical since it will provide greater intersection visibility. However, this is sometimes difficult to accommodate since the business requesting the loading zone generally wants it adjacent to their building where they can directly view the truck being unloaded and for convenience.

Central City

The highest density of housing, and thus demand for on-street parking, occurs in the central city. Many of these areas were built before multiple vehicle households were common, and many of these homes do not have driveways or adequate off-street parking areas. People come home from work to find parking at a premium, which may

force them to park a significant distance from their homes. During winter months this may occur during hours of darkness with reduced pedestrian visibility.

Corner parking restrictions are often needed and should be enforced. Supplemental parking restriction signs, such as NO PARKING WITHIN 30 FEET (or NO PARKING WITHIN 50 FEET) may be needed below STOP signs to obtain better motorist compliance or assist in enforcement. NO PARKING HERE TO CORNER (OR CORNER TO HERE) signs often provide the most straightforward information to motorists at intersections.

Individual intersections should be field checked to determine which parking restrictions are needed to provide adequate visibility for pedestrians and motorists. Crash history is often an important tool to determine if additional parking removal is needed at an intersection. Worn, faded, defaced or damaged parking restriction signs should be replaced to command respect from the public. Although the MUTCD does not require these signs to be reflectorized, they should be reflectorized to improve motorist compliance at night and to be more visible (and less of a potential obstacle) to traffic at night.

Figure 18-2. Pedestrian sight distance and parking restriction for a parallel-parked vehicle, pedestrian standing at the curb.

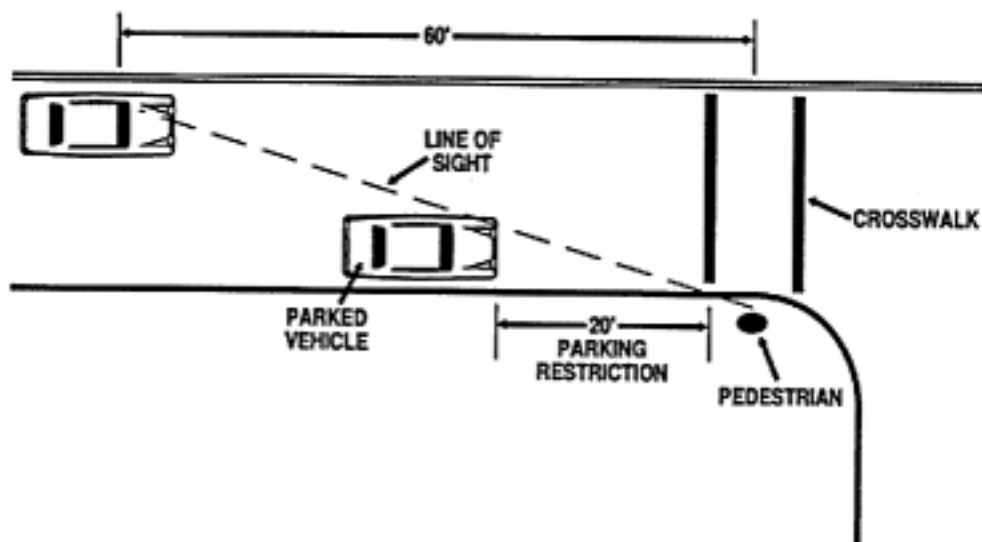
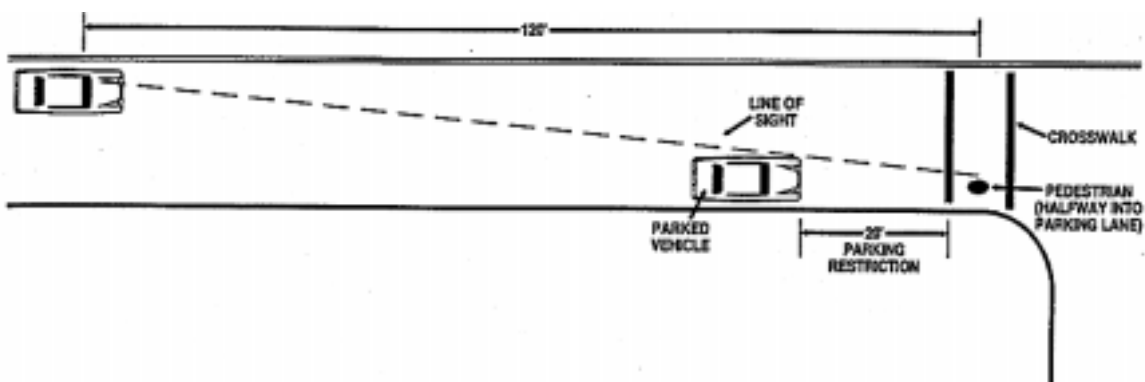


Figure 18-3. Pedestrian sight distance and parking restrictions — for a parallel-parked vehicle, pedestrian standing halfway into the parking lane.



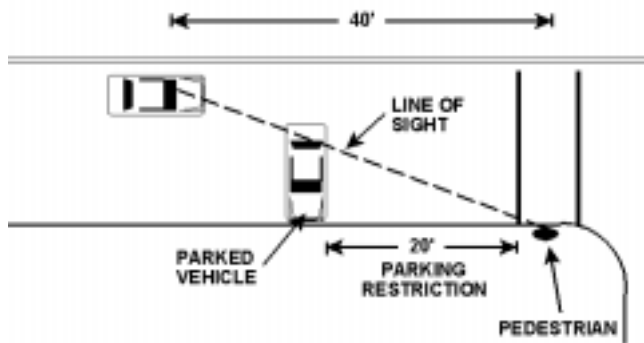


Figure 18-4. Pedestrian sight distance and parking restrictions—angle parking at 90 degrees.

Suburbs

Parking is generally restricted on the higher speed major arterials in suburban areas. However, parking is usually very common on lower speed collector streets and local streets. Housing is usually less dense and pedestrian volumes are lower than in CBD or central city areas, and parking restriction signs are usually not needed. In suburban areas, schools and parks warrant special attention.

School areas are areas with high numbers of young children, often with high levels of pickup and drop-off traffic during school crossing times. Most newer schools are designed with adequate on-site parking for teachers, parents and bus loading activities. This may not be the case at older schools, particularly during days of inclement weather. On-street parking around schools generally should be avoided. If on-street parent drop-off areas or bus loading area are needed, consideration should be given to providing loading bays. Parking should be restricted near crosswalks and driveways. Adult crossing guards should be stationed at busy crossing locations adjacent to elementary and middle schools to help monitor student activity and parent parking.

Removal of curb parking or designating on-street pickup zones along schools should

be coordinated with school officials. Enforcement of parking violations may be needed if parent notification through the school and adult crossing guard/teacher monitors fails to correct the problem.

Overflow parking problems may also occur near high schools and community colleges resulting in complaints from nearby residents. This overflow student parking is generally more of a nuisance and social problem, and usually does not pose a safety problem unless students park too close to driveways or intersections. In some cases residents should be allowed to request parking restrictions during the school day in front of their homes (i.e., NO PARKING 7 AM - 3 PM SCHOOL DAYS ONLY). These restrictions apply to *all* motorists, including the residents. Another potential option is a resident permit parking program, which requires the local jurisdiction to pass a special ordinance and establish guidelines for the program.

Community or regional parks are generally located along collector or local streets and may attract large numbers of vehicles on weekends or for special events. These facilities should be designed with adequate off-street parking. However, there may be times where on-street parking demand exists. A similar problem occurs along *recreational fields* such as soccer fields or baseball diamonds during practice sessions or league play. In many instances these athletic fields are adjacent to schools with adequate off-street parking, but these parking areas may be less convenient than adjacent on-street parking. On occasion consideration may be given to prohibiting curb parking to improve pedestrian safety. Not only do the parked cars obstruct the view of children who may run into the street, but every space between cars represents a potential crossing location. It is best to fence the areas along parks and athletic fields to channelize pedestrian crossings and help minimize midblock dartouts. Parking restrictions can be limited to pedestrian crossing areas and near

driveways. These areas should also be evaluated for lighting if nighttime pedestrian activity is present.

There are some instances where on-street parking is preferable or necessary due to a lack of alternate parking areas. Prohibiting parking on the side of the street closest to the park or athletic field may require everyone to cross the street to their parked vehicles. Prohibiting parking on the far side of the street and allowing parking adjacent to the park or athletic field may be a better option if practical. In some cases curb parking restrictions may cause overflow parking into nearby neighborhoods.

Roadway Type

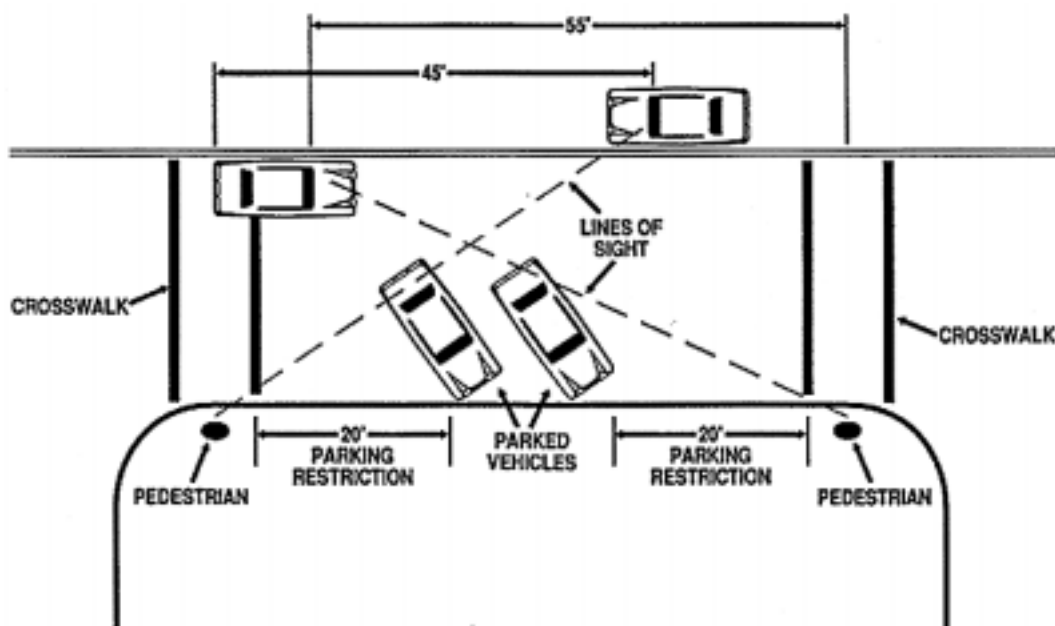
Not only is the location within the urban area a determining factor in the type of on-street parking restrictions, but the type of roadway (major arterial vs. collector street) must also be considered.

Major Arterials are wider and have higher traffic levels and higher speeds.

Pedestrians are generally accommodated at marked (or unmarked) crosswalks and at traffic signals. Parking is generally prohibited outside the CBD. The primary considerations generally relate to overall traffic safety and traffic capacity. The removal of parking lanes often allows for added through lanes or a two-way-left-turn lane. Improved pedestrian conditions may be the by-product of these actions. If parking exists along higher speed arterials, more parking restrictions should exist. For streets with speed limits of 55 to 70 km/h (35 to 45 mph), it is recommended to restrict parking within 15.3 m (50 ft) on the approach to the crosswalk. Streets with speed limits greater than 70 km/h (45 mph) should have parking restricted within 30.5 m (100 ft) of the crosswalk.

The width, traffic levels, traffic speed and function of the collector street are different from a major arterial street. Collector streets tend to have more on-street parking and neighborhood shopping centers or residential land uses. Under most

Figure 18-5. Pedestrian sight distance and parking restrictions — angle parking at less than 90 degrees.



circumstances curb parking is safely accommodated on collector streets. In some cases neighborhood shopping centers where adequate off-street parking is not available may pose a problem to pedestrians. Consideration for visibility at driveways, intersections and pedestrian crossings may conflict with the merchant's desire to provide as much convenient curb parking as possible. Signing or curb marking may be used to limit parking at pedestrian crossing areas. A review of curb parking may also be needed in dense residential areas with insufficient off-street parking. In both cases parking should not be removed until after consulting with and notifying the adjacent property owners or residents.

Sight Distance and Parking Restrictions

The primary purpose of restricting parking at intersections is to improve sight distance. In the past, this has been done mainly for the motorist and has resulted as a side benefit for pedestrians. The basic requirement for sight distance also applies to pedestrian crossing areas, and is based on safe stopping distances.² However, pedestrians have different operating characteristics and different capabilities than motor vehicles. For example, a pedestrian moves slower than a motor vehicle, and can stop faster or start faster than a motor vehicle. An adult pedestrian can see over or through a parked car. Pedestrians can safely position themselves at the edge of a parking lane to see around parked cars without exposing themselves to traffic. On the other hand, children may not have the maturity of a motorist and may be less apt to stop and look for traffic before crossing. Small children and pedestrians in wheelchairs usually can not see over or through a parked vehicle and are less likely to be seen by approaching motorists.

Figure 18-2 shows the condition of a pedestrian standing at a curb with the typical restriction of parking prohibited

within 6.1 m (20 ft) of the crosswalk. With parallel parked vehicle, a pedestrian can see 18.3 m (60 ft) without looking through or over the vehicle. If the pedestrian steps halfway into the parking lane, about 1 m (3 ft) into the street, the visibility increases to 36.6 m (120 ft) as shown in Figure 18-3. If the pedestrian moves to the edge of the parking lane, the sight distance is limited only by the individual's visual capacity.

Angle parking at 90 degrees to the curb has a much more dramatic effect on visibility at intersections as shown in Figure 18-4. If 90 degree parking exists within 6.1 m (20 ft) of a crossing, the pedestrian on the curb can only see 12.2 m (40 ft) beyond the parked car, and must walk 3.7 m to 4.9 m (12 to 16 ft) into the street to adequately see approaching traffic. To obtain the same visibility as parallel parking conditions at intersections, 90 degree angle parking should be prohibited within (9.2 m) 30 ft of the intersection. Angle parking at less than 90 degrees, for example 60 degrees, increases available sight distance for pedestrians looking to the left, but reduces it for the pedestrian looking to the right (Figure 18-5).

Fortunately angle parking is only practical in low speed CBD areas and is not practical on higher speed streets for safety purposes due to the awkward backing maneuver needed to leave the parking space. Angle parking should also not be allowed along the shoulders of high speed major arterials where the motorist has to back into the street. On occasion, signs such as PARALLEL PARKING ONLY may be needed to change undesirable parking patterns along the shoulders of major arterials.

Parking removal may be a double edged sword. While it may improve sight distance and increase the capacity of a roadway, parking removal will generally encourage higher travel speeds and longer effective crossing distances, which are not desirable for pedestrians.

Accident studies may be needed to determine if parking removal is needed. At times special measures may be needed to compensate the loss of parking to adjacent homeowners and businesses. If problems only occur during certain times of the day, part-time parking restrictions should be considered.

References

1. *Manual on Uniform Traffic Control Devices for Streets and Highways*, Report No. FHWA-SA-89-006, Federal Highway Administration, Washington, DC, 1988.
2. *A Policy on Geometric Design of Highways and Streets*, American Association of State Highway and

Transportation Officials, Washington, DC, 1984.

19

Street Lighting For Pedestrians

Street lighting is a very helpful tool for pedestrian safety, security, comfort and the economic vitality of a urban area (Figure 19-1). Ample lighting not only allows pedestrians to be better seen by motorists at night, it allows pedestrians to see better and feel more secure during nighttime hours. Street lighting allows pedestrians to read street name signs or to identify any obstacles in or near the sidewalk or path at night. Providing high levels of lighting is critical for revitalizing downtown urban areas and is needed to encourage pedestrian shopping and attendance at events and other recreational activities at night. In these areas, it is best to consider separate pedestrian level lighting, directly over the sidewalk area. In some cases, this lighting may be designed directly into nearby buildings and structures.

In general, lighting may be warranted at locations where the local governmental agency concurs that lighting will contribute substantially to the efficiency, safety and comfort of vehicle and pedestrian traffic.¹ It

is not practical to develop specific lighting warrants to satisfy all roadway conditions.

Often the decision to provide lighting or a specific level of lighting is linked to funding levels and other concerns. In rural

Pedestrians prefer lighting that makes nighttime conditions appear closer to daytime conditions.

areas and some neighborhoods on the fringe of suburban areas, residents may desire to have no street lighting to preserve a “rural” feel to the area. While there is no requirement to have street lights, this desire must be tempered with the concern to provide for pedestrian and other traffic needs.

It is a desirable practice to provide street lights at all public street intersections where there is an available power source. For major arterial streets in urban and suburban areas, continuous street lighting should be installed. Information on the spacing of street lights can be found in the Plans Preparation Manual. However, light spacing may be increased to take advantage of existing power poles rather than have an

Figure 19-1. Street lights improve pedestrian operations and security.



extra series of roadside obstacles (utility poles). For arterials with raised medians or wide streets of five or more lanes, double-sided lighting is preferable to single-sided light. It is best to install street lights on both sides of the street, rather than double headed lights in the median, to provide more light where pedestrian traffic exists.

For collector streets, continuous lighting should be installed if funds are available and there is a justification because of neighborhood security, traffic volume, or nighttime crashes which show that continuous lighting may be helpful. If justified, one-sided lighting is usually adequate.

For local streets, midblock lighting should be installed bordering parks, schools, large community centers, churches and housing projects where an engineering study demonstrates a need. Midblock lights may be installed on any residential street if funding is available. The spacing of the lights is directly related to the available funding level for lighting. A typical minimum spacing of 76 m (250 ft) is recommended, but the spacing may be closer if funds are available. Due to a concern for residents living near a proposed

street light, a petition should be submitted showing approval for the light by the adjacent residents. Shielding or lower-height lighting can be used to minimize light shining into nearby residences.

As a practical matter, street lights should be installed with all new development. Developers should be required to pay for installation of the street lights and fixtures subject to the specification and approval of the local jurisdiction. Lighting plans should be reviewed with other utilities to take advantage of existing power poles, and against landscaping plans to avoid future conflicts with trees. Street lights should be installed concurrently with all other off-site improvements.

Street light poles, like other power poles, should be installed behind the sidewalk, or at least 1.8 m (6 ft) behind the curb. If an existing utility line is not located adjacent to the street or pedestrian walkway, a separate set of street light poles may be needed.

Lighting for Other Pedestrian Facilities

Lighting should also be considered for

other pedestrian facilities where nighttime activity is expected. Pedestrian level lighting is recommended for pedestrian paths and walkways on separate rights-of-way or easements. The primary concern is for reduced likelihood of crime and improved pedestrian comfort and security. Lighting should also be considered for pedestrian underpasses and overpasses. Twenty-four hour lighting may be needed in pedestrian or mixed-use tunnels. Daytime lighting is generally not needed when the length to height ratio of a tunnel is less than or equal to 10:1.¹ When the length to height ratio exceeds 10:1, it is necessary to analyze the specific geometry, traffic conditions, and level of pedestrian activity to determine if lighting is needed. For short underpasses, favorable positioning of the lights adjacent to the underpass can often provide an adequate level of nighttime illumination without the need for light fixtures on the structure.

Vandal resistant fixtures are recommended where the light fixtures are at a lower level, or where they are more prone to vandalism. An inspection program should be established to review the lighting at periodic intervals.

Crosswalks should be located to the extent practical to take advantage of existing street lights where pedestrian activity is expected at night. In any case, nighttime inspections should be utilized to review conditions and determine if additional lighting is helpful, and where it would be most beneficial. This can also be used to evaluate nighttime pedestrian activity and light available from other sources. In some cases tree trimming may improve the effective illumination of the pedestrian crossing or sidewalk area.

While continuous lighting to provide a consistent and uniform level of light is highly desirable, it is also desirable to consider additional lighting at select pedestrian crossing locations where nighttime activity is frequent. This may be

accomplished by providing an additional street light, or by providing a brighter light. A review of nighttime pedestrian accidents or activity may be used to identify locations where additional lighting may be helpful.

Pedestrians prefer lighting that makes nighttime conditions appear closer to daytime conditions. Of the primary types of lighting available for pedestrian facilities (low pressure sodium, high pressure sodium, and mercury vapor), mercury vapor lighting provides the least color distortion. However, high pressure sodium is more energy efficient and is an acceptable alternative. While low pressure sodium street lights provide a higher output of light at a lower cost, pedestrians (and drivers) generally feel less comfortable with the yellow light produced. In most cases the high pressure sodium street lights offer the most overall advantages when lighting the street area.

References

1. *An Informational Guide for Roadway Lighting*, American Association of State Highway and Transportation Officials, Washington, DC, 1984.

Bibliography

Rowan, N.J., and N.E. Walton, "Lighting of Traffic Facilities," *Transportation and Traffic Handbook*, Chapter 20, Institute of Transportation Engineers, Washington, DC.

Walton, N.E. and N.J. Rowan, *Warrants for Highway Lighting*, National Cooperative Highway Research

Program Report No. 152, Transportation Research Board, Washington, DC, 1974.

Grade-Separated Crossings

Grade-separated crossings are facilities that provide for pedestrians and motor vehicles to cross at different levels. Such facilities can greatly reduce pedestrian-vehicle conflicts and potential accidents. Not only have grade-separated structures been found to substantially improve pedestrian safety, they can also reduce vehicle delay, increase highway capacity, and reduce vehicle crashes when appropriately located and designed.^{1,2} However, grade-separated crossings are expensive and they work only in limited settings.

Types of Facilities

Several types of grade-separated crossings have been used, including:

Overpasses:

1. Pedestrian Overpasses/Bridges - These are passageways for pedestrians constructed over a roadway in which stairs or ramps generally lead up to the overpass. In some cases, however, the road is depressed and the bridge is at ground level.

Grade-separated crossing can greatly reduce pedestrian-vehicle conflicts and potential accidents.

2. Elevated Walkways - These refer to sidewalks or walkways above ground level that often run parallel to the flow of motor vehicles. Such facilities may be freestanding or connected to adjacent buildings.
3. Skywalks/Skyways - These typically refer to enclosed walkways built one or more levels above ground level that connect buildings at midblock. These crossings allow for walking between buildings without being exposed to inclement weather and are especially beneficial to elderly and physically



Figure 20-1. Grade-separated crossings improve pedestrian safety.

disadvantaged pedestrians with lesser mobility.

Underpasses:

4. Pedestrian Tunnels/Underpasses - These generally involve stairs or ramps that lead down to a below-ground passageway. In some cases, however, the underpass is at ground level and the road is elevated.
5. Below-Grade Pedestrian Networks - These consist of extensive underground walkways that carry pedestrians parallel and perpendicular to the flow of motor vehicles traveling above them. These networks are sometimes used in conjunction with subway systems.

Planning Considerations

Locations that are prime candidates for grade-separated crossings are in areas where the pedestrian attractors such as shopping centers, large schools, recreational facilities, parking garages, or other activity centers are separated from the pedestrian generators by high-volume and/or high-speed arterial streets. Grade-separated facilities are

sometimes found in suburban and rural areas to connect residential areas with shopping centers or schools that are separated by freeways or high-speed arterial highways. In downtown areas, urban renewal projects provide an opportunity for adding grade-separated crossings.^{2,3,4,5}

The effectiveness of grade-separated crossings depends on their perceived ease of accessibility by pedestrians, because an overpass or underpass will not necessarily be used simply because it improves safety. Instead, pedestrians tend to weigh the perceived safety of using the facility against the extra effort and time required.² Studies have also shown that grade-separated crossings should ideally be on the normal path of pedestrian movements. However, fences, medians, railings, or other barriers may also be needed to prevent pedestrians from crossing at-grade.^{2,7} Otherwise, pedestrians tend to cross at locations they believe to be more direct.

Overpasses vs. Underpasses

The decision of whether to use an overpass or underpass involves the consideration of the relative advantages and disadvantages of each. Overpasses, more

commonly used than underpasses, require more vertical separation to provide clearance for large trucks. Underpasses need to be only 3.1 m (10 feet) (less than half the height of an overpass) and require shorter stairs or ramps and less right-of-way than overpasses. Two disadvantages of underpasses are their possible greater expense and costs related to relocation of utility lines, and possible drainage problems. Also, potential security problems often discourage pedestrians from using underpasses, particularly at night. The presence of activity centers at or near a grade-separated crossing helps to reduce crime and allows users to feel more secure. Overpasses should be enclosed to prevent the dropping of rocks or other debris onto vehicles passing below.^{2,7}

Warrants for Overpasses and Underpasses

Because of the high costs associated with grade-separated facilities, they should be incorporated into the early stages of planning new developments which are intended to generate substantial volumes of pedestrians. General guidelines and criteria for installing overpasses and tunnels are as follows:

Overpasses:

1. Work best if a very high volume of both motorized traffic and pedestrian activity exists. An overpass placed where there is an almost total lack of gaps, such as on a well-used freeway or nearly saturated multilane highway, may meet this warrant. When pedestrian activity is low, crime problems increase. Any perception of crime eliminates those few remaining pedestrians who desire to use the facility.
2. Are needed across roads with high speeds and many lanes with limited gaps. In this high risk crossing condition, there may be more gaps, but the conditions are so risky that many pedestrians will use the overpass. Such overpasses may be warranted near schools or other activity centers such as sporting or entertainment

complexes.

3. Can connect two activity centers. Sites with the above roadway conditions, or a school where the highway separates athletic fields or a second campus from the main campus, are warranted locations. When these conditions exist, it is best to begin the crossing from the second floor of one building and cross to a terraced earth wall on the opposite side. Pedestrians have a strong dislike for long stairs and ramps.
4. Work best with wide bridges. Bridges 3.1 m (10 feet) or more in width are best. They should be open and well lit and should minimize the need to use stairs or ramps to get across the bridge.
5. Require activity centers. When possible, have commercial kiosks or other activity centers at or near an overpass to curtail crime and unwanted activity.
6. Can be used with trails. On long, straight trail approaches, virtually all users will make use of an overpass. However, pedestrians approaching an overpass horizontally along the roadway are not inclined to go out of their way to reach the structure. Some use will be achieved by installing stairs and ramps. An even better action is to terrace the approach and allow a natural climb to the bridge structure.
7. Need to meet ADA standards.

Tunnels:

1. Are well lit. Consider using a median in the road and placing a large skylight in the center of the tunnel for natural light. Use overhead luminaries above this skylight to further light the tunnel at night.
2. Have vandal-resistant walls. Pedestrians do not like graffiti and other acts of vandalism. The best tunnels use artwork, glazing, or other methods to reduce vandalism.

3. Split the grade. Individuals about to enter a tunnel want to see the horizon at the far side. This effect is achieved by raising the roadway at least halfway, and thus depressing the tunnel only half of the elevation change.
4. Require robust activity. Commercial kiosks, entertainment complexes, and other activity centers are even more essential for successful tunnels, especially for major tunnels where undesirable elements might otherwise congregate.
5. Need to meet ADA standards.
6. Have good drainage - make drainage grates pedestrian-friendly.
7. Have video monitors. These need to be monitored, otherwise pedestrians will get a false sense of security.

While these criteria above are somewhat general, they do provide important factors for designers, planners, and developers to consider in determining where pedestrian facilities should be constructed. More specific warrants were developed by Axler in 1984 for grade-separated pedestrian crossings:⁸

1. The hourly pedestrian volume should be more than 300 in the four highest continuous hour periods if the vehicle speed is more than 65 km/h (40 mph) and the proposed sites are in urban areas and not over or under a freeway. Otherwise, the pedestrian volume should be more than 100 pedestrians in the four highest continuous hour periods.
2. Vehicle volume should be more than 10,000 in the same four-hour period used for the pedestrian volume warrant or have an ADT greater than 35,000 if vehicle speed is over 65 km/h (40 mph) and the proposed site(s) are in urban areas. If these two conditions are not met, the vehicle volume should be more than 7,500 in the four hours or have an ADT greater than 25,000.
3. The proposed site should be at least 183

m (600 ft) from the nearest alternative “safe” crossing. A “safe” crossing is defined as a location where a traffic control device stops vehicles to create adequate gaps for pedestrians to cross. Another “safe” crossing is an existing overpass or underpass near the proposed facility.

4. A physical barrier is desirable to prohibit at-grade crossing of the roadway as part of the overpass or underpass design plan.
5. Artificial lighting should be provided to reduce potential crime against users of the underpasses or overpasses. It may be appropriate to light underpasses 24 hours a day and overpasses at nighttime.
6. Topography of the proposed site should be such as to minimize changes in elevation for users of overpasses and underpasses and to help ensure that construction costs are not excessive. Elevation change is a factor that affects the convenience of users.
7. A specific need may exist for a grade-separated crossing based on the existing or proposed land use(s) adjoining the proposed development site that generates pedestrian trips. This land use should have a direct access to the grade-separated facility.
8. Funding for construction of the pedestrian overpass or underpass must be available prior to a commitment to construct it.

Note that these criteria provide specific volumes of pedestrians and motor vehicles and vehicle speeds for which a pedestrian overpass or underpass is justified. However, while these specific values may be considered appropriate in certain instances, many economic and other factors also should be considered before making a final decision about installing high-cost grade-separated facilities for pedestrians.

Formal procedures have been established for assigning benefits and costs associated with adding overpasses and underpasses.

Benefits are weighed based on their	perceived importance to the local community. Lists are given in Tables 20-1 and 20-2 of benefit variables and cost items associated with such facilities. Benefits can include not only improved safety to pedestrians, but also reduced travel time, maintenance of the continuity of a neighborhood, and many others. Facility costs include design and construction costs, site preparation, finishing touches (e.g., lighting, landscaping), and operation and maintenance costs. Further details on quantification of benefits and costs for grade-separated pedestrian crossings are given in NCHRP Report No. 189 (<i>Quantifying the Benefits of Separating Pedestrians and Vehicles</i>, 1978) and NCHRP Report No. 240 (<i>A Manual to Determine Benefits of Separating Pedestrians and Vehicles</i>, 1981)^{9,10,11}
Other Transportation	
Safety	
Environment/ Community	Pedestrian Transportation 1. Travel time 2. Ease of Walking 3. Convenience 4. Special Provision for Various Groups
Residential/ Community	5. Motor Vehicle Travel Costs 6. Use of Automobiles 7. Impact on Existing Transportation Systems 8. Adaptability to Future Transportation Development Plans
Commercial/ Industrial Districts	9. Societal Cost of Accidents 10. Accident Threat Concern 11. Crime 12. Emergency Access/Medical & Fire Protection
Urban Planning	13. Pedestrian-oriented Environment 14. Effects of Air Pollution 15. Noise Impacts 16. Health Effects of Walking

Table 20-1. Pedestrian facility evaluation variables.²

- | | |
|---|--------------|
| 17. Residential Dislocation | |
| 18. Community Pride and Cohesion | |
| 19. Community Activities | |
| 20. Aesthetic Impact, Compatibility with | Neighborhood |
| | |
| 21. Gross Retail Sales | |
| 22. Displacement, Replacement, or Renovation Encouraged by Facility | Required or |
| 23. Ease of Deliveries & Employee Commuting | |
| 24. Attractiveness of Area to Business | |
| | |
| 25. Adaptability to Future Urban Development Plans | |
| 26. Net Change on Tax Receipts and Other Revenue | |
| 27. Public Participation in the Planning Process | |
| | |
| 1. Design and architect costs | |
| 2. Financing costs and legal fees | |
| 3. Site preparation | |
| ◆ Real estate acquisition | |
| ◆ Demolition | |
| ◆ Drainage | |
| ◆ Grading | |
| ◆ Utilities relocation | |
| ◆ Foundations | |
| ◆ Required permits | |
| 4. Construction | |
| ◆ Height, width and length of facility | |
| ◆ Length of span (if any) | |
| ◆ Method of support | |
| ◆ Enclosures (if any) | |
| ◆ Materials | |
| ◆ Walkway paving, curbs | |
| 5. Finishing touches | |
| ◆ Lighting | |

- ◆ Street furniture
- ◆ Amenities
- ◆ Landscaping
- 6. Operation and maintenance
 - ◆ Cleaning
 - ◆ Gardening
 - ◆ Maintenance and repairs
 - ◆ Lighting
 - ◆ Security
 - ◆ Taxes
 - ◆ Insurance

Control, May 1983.

7. Van Der Voordt, D.J. "Underpasses for Pedestrians and Cyclists - User Requirements and Implications for Design," *Transportation Planning and Technology*, 1983, Vol. 8.

8. Axler, E.A. *Warrants for Pedestrian Over and Underpasses*, Report No. FHWA/RD-84-082, U.S. Department of Transportation, Washington, DC, July 1984.

9. Richter, R.A. and C.L. King. *Guidelines*

Table 20-2. Major cost components of pedestrian facilities.²

References

1. Zegeer, C.V. and S.F. Zegeer. *Pedestrians and Traffic-Control Measures*, Synthesis of Highway Practice No. 139, Transportation Research Board, Washington, DC, November 1988.
2. Bowman, B.L., J.J. Fruin, and C.V. Zegeer. *Planning, Design, and Maintenance of Pedestrian Facilities*, Federal Highway Administration, Report No. FHWA IP-88-019, October 1988.
3. Institute of Transportation Engineers. "Pedestrian Overcrossings - Criteria and Priorities," *Traffic Engineering*, October 1972.
4. Prokopy, J.C. *A Manual for Planning Pedestrian Facilities*, Report No. DOT-FHWA-74-5, U.S. Department of Transportation, Federal Highway Administration, Washington, DC, June 1974.
5. Lindley, J.A. "A Method for Evaluating the Feasibility of Grade-Separated Pedestrian Crossings," 1986 TRB Meeting, Transportation Research Board, Washington, DC.
6. Allos, A.E. "Usage of Pedestrian Footbridges," *Traffic Engineering and*

for Making Crossing Structures Accessible - An Implementation Manual, Report No. FHWA-RD-80-02, Federal Highway Administration, Department of Transportation, Washington, DC, August 1980.

10. Braun, R.R. and M.F. Roddin. *Quantifying the Benefits of Separating Pedestrians and Vehicles*, NCHRP

Report No. 189, Transportation Research Board, Washington, DC, 1978.

11. Rodding, M.F. *A Manual to Determine Benefits of Separating Pedestrians and Vehicles*, NCHRP Report No. 240, Transportation Research Board, Washington, DC, November 1981.

Boulevards

Suburban strip style streets emphasize speed and volume for motor vehicles, and de-emphasize human activity. Better forms for streets and highways are needed. Boulevards still allow volume, but reduce urban area speed. The modern boulevard was perfected in Paris, then used heavily throughout Europe and North America. Examples abound in most older U.S. cities, with the park movement in the late 1800's and the city beautiful movement in the early 1900's.

Getting back to the basics of good urban form, boulevards are now being reconsidered in many cities throughout America. They are friendlier for pedestrians, they elicit successful transit, make for successful commercial districts, and often are accepted by nearby residents as an approved form of roadway widening.

Best known boulevards include New Orleans classic St. Charles sporting a central median allowing the oldest continuous operating trolley in America; Monument Avenue gracing some of the finest homes in Richmond, Virginia; Fairmount Boulevard in Cleveland, Ohio; K Street in Washington, D.C.; and Dolores Street in San Francisco. One of the freshest new boulevards is the 1990's remake of Pennsylvania Avenue in Washington, D.C. This bustling eight-lane roadway has generous 9.2 - 18.3 m (30-60 foot) wide sidewalks with ample plantings of trees, and daytime parking in one of the

Boulevards are being reclaimed in diverse downtowns such as Baltimore, Boston, Cleveland, and Denver.

lanes to buffer the vehicle movements from adjacent pedestrians. Other new boulevards are being reclaimed in diverse downtowns such as Baltimore, Maryland; Boston, Massachusetts; Cleveland and Columbus, Ohio; Denver, Colorado; and Portland, Oregon.

This chapter is intended as an introduction to what boulevards are and how they are used. The design considerations of boulevards are too complex to be covered in a single chapter.

Figure 21-1. K Street in Washington, D.C., is an example of a successful boulevard.



What is a Boulevard?

The Classic Boulevard is inviting as a new form for moving vast volumes of traffic, yet creating an exciting partnership for successful people oriented commerce and neighborly places to live and play alongside. This form is characterized by a central roadway of at least four lanes, for generally through and non-local traffic. On both sides of the central roadway, tree-lined medians separate it from access lanes and sidewalks.

An example of this classic design is “K” Street in downtown Washington, D.C. (Figure 21-1). With four lanes in the center, two twelve foot side medians, then nineteen feet for a combined parking and access lane on either side and 6.1 m (20 feet) for each sidewalk, the cross section finishes out at 46 m (150 feet), building to building. The success of the access street in this classic boulevard model is that it strips away many of the turning movements. The medians allow superior transit operations, while the pedestrians move freely from the sidewalk space to the medians for temporary storage while awaiting a bus.

Why Are Boulevards Better than the Alternative?

Boulevards will not work everywhere, but where they do work there are many benefits. From the perspective of the pedestrian there is much to gain from a boulevard. Boulevards often create pleasant environments with shade, reduced corridor traffic speeds, low turning speeds, parking buffers to the street and ample width sidewalks. Often boulevards result in more successful adjacent neighborhood and commercial land use. There is often room for parks, plazas and cafes. The increased activity of a boulevard leads to reduced crime. For the motorist there is a significant reduction in stress. Boulevard style streets give the perception to motorists that their travel times and distances are 20-40% shorter than reality.

Esplanade — Chico, California

Chico is a small college and agricultural town in California’s Central Valley. This street was not originally a boulevard. It was

reconfigured in the 1950's. Residents of Chico have voted the Esplanade the best street in the city. The Esplanade is the major north/south traffic street and business street serving State Highway 99. The boulevard has four lanes occupying 8.2 m (27 feet) on each side of a 3.1 m (10 foot) center median. A twenty-eight foot and a ten-foot median are found on the two sides, followed by a 6.2 m (20 foot) parking and access lane. Sidewalks are found at the back of the parking lanes. The boulevard is 15 blocks long, and is graced by bungalow style homes. The tree plantings are large Sycamore and London Planes spaced 9.2 - 10.7 m (30-35 feet). Signal timing is set at 45 km/h (28 mph) in the center, with a new signal every two blocks. Traffic in the center moves at 50 km/h (31 mph), while 34 km/h (21 mph) is characteristic on the access roads. Virtually all traffic (875 average VPH per direction) moves in the center. Only a dozen cars an hour were found moving along the side streets. Bicycles use the access roads.

Comparisons Between Boulevards

A. Jacobs found that the low operating speeds of boulevard streets allow motorists and pedestrians to intermingle safely and efficiently. There are far fewer conflicts than the high numbers of users would suggest. Although the streets are capable of carrying very high volumes of pedestrians and vehicles, the physical space remains very pleasant. Boulevard streets were compared to similar volume roadways in the same part of town. In all cases the boulevard streets were at least as safe as the comparison road. The areas are often quieter than other styles of streets, nicely shaded, and there is plenty of human activity and purposeful lingering.

What Designs Are Most Safe?

Boulevards that emphasize low travel speeds, especially on access lanes, produce the best results. Motorists are mindful of



Figure 21-2. Neighborhood boulevard streets produce low-speed travel. Proper placement and undercutting of trees keep sight lines open.

traffic signals and stop signs. And generally pedestrians are watchful of cars and they pay attention to signals. Motorists are more considerate of pedestrians, partly because they see more of them and they are traveling at speeds where courtesy is easy (Figure 21-2).

Wide traffic lanes and long blocks are associated with higher speeds and more midblock crossings by pedestrians. Pedestrians are frustrated by long walks to intersections, and on the higher speed roads their injury rates and injury severity go up.

Intersections

Classic boulevard intersections can be highly complex. Sketches showing the potential crossing conflicts defy logic and common sense. Potential crash conflicts are staggering. Yet in application, especially when the physical features of design are well crafted, the intersection has a harmony and quality producing limited and low impact crashes. Based on volume, pedestrian movements are very safe. As an example of the very complex movements and the very low vehicle crash rate, France's Avenue Marceau has four streets intersecting at one point. Accident data at this intersection reveals that none of the intersections have more than ten crashes a year, which was the

Figure 21-3. This boulevard has an attractively-landscaped median. The sidewalk offers pedestrians a scenic, tree-lined place to walk.



threshold for entry into the report that was provided.

Removing complexity from rather straightforward intersections may not always make them safer. Mangrove Avenue in Chico runs parallel to the Esplanade, has significantly fewer intersections, and carries about the same amount of traffic. Major intersections have lights timed to eliminate left-turn conflicts. And yet, Mangrove has a similar crash rate to the Esplanade. The simplification of the intersections of boulevard streets, such as in Washington D.C., does not improve safety, but possibly erodes safety. A. Jacobs points out that one-way boulevards, which greatly simplify complex intersections, have a higher crash rate than those that are more complex.

Access Lanes

On urban streets, where abutting uses have direct access to the street, with the constant need for pickup and drop-off, and with deliveries to shops, the disturbance to through traffic caused by single- and double-parking, and by cars pulling in and out of

parking, is much greater on normal streets than on boulevards, where it is unobtrusively carried out on the access lanes. Access roads should be kept relatively narrow and slow. If desired, bike lanes can be added to access lanes, along with parking, to narrow wide existing lanes to those that are safer. It is best if blocks are short, and for signal phasing to favor lower speed (40-48 km/h) (25-30 mph) center travel lane speeds.

Boulevards Work Best When the Pedestrian Is an Equal

Note that all successful boulevards have ample space for the pedestrian. Those that tend to fail for both motorists and pedestrians leave the pedestrian as a secondary consideration. Along a classic boulevard, pedestrians require:

- ◆ Narrow access roads
- ◆ A buffer (parking, nature strip or bike lanes)
- ◆ Ample lines of shade trees
- ◆ Short blocks

- ◆ Good street lighting

and ideas, boulevards have lasting value.

Desired features include:

Outdoor parks

- ◆ Cafes, kiosks, phone booths
- ◆ Benches, walls and other good sitting places
- ◆ An abundance of stores at ground level
- ◆ Interesting, nicely landscaped traditional style homes

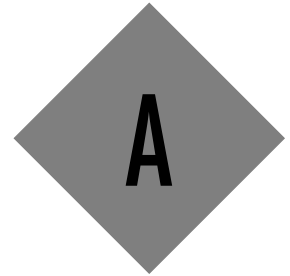
References

Conclusion

Boulevards bring additional needed form, function, tools and challenge to a community's public space. They are more complex and diverse in their operations than conventional streets and street patterns. Boulevards are highly flexible, and they can be used where there is low or high density, in residential as well as commercial parts of town. A successful boulevard can often be built within existing rights-of-way.

Boulevards offer space for motorists, transit and pedestrians. Boulevards meet the needs of a total public, from young children, to those with physical limitations, to those in their retirement years. Boulevards are born out of the history of great cities. They offer efficiency and quality. Boulevards have the ability to carry people and goods with safety, convenience and charm in their center, on their edges, and even underneath.

Well designed boulevards compete on an equal basis with conventional roadways in safety and capacity. They do not operate at high speeds, nor should they be designed to. Instead they offer to the commuter, the through driver, and the local resident, a sense of place, a tranquility, a fullness and wholesomeness all too rare under conventional highway design. Because of their value in bringing back commercial street activity, diversity, chance discovery, social interaction, and the exchange of knowledge



Transportation Center. Funded in part by FHWA.

F. Kent interview, *Project For Public Spaces* research on public spaces.

W. Kulash interview by Dan Burden, and *Washington Post* article, September 1995.

Appendix Traffic Laws and Definitions for Pedestrians

Traffic laws are written and enforced to create uniform and predictable movements between vehicles, and in vehicles and pedestrians and other moving traffic. Although laws may vary slightly from state to state, there is striking similarity between

the language of most states. The uniformity of this language is achieved by having each state legislature address specific laws as set forth in the Uniform Vehicle Code (UVC). The language in this section is taken from the UVC.

Design/Law Link

A general observation regarding motorist behavior is that most motorists fail to respect the safety and needs of pedestrians. Many pedestrians correspondingly ignore traffic law, forcing many motorists to take evasive actions.

The behavior between the two groups can be and is strongly influenced by design. For example, a motorist approaching a crosswalk at low speed (below 32 km/h (20 mph)) is likely to stop for a pedestrian wishing to cross. Motorists traveling at speeds of 48 km/h (30 mph) or greater are likely to continue, even though the pedestrian may be clearly intending to cross.

By paying closer attention to designs that elicit the best behavior of both groups, the designer may be able to create crossings that do not require signalization or other highly evasive design strategies.

Jaywalking

This commonly used word does not appear in traffic law. Generally, however, a person is breaking the law and is considered to be *jaywalking* when he or she is doing any of the following:

- ◆ Crossing against a red light
- ◆ Crossing not fully in a crosswalk or crosswalk area
- ◆ Crossing midblock between two adjacent signalized intersections
- ◆ Crossing diagonally
- ◆ Causing a vehicle to have to brake suddenly, creating an unsafe condition
- ◆ Crossing at grade when in the immediate presence of an overpass or tunnel, and when a vehicle has to correct for the actions of the pedestrian.

Common Motorist Violations

- ◆ Speeding
- ◆ Failure to stop or yield to a traffic control
- ◆ Failure to stop or yield to a pedestrian in a crosswalk
- ◆ Illegal right turn on red
- ◆ Parking in a restricted zone

DUI

Sidewalks

Where sidewalks are provided, no pedestrian shall, unless required by other circumstances, walk along and upon the portion of a roadway paved for vehicular traffic. Where sidewalks are not provided, any pedestrian walking along and upon a highway shall, when practicable, walk only on the shoulder of the left side of the roadway, facing traffic. Sidewalks are bidirectional, and pedestrians walk both with and against traffic.

Designers need to be aware that, on

multilane highways, pedestrians are not likely to cross to the other side. Sidewalks on both sides of all urban multilane roadways are essential for the safety of pedestrians and motorists. Paved shoulders in rural areas will benefit the lower number of pedestrians likely to be traveling in these locations.

Pedestrian Control Signals

There is widespread confusion on the use of these signal phases. According to a recent American Automobile Association financed research project, 51% of the American public does not know the meaning of a flashing *DON'T WALK*. A *WALK* phase permits pedestrians facing such a signal to cross the roadway in the direction of the signal and requires motorists to yield the right-of-way. A flashing *DON'T WALK* signal means that no pedestrian shall start to cross the roadway, but any pedestrian who has entered or partially entered the roadway may proceed to the far sidewalk or safety zone. A steady *DON'T WALK* means that no pedestrians should be in the roadway.

When Do Pedestrians Have the Right of Way?

On Sidewalks

The driver of a vehicle shall yield the right of way to any pedestrian on a sidewalk. Since bicycles are vehicles, bicyclists must yield to pedestrians on sidewalks.

In Crosswalks

The driver of a vehicle shall stop and remain stopped to allow a pedestrian to cross the roadway within an unmarked or marked crosswalk when the pedestrian is upon or within one lane of the half of the roadway upon which the vehicle is traveling or onto which it is turning. *Half of the roadway* means all traffic lanes carrying traffic in one direction of travel, and includes the entire width of a one-way

roadway.

Every driver of a vehicle shall exercise due care to avoid colliding with any pedestrian or any person propelling a human-powered vehicle, and exercise proper precaution upon observing a child or any obviously confused or incapacitated person upon a roadway.

Notwithstanding the foregoing provisions, every driver of a vehicle shall exercise due care to avoid colliding with any pedestrians upon any roadway and shall give warning by sounding the horn when necessary and shall exercise proper precaution upon observing any child or any obviously confused or incapacitated person upon a roadway.

Other Drivers

Whenever any vehicle is stopped at a marked crosswalk or at any unmarked crosswalk at an intersection to permit a pedestrian to cross the roadway, the driver of a vehicle approaching from the rear shall not overtake and pass such stopped vehicle.

When Do Pedestrians Yield the Right of Way?

- ◆ Every pedestrian crossing a roadway at any point other than within a marked or unmarked crosswalk at an intersection shall yield the ROW to all vehicles upon the roadway.
- ◆ Between adjacent intersections at which traffic signals are in operation, pedestrians shall not cross at any place except in a marked crosswalk.
- ◆ Any pedestrian crossing a roadway at a point where a pedestrian tunnel or overhead pedestrian crossing has been provided shall yield the ROW to all vehicles upon the roadway.
- ◆ No pedestrian shall, except in a marked crosswalk, cross a roadway at any other place than by a route at right angles to the curb or by the shortest route to the opposite curb. No pedestrian shall cross a roadway intersection diagonally unless authorized by official traffic control devices.
- ◆ No pedestrian shall suddenly leave a curb or other place of safety and walk or run into the path of a vehicle which is so close that it is impossible for the driver to yield.
- ◆ No pedestrian shall enter or remain upon any bridge or approach thereto beyond a bridge signal gate, or barrier indicating a bridge is closed to through traffic, after a bridge operation signal indication has been given.
- ◆ No pedestrian shall pass through, around, over, or under any crossing gate or barrier at a railroad grade crossing or bridge while such gate or barrier is closed or is being opened or closed.

Bicyclists

Bicyclists may use sidewalks in some states. In others they may use sidewalks until the age of 14. Generally, bicyclists cannot ride bicycles on sidewalks in business districts (check local ordinances). When riding on sidewalks, bicyclists:

- ◆ Must yield to pedestrians, using care to pass
- ◆ Have the same rights and responsibilities as pedestrians at driveways and intersections
- ◆ Although granted the right of way at driveways, bicyclists coming from the motorist's right often go undetected. For this reason, every effort should be made to provide on-road facilities to support bicycle traffic where it can be best detected, and where it minimizes the impact on pedestrians.

Definitions

AASHTO — American Association of State Highway and Transportation Officials.

AASHTO publishes a number of guidelines for highway and other design and construction which is often an unofficial or official set of guides for a given city, county or state.

ACCESS MANAGEMENT — The principles, laws and techniques used to control access to highways.

ADA — The Americans with Disabilities Act; civil rights legislation passed in 1990, effective July 1992.

ADT — Average Daily Traffic. The measurement of the average number of vehicles passing a certain point each day on a highway, road, street or path.

AUDIO-TACTILE — A special signal and control that alerts visually impaired pedestrians when to cross a particular roadway. Some experimental models also remind pedestrians to search before leaving the curb.

ARTERIAL (ROAD) — A road designated to carry traffic, mostly uninterrupted, through an urban area, or to different neighborhoods within an urban area.

BARNES DANCE — An exclusive phase on a signal where all vehicular traffic is stopped and pedestrians are permitted to cross in multiple directions.

BARRICADE — A portable or fixed barrier having object markings, used to close all or a portion of the right-of-way to vehicular and/or pedestrian traffic.

CHANNELIZING LINE — A line which directs traffic and indicates that traffic should not cross but may proceed on either side.

COLLECTOR (ROAD) — A road designated to carry traffic between local streets and arterials, or from local street to local street.

CROSS SECTION or TYPICAL CROSS SECTION or TYPICAL — Diagrammatic presentation of a highway or path profile which is at right angles to the centerline at a given location.

CROSSING, PUFFIN — An experimental British crosswalk (Pedestrian User Friendly Intelligent Crossing) which uses modern computers, video cameras and sensors to permit pedestrians to cross midblock in greater safety. The system monitors the approach of vehicles and pedestrians, gives the right crossing cycle length for a pedestrian based on observed speed, and alerts pedestrians if a motorist is not going to stop.

CROSSWALK — (a) That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the traversable roadway whether marked or unmarked; (b) Any portion of a roadway distinctly indicated for pedestrian crossing by lines or other markings on the surface.

DESIGN STANDARDS — The specific values selected from the roadway design criteria become the design standards for a design project. These standards will be identified and documented by the designer.

EDGE LINE — A painted or applied line to designate the edge of the road (6-8 inches, or 150-200 mm)

ENHANCEMENT FUNDS — Under ISTEA, independent funds for bicycling and walking facilities, trails, and eleven other activities.

FRONTAGE ROAD — A road designed and designated to serve local traffic parallel and adjacent to a highway or arterial street.

GRADE — A measure of the steepness of a roadway, bikeway or walkway, expressed as a ratio of vertical rise per horizontal distance, usually in percent. For example, a 5% grade equals a 5 meter rise over a 100 meter horizontal distance.

GRADE SEPARATION — The vertical separation of conflicting travelways with a structure. An overpass and a tunnel are examples of common grade separations used to avoid conflicts.

HIGHWAY — A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

INTERSECTION — The area embraced within the prolongation or connection of the lateral curb lines, or, if none, then the lateral boundary lines of the roadways of two highways which join one another at, or approximately at, right angles; or the area within which vehicles traveling upon different highways joining at any other angle may come in conflict.

ISLAND — An area within a roadway from which vehicular traffic is intended to be excluded, together with any area at the approach thereto occupied by protective deflecting or warning devices.

ISLAND, CHANNELIZING — A traffic island located in a roadway area to confine specific movements of traffic to specific channels.

ISLAND, DIVISIONAL OR MEDIAN — A traffic island, usually elongated and narrow, following the course of the roadway to separate traffic moving in the same or opposite directions and sometimes used as a pedestrian refuge.

ISLAND, LOADING — A pedestrian island especially provided for the protection of transit vehicle users.

ISLAND, TRAFFIC — An island designed to separate or direct streams of vehicle traffic. Included are both divisional and channelizing islands.

ISTEA — The Intermodal Surface Transportation Efficiency Act enacted in 1991. Federal legislation guiding the expenditure of federal highway funds.

MEDIAN LANE — A speed change and storage lane within the median to accommodate left-turning vehicles and

sometimes used as a pedestrian refuge.

MEDIAN — The portion of a divided highway separating traveled ways for traffic in opposite directions and sometimes used as a pedestrian refuge.

MULTIUSE PATH/TRAIL (BIKE PATH, BIKE TRAIL) — Any bikeway that is physically separated from motorized vehicular traffic by an open space or barrier. It is either within the highway right of way or within an independent right of way. Due to a lack of pedestrian facilities, most bike paths/trails are commonly designed and referenced as multiuse paths or trails.

MUTCD — *The Manual on Uniform Traffic Control Devices*, approved by the Federal Highway Administration as a national standard for the placement and selection of all traffic control devices on or adjacent to all highways open to public travel.

PATHWAY — Simply-kept graded or improved pedestrian-vehicle separation.

PAVEMENT — That part of a roadway having a constructed surface for the facilitation of vehicular traffic.

PAVEMENT MARKINGS — Painted or applied lines or legends placed on a roadway surface for regulating, guiding, or warning traffic.

PEDESTRIAN — A person in or adjacent to a trafficway, not in or on any vehicle or other device used for transportation, sport, or recreation.

PEDESTRIAN ADVISORY COMMITTEE — Most metropolitan areas and some counties have a politically appointed group of citizens and technicians who oversee pedestrian planning and provide technical review of local pedestrian facilities. These groups are known as Pedestrian Advisory Committees (PAC's) and are usually associated with Metropolitan Planning Organizations (MPO's).

PEDESTRIAN CLEARANCE INTERVAL — The time of display of the *DON'T WALK* indication following the *WALK* interval

before opposing vehicles receive a green indication.

PEDESTRIAN DETECTOR — A detector, usually of the push-button type, installed near the roadway and capable of being operated by hand.

PEDESTRIAN PHASE (PEDESTRIAN MOVEMENT) — A traffic phase allocated to pedestrian traffic.

A. COMBINED PEDESTRIAN-VEHICLE PHASE — A traffic phase wherein pedestrians are directed to move on certain crosswalks parallel to the through vehicular movement and wherein vehicles are permitted to turn across the said crosswalks.

B. SEMI-EXCLUSIVE PEDESTRIAN VEHICLE PHASE — A traffic phase wherein pedestrians are directed to move on certain crosswalks with parallel or other vehicular movements, but vehicles are not permitted to turn across the said crosswalks during the pedestrian movement.

C. LEADING PEDESTRIAN PHASE — Signal phasing wherein an exclusive pedestrian phase, in advance of the minor street vehicular green phase, is provided for pedestrians crossing the main street only.

D. EXCLUSIVE PEDESTRIAN PHASE — A traffic phase wherein pedestrians are directed to move on any crosswalk or cross the intersection diagonally during an exclusive phase while all vehicles are stopped (Also called Barnes Dance).

PEDESTRIAN SIGNAL — A traffic control signal which is erected for the exclusive purpose of directing pedestrian traffic at signalized locations.

PEDESTRIAN REFUGE ISLAND — A pedestrian island designed for the use and protection of pedestrians. A pedestrian island included the safety zone together with the area at the approach occupied or outlined by protective deflecting or warning devices. This includes loading islands.

RIGHT-OF-WAY — A general term

denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

RIGHT OF WAY — The right of one vehicle or pedestrian to proceed in a lawful manner in preference to another vehicle or pedestrian.

ROADWAY — That portion of the highway, including shoulders. Sidewalks are outside of the roadway, but inside the highway right-of-way.

ROADWAY DESIGN CRITERIA — Criteria for the design of new or major reconstruction projects on the Florida State Highway System. These criteria are found in Chapter 2 of the Roadway Plans Preparation Manual. Design criteria for resurfacing, restoration, and rehabilitation are presented in Chapter 25 of the Roadway Plans Preparation Manual.

ROUNDABOUT — A circular or other shaped object placed in the center of an intersection, along with channel islands on all approaches, that restrict entering speed and flow direction of traffic. Roundabouts require a yield upon entry, and are an alternative to signalization at some intersections. Generally pedestrians and motorists benefit from roundabouts.

RRR PROJECTS — Specific roadway improvement projects that include Resurfacing, Restoration and Rehabilitation of roadways. These projects use a different pot of funds than new construction.

RULES OF THE ROAD — That portion of a motor vehicle law that contains regulations governing the operations of vehicular and pedestrian traffic.

SHOULDER (PAVED) — That portion of a highway which is contiguous to the travel lanes, allowing motor vehicle use in emergencies, for specialized use of pedestrians and bicyclists, and for lateral support of base and surface courses.

SHY DISTANCE — The distance between the edge of a travelway and a fixed object. Also, the separation distance a roadway user

needs to feel safe operating near a fixed object.

SIDEWALK — That portion of a highway designed for preferential or exclusive use by pedestrians.

SIGHT DISTANCE — The distance a person can see along an unobstructed line of sight.

SKEW ANGLE — The angle formed between a roadway, bikeway or walkway and an intersecting roadway, bikeway, walkway or railroad line, measured away from the perpendicular.

SLIP LANE — A raised island near the corner of an intersection that permits vehicular right turning traffic to move independent of signalization. Properly designed slip lanes are helpful to pedestrians, while poorly designed slip lanes can create problems. (Also **ISLAND**, **CHANNELIZED**.)

STOP BAR, STOP LINE — A pavement marking placed in the roadway at the location where a motorist is expected to stop. Typically this line is placed 4 feet in front of the crosswalk.

STOP BAR, STOP LINE, ADVANCED — A special placement of a stop bar or line, usually 50 feet in advance of a midblock crossing. Used in this location, it is possible to give motorists and pedestrians advance notice of any unsafe movement.

STRUCTURE — A bridge, overpass, retaining wall or tunnel.

TRAFFIC — Pedestrians, ridden or herded animals, vehicles, streetcars, and other conveyances either singly or together while using any highway for purpose of travel.

TRAFFIC-ACTUATED SIGNAL — A type of traffic control signal in which the intervals are varied in accordance with the demands of traffic as registered by the actuation of detectors.

A. SEMITRAFFIC-ACTUATED SIGNAL — A type of traffic-actuated signal in which means are provided for traffic

actuation on one or more but not all approaches to the intersection.

B. FULL TRAFFIC-ACTUATED SIGNAL — A type of traffic-actuated signal in which means are provided for traffic actuation on all approaches to the intersection.

TRAFFIC CONTROL SIGNAL — Any device whether manually, electronically, or mechanically operated by which traffic is alternately directed to stop and permitted to proceed.

TRAFFIC CONTROL DEVICES — Signs, signals or other fixtures, whether permanent or temporary, placed on or adjacent to a travelway by authority of a public body, having jurisdiction to regulate, warn or guide traffic.

TRAFFIC MARKINGS — All lines, patterns, words, colors, or other devices, except signs, set into the surface of, applied upon, or attached to the pavement or curbing or to objects within or adjacent to the roadway officially placed for the purpose of regulating, warning, or guiding traffic.

TRAFFIC SIGN — A traffic control device mounted on a fixed or portable support whereby a specific message is conveyed by means of words or symbols, officially erected for the purpose of regulating, warning, or guiding traffic.

TRAFFIC VOLUME — The given number of vehicles that pass a given point for a given amount of time (hour, day, year). See **ADT**.

TRUNCATED DOMES — Raised domes cut off at the top, usually a quarter in size, that are positioned to alert a visually impaired pedestrian of their final approach to a train platform, a curb ramp, or some other point of danger.

UNIFORM VEHICLE CODE — Model statutes specifically designed to provide the content and language of legislation needed to give uniformity to the “rules of the road” and traffic control devices.

VEHICLE — Any device in, upon or by which any person or property is or may be transported or drawn upon a highway and includes vehicles that are self-propelled or powered by any means. Includes legally