



City of Langley
Master Transportation Plan

APPENDIX C
Bicycle and Pedestrian Facility
Design Guidelines



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1.0 BICYCLE FACILITY DESIGN GUIDELINES

This section presents a comprehensive set of guidelines to assist the City of Langley in designing, constructing, and maintaining bicycle facilities for the bicycle network. These guidelines reflect current design practices adopted by the Transportation Association of Canada, as well as innovative designs used in BC and elsewhere in North America. This Plan recognizes that TAC will continue to monitor and update its guidelines. As such, the information in this section should be considered as dynamic rather than fixed.

These bicycle facilities design guidelines should be used for the planning, design and maintenance of bicycle facilities throughout the municipality. Although these guidelines are intended to maximize safety and improve access and efficiency for all users, it should be recognized that the consideration of costs and impacts may result in modified designs. However, in areas where costs or impacts are prohibitive to achieving a design guideline, the City may wish to consider alternate routes, rather than using a modified standard.

1.1 How the Guidelines Were Developed

The guidelines identified in this report reflect the state-of-the-art in bicycle planning in North America. They are based on experience in communities across Canada and the United States. Design guidelines adopted by the Transportation Association of Canada (TAC) form the basis of the designs incorporated in the City of Langley guidelines, as provided in the following publications:

- *Regional Bicycle Plan – Bicycle Facility Design Guidelines*, TransLink, 2000.
- *Bikeway Traffic Control Guidelines for Canada*, Transportation Association of Canada, 1998.
- *Pedestrian Crossing Control Manual*, Transportation Association of Canada, 1998.
- *Canadian Guide to Neighbourhood Traffic Calming*, Transportation Association of Canada/Canadian Institute of Transportation Engineers, 1998.
- *In-Line Skating Review: Phase 2*, Transportation Association of Canada, 1997.
- *Urban Supplement to the Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, 1995.

In cases where TAC has not provided guidelines for specific situations encountered when planning for bicycles, other key resources were used in a supplemental capacity in developing the City of Langley Bicycle Facility Design Guidelines, including:



- *Cycling Guide*, Ministry of Transportation and Highways, 2000.
- *Guide for the Development of Bicycle Facilities*, American Association of State Highway and Transportation Officials, 1999.
- *Minnesota Bicycle Transportation Planning and Design Guidelines*, Minnesota Department of Transportation, 1996.
- *Oregon Bicycle and Pedestrian Plan*, Oregon Department of Transportation, 1995.
- *Bicycle Blueprint - Creating a Transportation Alternative*, City of Surrey, 1993.
- *Community Cycling Manual*, Canadian Institute of Planners, 1990.

1.2 On-Street Facilities

On-street facilities described in this section include three types – shared bicycle routes, marked wide curb lanes, and bicycle lanes. Crossings are discussed separately in Section 1.3.

1.2.1 Shared Bicycle Routes

Shared bicycle routes generally make use of local streets, local collector roads and local commercial/industrial roads. Because fewer motor vehicles use these roads, bicycles and motor vehicles can safely share the road space. Consequently, it is not necessary to provide extra width for bicycles or designate specific areas of the roadway for bicycle use. All that is required is ‘bicycle route’ signage, as described in Section 1.5.

Facility design guidelines that apply to shared bicycle routes include:

- When a roadway that is designated as a bicycle route is reconstructed, widened or overlaid, it is recommended that gravel driveways with significant traffic be paved back a minimum of 5.0 m, as illustrated in Figure 1.1, to prevent loose gravel from spilling on to the side of the roadway. It is generally not necessary to pave gravel driveways to single-family residential dwellings, as traffic on these driveways is low.
- Openings in catchbasins should be oriented at an angle to the direction of bicycle travel, so that bicycle wheels are not caught in the openings. Appropriate catchbasin designs are illustrated Figure 1.2.



Figure 1.1: Paved Driveway Apron

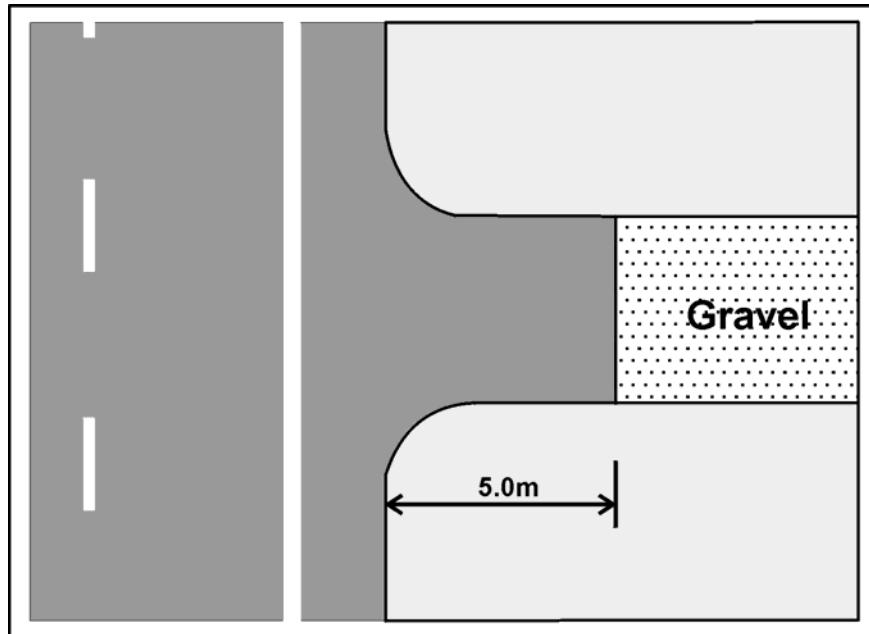
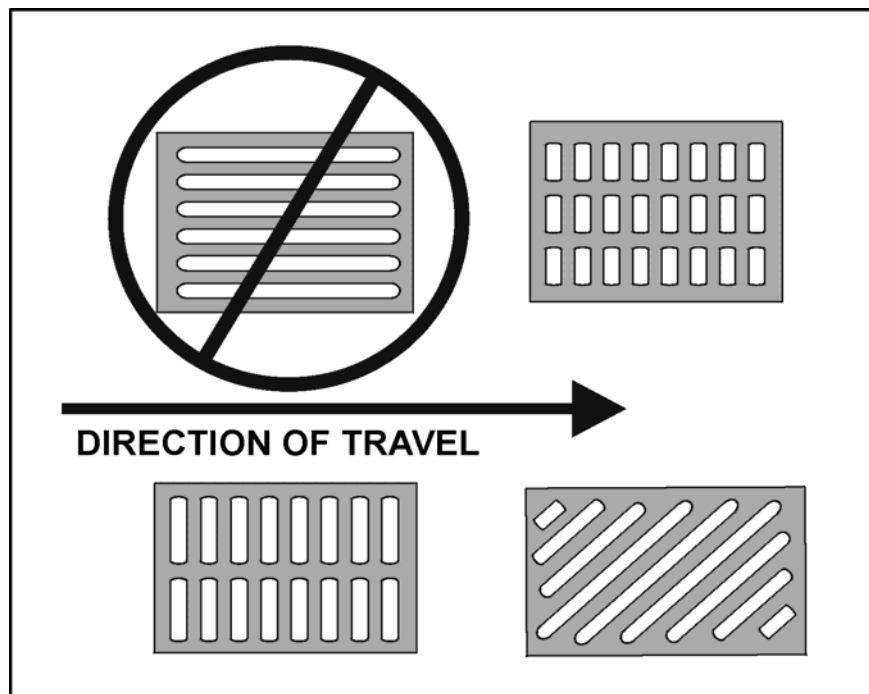


Figure 1.2: Bicycle-Friendly Catchbasins



- Abrupt changes in pavement elevation over drainage outlets, utility covers, and maintenance covers should be avoided. Pavement overlays may require that adjusting



rings be used on maintenance covers to bring the covers up to the elevation of the overlay. Alternatively, overlays should taper into outlets and covers to avoid the creation of abrupt edges in the road surface.

- Shared bicycle routes should be adequately illuminated to ensure that both motor vehicles and bicyclists are highly visible during non-daylight hours on these shared route facilities.

1.2.2 Marked Wide Curb Lanes

A wide curb lane is designed to allow sufficient width for an automobile to safely overtake a bicycle without crossing into the adjacent or oncoming traffic lane. This shared use of a wider curb lane also helps to assimilate bicycles into the domain of the automobile, fostering a mutual respect between motorists and cyclists. This helps to reduce confusion and conflicts between bicycles and motorists at intersections, where the majority of problems with conventional bicycle lanes occur.

A marked wide curb lane must incorporate bicycle symbols stencilled on the right side of the lane at regular intervals. This identifies the right side of the lane as the area used by bicycles, which serves to alert motorists to the potential presence of bicycles even when there is no bicycle on the road. Because an area of the roadway is identified for bicycle use, marked wide curb lanes are more attractive than unmarked wide curb lanes to casual and recreational cyclists who may be afraid of traffic. The roadway stencils are also a means of increasing awareness of bicycle facilities and encouraging cycling.

Marked wide curb lanes do not include a white line separating bicycles from other traffic, which means that some concerns regarding standard bicycle lanes are avoided. Many motorists – and even cyclists – interpret the white line to mean that cyclists are confined to the bicycle lane. With marked wide curb lanes, on the other hand, motorists and cyclists both recognize that cyclists are free to ride elsewhere on the roadway as necessary (such as to make a left turn or when travelling through an intersection).

In the following situations, marked wide curb lanes are the preferred method of providing bicycle facilities:

- **Moderate to high traffic volumes.** Marked wide curb lanes are recommended for roads with relatively high traffic volumes, including major and minor collector roads, and arterial roads. The additional road width provided by the wide curb lane and the demarcation provided by the bicycle symbols allow motor vehicles and bicycles to effectively share the curb lane along major roadways.
- **High turning movement volumes.** Along corridors with numerous intersections and driveways, wide curb lanes with bicycle stencils are the preferred



option. Cyclists are able to use all areas of the travel lane to avoid hazards, anticipate turning vehicles and merge across traffic to make left turns. With conventional bicycle lanes, some cyclists feel as though they must remain within the bicycle lane at all times, and may even feel a false sense of security within the painted lane.

- **On-street parking.** The shared-lane concept of the marked wide curb lane works best with on-street parking. If a car door suddenly opens in front of a cyclist, he or she is free to move into an area of the shared lane where they are not obstructed. With a conventional bicycle lane, motorists may not be expecting cyclists to leave their marked lane.
- **Frequent bus stops.** The wide curb lane allows cyclists to manoeuvre easily around stopped buses. With conventional bicycle lanes, cyclists are often expected to wait behind stopped buses – which rarely happens. The wide curb lane provides enough width to allow cyclists to pass by stopped buses. There is also less confusion between cyclists and bus drivers when buses are pulling next to the curb to make a stop.

Other benefits of marked wide curb lanes include:

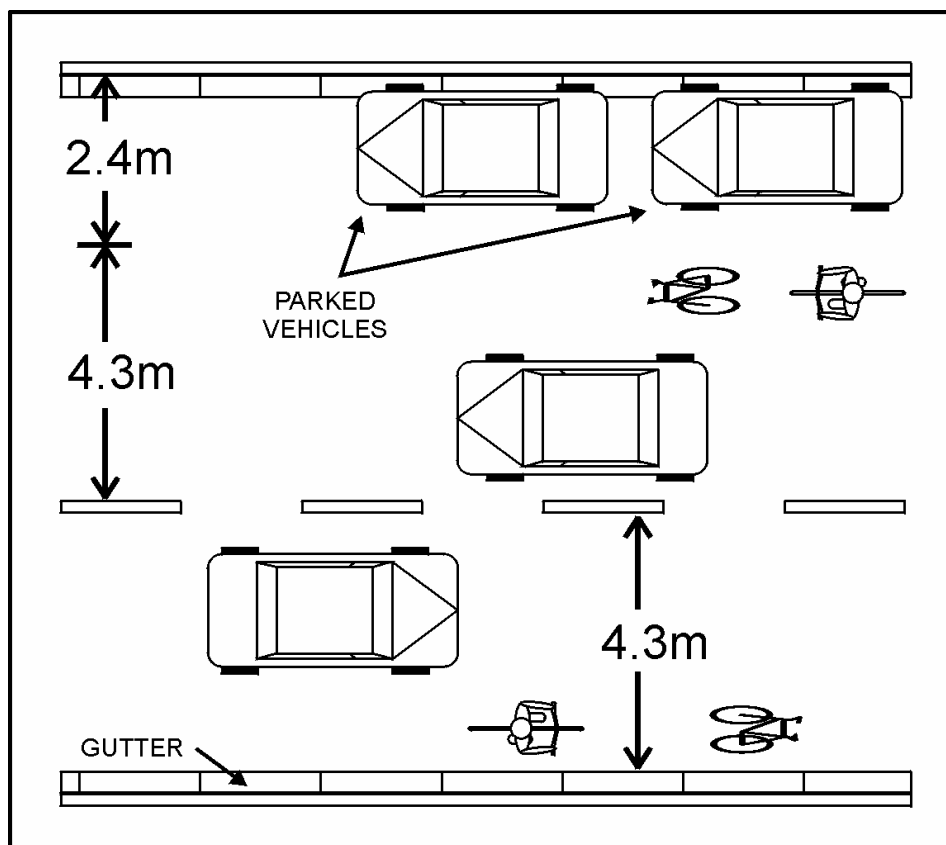
- **Marked wide curb lanes educate cyclists** as to how to share the road with other vehicles. Bicycle lanes, on the other hand, do not encourage shared use. Because bicycle facilities cannot yet be provided on every road, cyclists benefit from learning how to ride in traffic and share the travel lane with other vehicles.
- **Marked wide curb lanes do not accumulate debris to the same extent as bicycle lanes.** Because motor vehicles are allowed to use all areas of the marked wide curb lane or shared lane, the sweeping motion of vehicles helps to clear the lane of debris that could create hazards for cyclists. With bicycle lanes, debris is often swept from the vehicle lanes into the bicycle lane, creating a need for frequent road sweeping.
- **Marked wide curb lanes are more economical than bicycle lanes.** Because the marked wide curb lane is a shared-use lane, only an additional 50 to 70 cm of pavement is typically needed to accommodate bicycles. In comparison, a bicycle lane requires 1.5 to 1.8 m of additional road width. In some cases, additional right-of-way may be required to implement bicycle lanes. In some cases, marked wide curb lanes can be established by narrowing the adjacent travel lane(s).



Key design guidelines regarding marked wide curb lanes include:

- A width of 4.3 m (not including the gutter) is recommended, as illustrated in Figure 1.3. A width of 4.3 m allows a motor vehicle to safely pass a cyclist without having to cross into the oncoming travel lane. Where on-street parking is provided, this standard also allows enough width for cyclists to avoid conflicts with opening car doors. The width of a marked wide curb lane should not exceed 4.5 m, however, as this would enable vehicles to pass other vehicles on the right.
- It is important that the width of the gutter is not included in the 4.3-m width. For safety reasons, cyclists will not ride in the gutter or even within 20-30 cm of the gutter. Gutters typically collect debris, the surface of the gutter is often not level with the asphalt road surface, and joints in the concrete gutter create an uneven riding surface.

Figure 1.3: Marked Wide Curb Lanes



- If on-street parking exists along the route, a width of 2.4 m should be allowed for parked vehicles, in addition to the 4.3 m required for the wide curb lane with stencils. As illustrated in Figure 1.3, the 2.4-m width of the parking lane includes the gutter.



- Any increase in the width of the curb lane is desirable for bicycle routes. However, it is recommended that the widths of other traffic lanes be reduced as necessary to provide a curb lane width of at least 4.0 m as an interim condition, until such time as a 4.3-m marked wide curb lane can be provided.
- Bicycle symbols, as illustrated in Figure 1.4, should be placed at regular intervals (every 200m), as well as in advance of all intersections and major driveways on the right side of the wide curb lanes. The bicycle symbols identify the right portion of the lane as a bicycle facility, and enhance the awareness of road users as to the potential presence of cyclists in the curb lane. In cases where marked wide curb lanes are provided and on-street parking is not permitted, the bicycle stencils should be placed on the pavement next to the gutter pan. Where on-street parking is provided, the bicycle stencils should be placed on the right side of the travel lane, adjacent the parking lane. Figure 1.5 illustrates the placement of bicycle symbols with wide curb lanes.

Figure 1.4: Marked Wide Curb Lane Bicycle Symbol

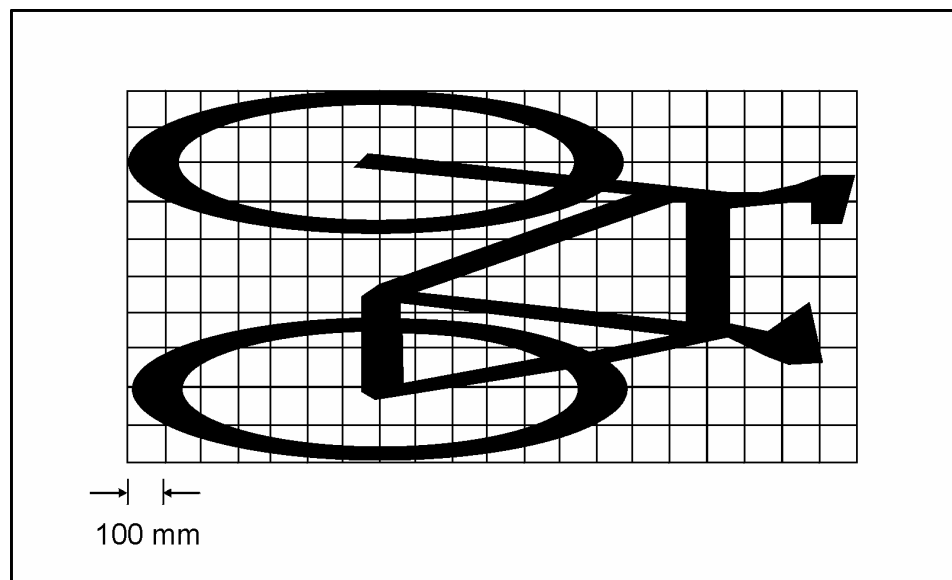
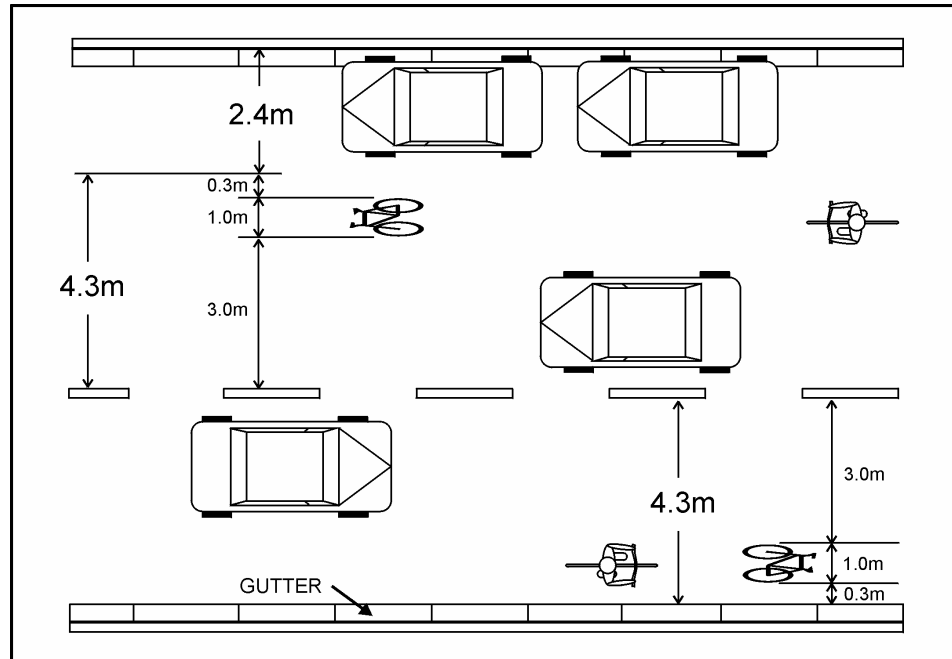




Figure 1.5: Bicycle Symbol Placement in Marked Wide Curb Lanes



- Where a wide curb lane ends and the travel lane is reduced to a width of less than the interim marked wide curb lane standard identified in Section 1.7, a warning sign should be posted in advance to inform cyclists of the lane narrowing.

Notable cases where marked wide curb lanes have been applied include:

- **Transportation Association of Canada** recently adopted marked wide curb lanes in its Bikeway Traffic Control Guidelines for Canada.
- **Denver, Colorado.** The marked wide curb lane concept has been applied along Denver bicycle routes, with a modified bicycle stencil design. The bicycle stencil is based on a CalTrans design and has been integrated with an arrow stencil. This approach has been implemented effectively since June 1993.
- **San Francisco, California.** Bicycle planners in San Francisco have recently applied the marked wide curb lane concept to their bicycle network. They incorporate the bicycle symbol pavement marking at regular intervals.
- **Hamilton, Ontario.** Marked wide curb lanes have been used on a number of bicycle routes in Hamilton, similar to the design developed in Denver.



- **Ottawa, Ontario.** The City of Ottawa will be implementing marked wide curb lanes on its regional roads as part of its Cycling Facilities Improvement Program.
- **Surrey, BC.** The City of Surrey currently has several wide curb lane routes, including 64 Avenue from Scott Road to 152 Street, 152 Street from Highway 10 to 64 Avenue, and 92 Avenue from Scott Road to 128 Street. Although these routes do not yet incorporate bicycle symbol pavement markings, the City has adopted guidelines for marked wide curb lanes and will be adding the bicycle symbols to new and existing routes in the near future.
- **Delta, BC.** The Corporation of Delta recently implemented wide curb lanes on 56 Street in the Tsawwassen area as part of a reconstruction project.

Marked wide curb lanes have also been recommended for bicycle routes in the following jurisdictions:

- Coquitlam
- New Westminster
- University of British Columbia
- Nanaimo
- Kamloops

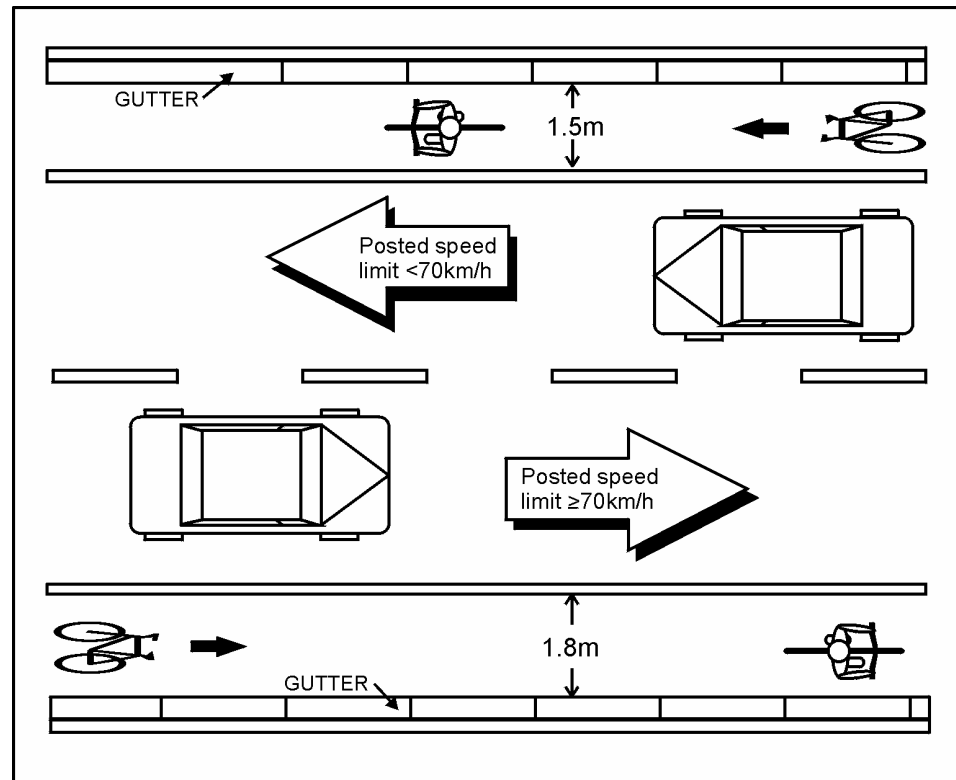
1.2.3 Bicycle Lanes

Bicycle lanes are separate travel lanes on the roadway for cyclists, identified with a solid white line that is dashed at intersections to indicate where motor vehicles may cross the lane for turning movements. Specific guidelines for bicycle lanes include:

- Bicycle lanes should never be planned for two-way travel – cyclists should always travel one-way in the direction of travel of adjacent traffic.
- At a minimum, bicycle lanes should be 1.5 m wide, excluding the gutter, as illustrated in Figure 1.6. On roadways with posted speeds of 70 km/h or more, bicycle lanes should be 1.8 m wide, excluding the gutter. Bicycle lanes should not be wider than 1.8 m, as this encourages two-way bicycle travel and encourages motorists to park in the lane.



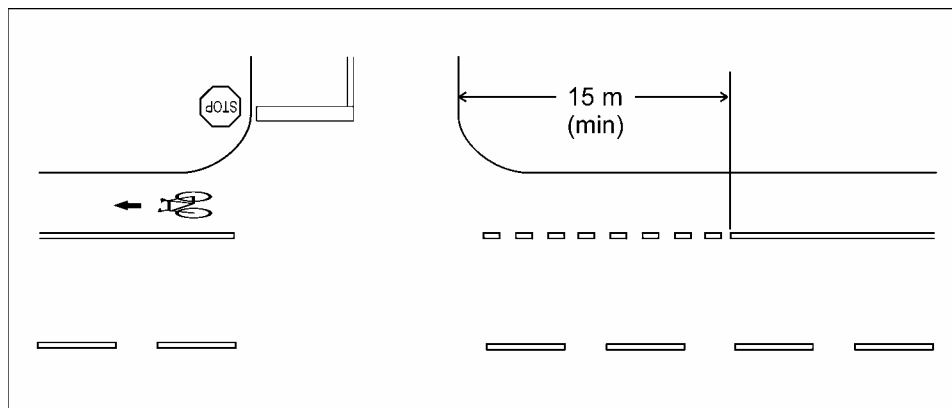
Figure 1.6: Bicycle Lanes



- Bicycle lanes should be continuous between intersections. If a section of road between two intersections is improved to provide sufficient width for a bicycle lane without improvements to the remaining sections of road, the lane should not be marked or otherwise identified until the remaining sections are improved to provide sufficient width for the bicycle lane.
- Bicycle lane lines are white and 10 cm in width.
- Bicycle lane lines should be dashed for a distance of 15 m in advance of intersections, as illustrated in Figure 1.7. This allows a cyclist to exit from the bicycle lane to make a left turn, and allows right-turning vehicles to merge into the bicycle lane. The bicycle lane line should be discontinued through the intersection.

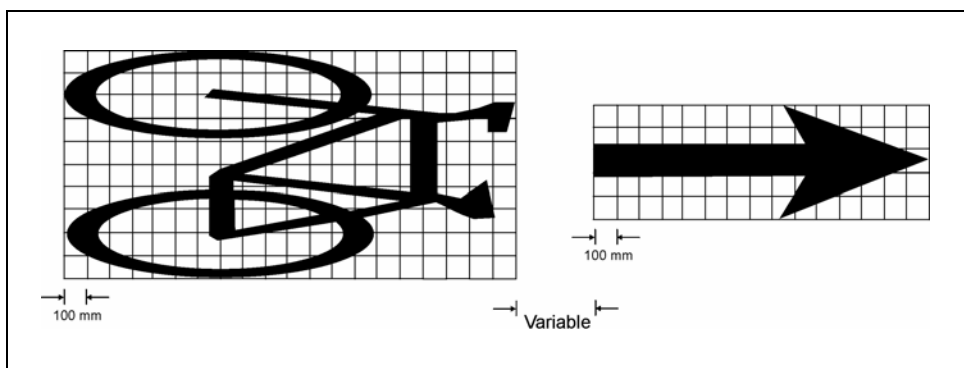


Figure 1.7: Bicycle Lane Markings at Intersections



- Bicycle lanes should be identified with a painted bicycle symbol and may include an arrow indicating the direction of travel, as illustrated in Figure 1.8. Bicycle lane symbols should be spaced at approximately 350-m intervals for roadways with a posted speed limit of 50 km/h (symbol spacing = posted speed in km/h x 7), and should be located after intersections, as illustrated in Figure 1.7. This alerts drivers and bicyclists entering the roadway to the existence of the bicycle lane.

Figure 1.8: Bicycle Lane Symbol

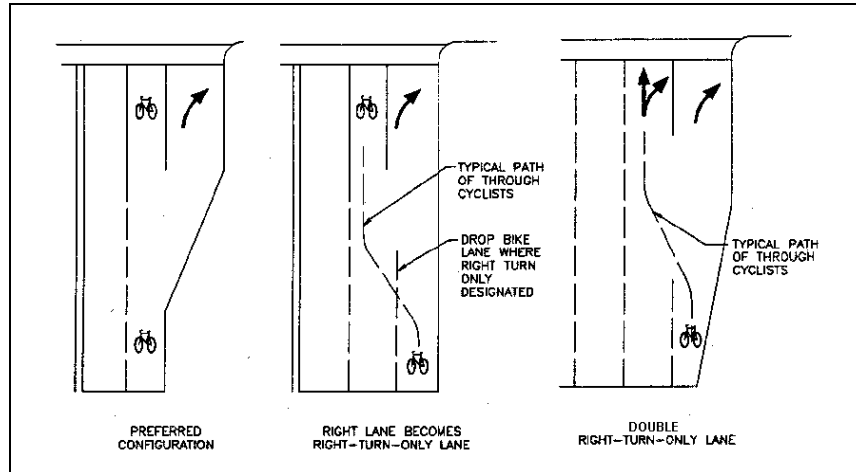


- Where bicycle lanes are to be provided adjacent to on-street parked vehicles, the combined width of the bicycle/parking lane should be at least 3.9 m. This provides 2.4 m for the parking lane and 1.5 m for bicycles, and provides adequate clearance for cyclists to avoid opened car doors. The preferred approach, however, is to provide marked wide curb lanes adjacent to parked vehicles, as the absence of the white bicycle lane line allows cyclists to manoeuvre throughout the entire curb lane to avoid parked cars and other hazards as necessary.
- Special treatment is required at intersections to minimize conflicts between cyclists and right-turning vehicles, as illustrated Figure 1.9. The optional double right-turn-



only lane is not desirable unless there are no alternatives, as it is difficult for cyclists to cross a lane of moving traffic in advance of an intersection.

Figure 1.9: Right-turn Lane Configurations for Bicycle Lanes

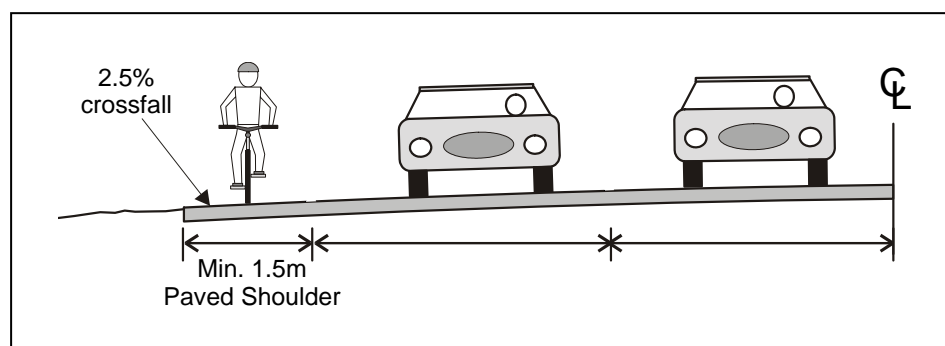


1.2.4 Paved Shoulders

On roads with rural cross-sections, where there are no curbs or gutters, cyclists are accommodated on paved shoulders. Specific design guidelines regarding paved shoulders include:

- Shoulders should be a minimum of 1.5 m in width, as illustrated in Figure 1.10. On roadways with a posted speed in excess of 70 km/h and daily traffic volumes greater than 5,000 vehicles, a paved shoulder width of 2.0 m is recommended. For roadways with posted speeds in excess of 80 km/h and daily traffic volumes greater than 10,000 vehicles, a minimum width of 2.5 m is recommended.
- Paved shoulders should never be planned nor designated for two-way travel – cyclists should always travel one way in the direction of travel of adjacent traffic.

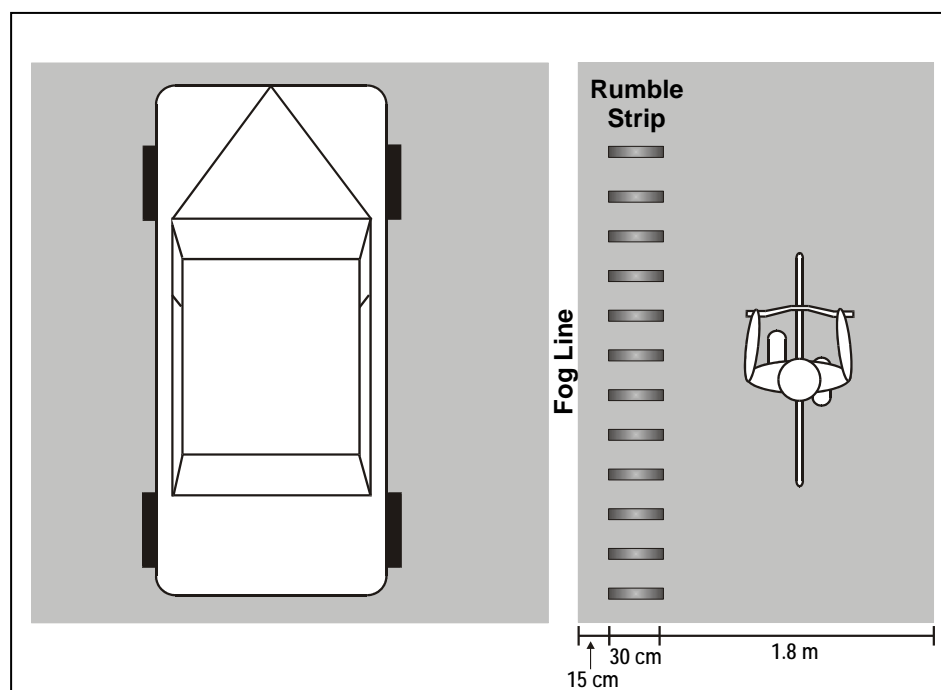
Figure 1.10: Paved Shoulder





- Shoulders should be paved and free of obstructions, such as drainage aprons. If rumble strips are used to prevent motor vehicle drive-off accidents, these should be located on the far left of the shoulder, immediately adjacent the white fog line, and should be a maximum of 30 cm wide, as illustrated in Figure 1.11. The remainder of the shoulder should be a minimum of 1.8 m wide.

Figure 1.11: Paved Shoulder with Rumble Strip



- Shoulders should incorporate a 2.0% crossfall to provide adequate drainage, as illustrated in Figure 1.10. The crossfall of the shoulders should not exceed 5%.
- Non-emergency parking or stopping should be prohibited on the shoulder at all times.
- Where possible, shoulders should be continuous between intersections.
- Where a paved shoulder ends and cyclists must ride within a traffic lane, a warning sign should be posted in advance to advise cyclists that the shoulder ends, and to advise motorists that cyclists may be present on the roadway.

1.3 Crossings

The critical locations on a bikeway or pathway are where these facilities intersect major roadways. Crossing treatments can be used to assist cyclists, pedestrians and others in



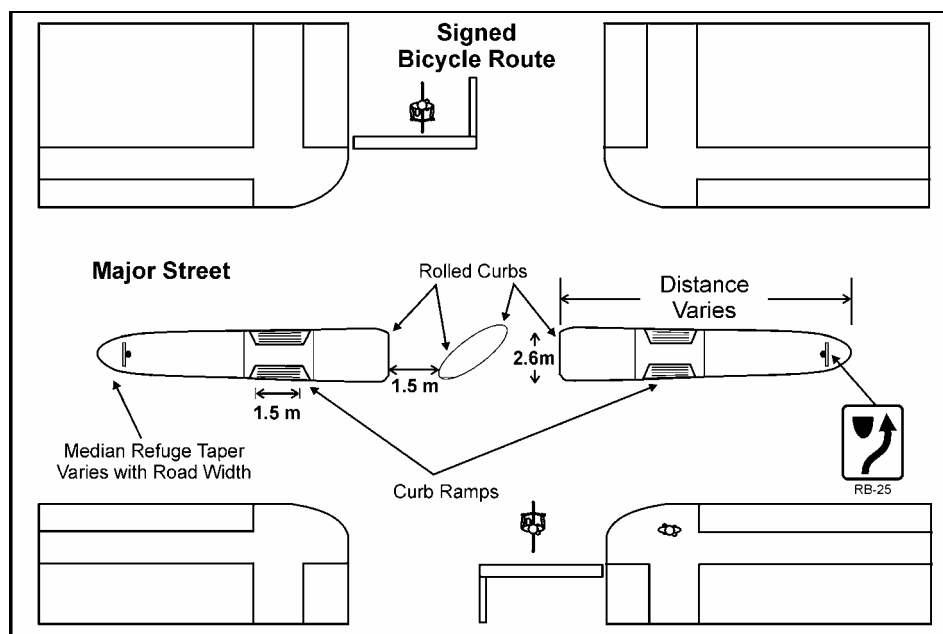
crossing major roads, and to minimize potential conflicts with motor vehicles. This section provides an overview of crossing treatments, including marked/signed crossings, median refuges and signalized crossings.

1.3.1 Bicycle Routes

Where on-street bicycle routes intersect major roads, a variety of crossing treatments can be applied, including:

- **Signed crossing.** Where bicycle routes intersect major roads with relatively low traffic volumes or regular gaps in traffic flow, all that may be required are signs indicating the presence of the bicycle route.
- **Raised median island.** In situations where the interruption of traffic flow on a major road is not warranted, but traffic volumes are too high to rely on a signed crossing alone, a raised median island can be provided. The median island, as illustrated in Figure 1.12, allows cyclists to cross one direction of traffic at a time, rather than having to wait for a gap in both directions of traffic flow. This reduces delays to cyclists, and improves safety for cyclists by increasing the visibility of the crossing to motorists.

Figure 1.12: Raised Median Island for Shared Bicycle Route Crossing



The installation of a raised median island may result in the loss of some on-street parking spaces on the major road to accommodate the taper of the median islands.



- **Signalized crossing.** Where high traffic volumes on a major road do not permit a bicyclist to safely cross the road, even with a median refuge, a traffic signal may be required. The signal can be activated by either a cyclist push-button located adjacent the curb (supplementing the pedestrian pushbuttons), or by an in-pavement loop detector. Loop detectors that are most easily activated by bicycles are illustrated in Figure 1.13. Some municipalities have recently begun using circular detectors (C), and have found that these have the greatest sensitivity to bicycles. Other designs include the diagonal quadruple loop (A), which can detect bicycles over its entire area, and the quadruple loop (B), which is most sensitive in the centre. In all cases, it is recommended that loops used to detect bicycles be accompanied by pavement markings that identify the ‘hot-spot’ on which cyclists can situate their bicycle to activate the signal, as illustrated in Figure 1.14. Where bicycle sensitive loops are not provided along a bikeway, push button activation should be provided adjacent the curb.

Figure 1.13: In-Pavement Loop Detectors

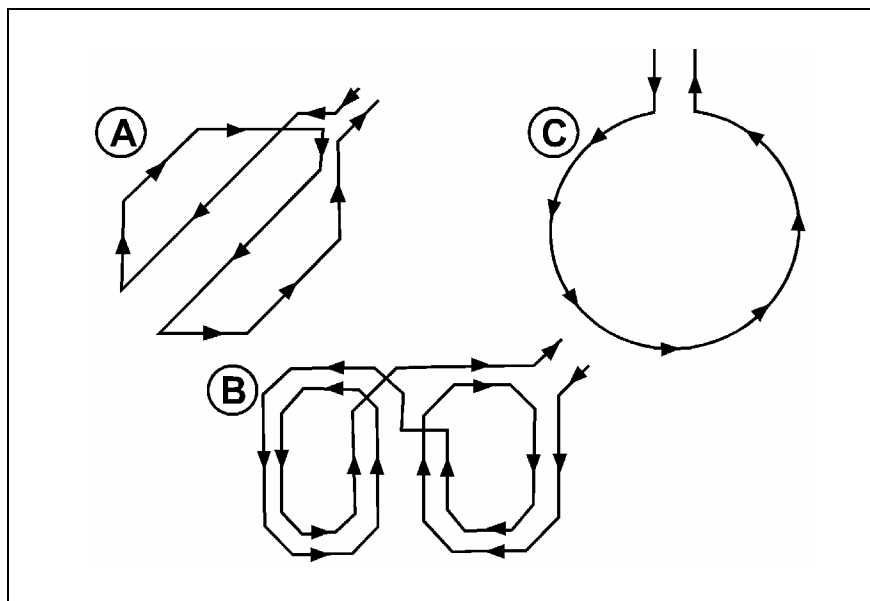
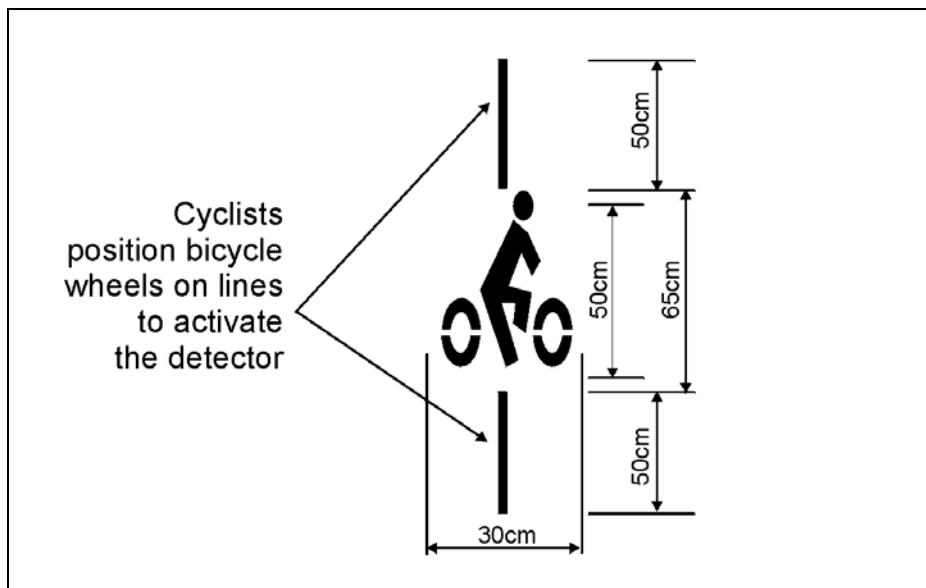




Figure 1.14: Loop Detector Pavement Marking



1.3.2 Multi-Use Pathways

Multi-use pathway crossings can be located at intersections and mid-block, as described below.

- Where pathways are located parallel to a roadway, crossings should be located as close to an intersection as possible. Figure 1.15 illustrates how a pathway should be accommodated at a signalized intersection in order to maximize the visibility of approaching pathway users to motorists. Figure 1.16 illustrates a similar crossing at an unsignalized intersection.
- As illustrated in Figure 1.15 and Figure 1.16, it is preferable to use standard traffic control signage (such as stop signs) to regulate the movement of pathway users at intersections. Cyclists in particular should be treated as vehicles and should, therefore, be controlled by the same signage as motorists. In some cases, however, there may be a desire to supplement the signage with physical devices to reinforce the need for cyclists to stop at intersections. If such devices are used, bollards are preferable. These should always be installed in odd numbers (typically one or three). Bicycle baffles (two staggered 'gates' that create a tight chicane through which cyclists must pass) are another, less desirable, option for slowing cyclists. Baffles represent a significant barrier to cyclists and are often impassable for bicycles pulling trailers and tandem bicycles. Unless baffles are highly visible, there is also a potential risk for cyclists hitting them, particularly at night. Although they achieve the effect of slowing cyclists down, they discourage the equal treatment of cyclists as vehicles on



the road network and discourage the use of bicycles for utilitarian travel. For these reasons, they are the least desirable physical device for encouraging cyclists to slow and their use is discouraged.

- To minimize potential safety concerns, mid-block crossings should be located so as to maximize visibility for approaching motorists, and should be adequately signed and illuminated as described in this section. The addition of a median island — as described in this section — also helps to maximize visibility for motorists and awareness of the crossing.
- Where pathways approach a mid-block section of a roadway at an angle, it is recommended that the pathway be reconfigured to intersect the roadway at or close to perpendicular, as illustrated in Figure 1.17.

Figure 1.15: Multi-Use Pathway Crossing at Signalized Intersection

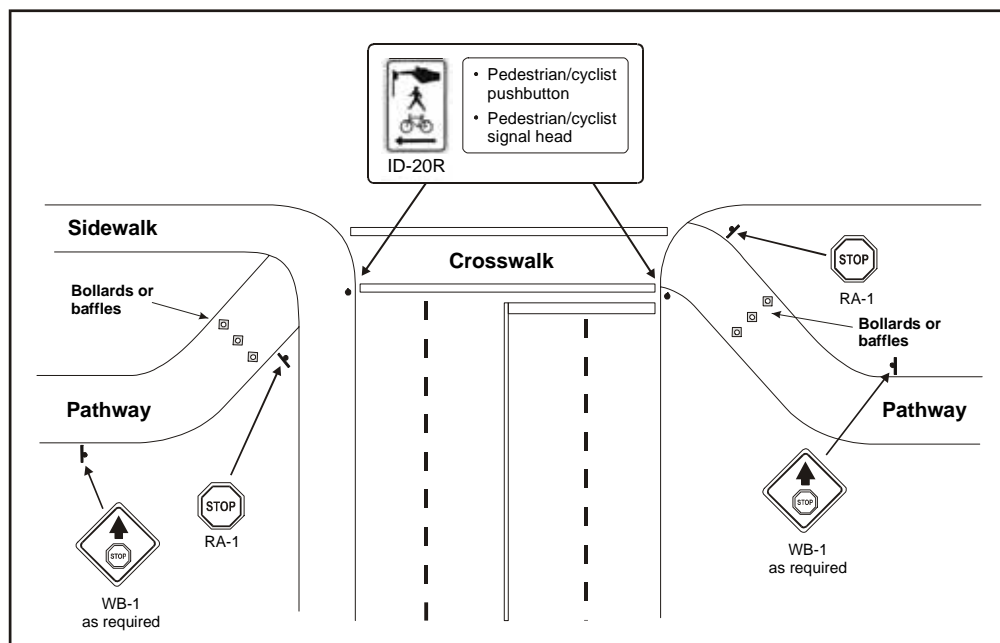




Figure 1.16: Multi-Use Pathway Crossing at Unsignalized Intersection

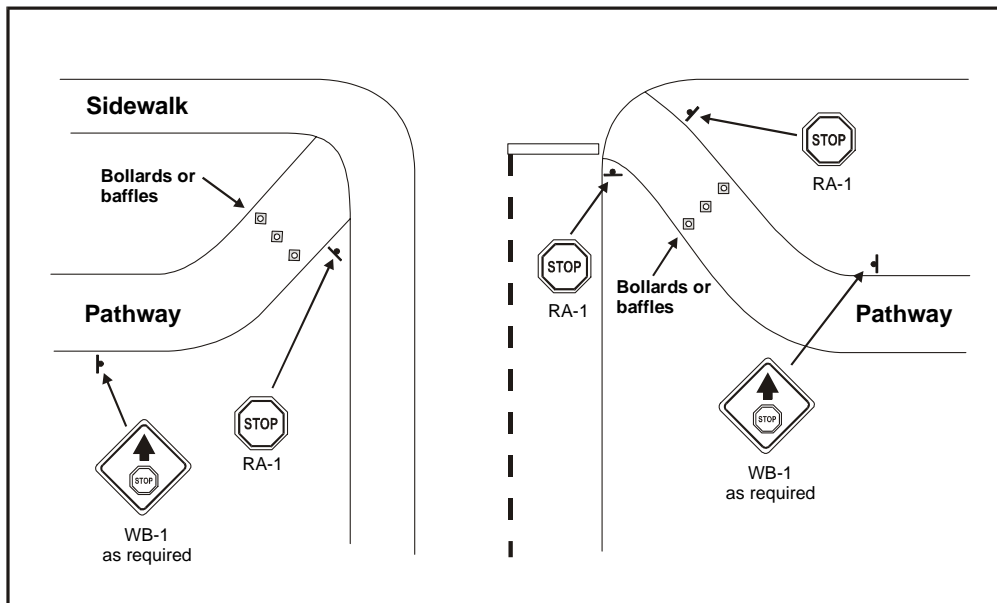
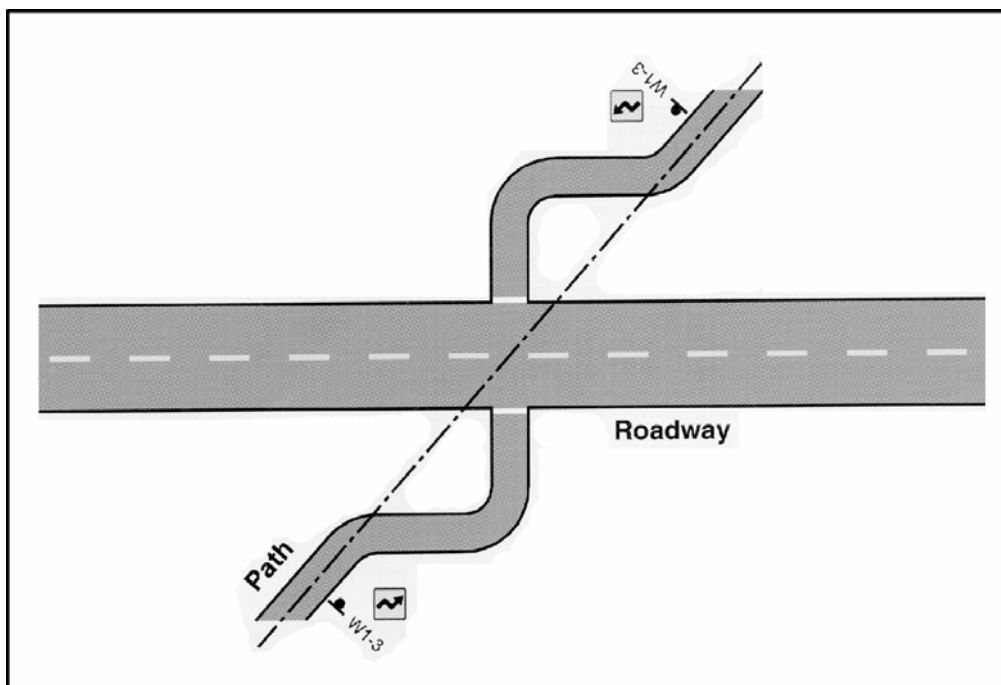


Figure 1.17: Typical Alignment for Diagonal Pathway Crossing

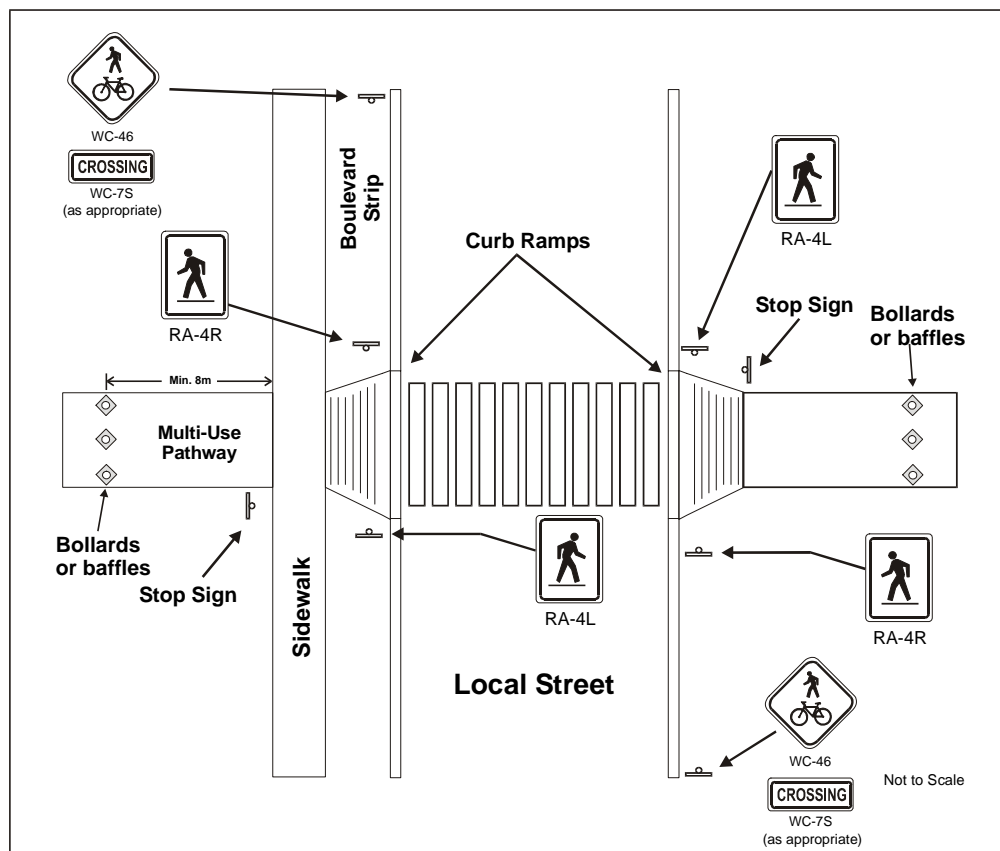


Common crossing treatments for multi-use pathways include:



- **Marked crossings** are provided where multi-use pathways cross major roads with relatively low traffic volumes and consistent gaps in traffic flow, as illustrated in Figure 1.18. As illustrated, bollards (placed in odd numbers) are the preferred treatment for slowing pathway users approaching the crossing, and for preventing motorized vehicles from entering the pathway. As described previously, baffles are another option, but should be used very sparingly if they are used at all.

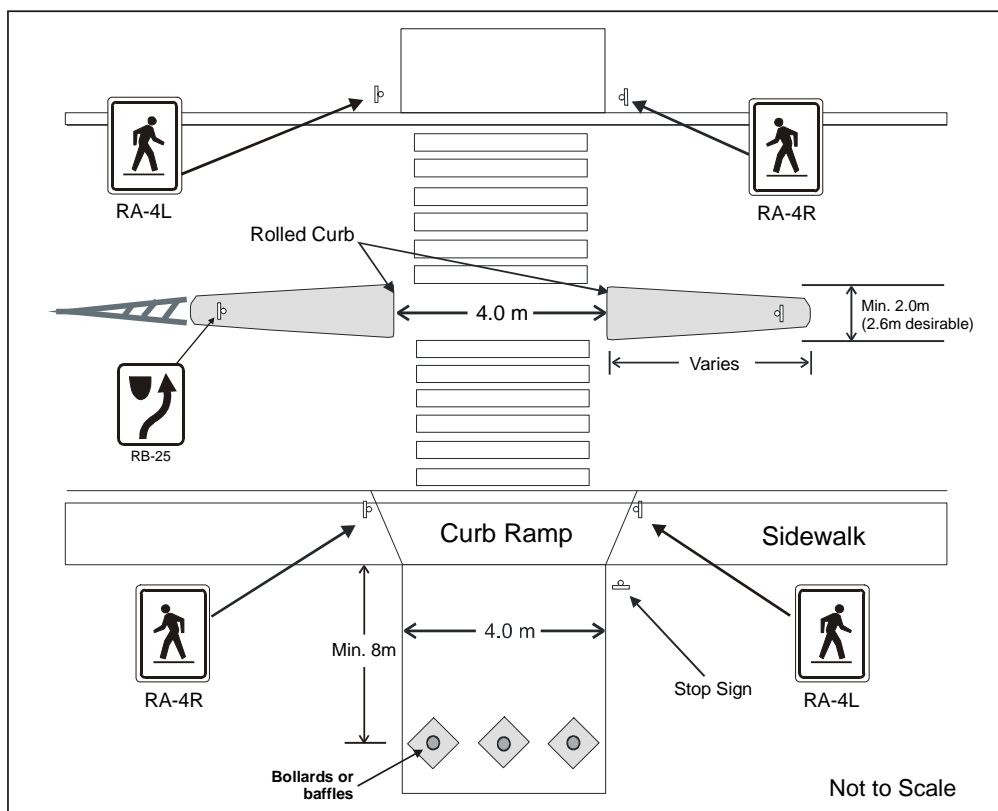
Figure 1.18: Marked Crossing – Multi-Use Pathway



- **Raised median island crossings** allow pathway users to cross one direction of traffic at a time at major roadways. An illustration of a pathway median island crossing is provided in Figure 1.19.



Figure 1.19: Raised Median Island Multi-Use Pathway Crossing



- **Signalized crossings.** Where high traffic volumes and a consistent flow of traffic make it difficult for pathway users to cross a major roadway, pedestrian/cyclist activated signals can be provided. In most cases, it is recommended that a ‘hot’ pedestrian button be used to activate the signal immediately for pathway users, unless traffic conditions necessitate the coordination of signal timings along the roadway in question.
- **Grade-separated crossings.** Where it is not possible to provide an at-grade crossing facility, such as with a freeway, major highway, railway, or waterway, cyclists and pedestrians can be provided with a grade-separated crossing. Overpasses and underpasses, as illustrated in Figure 1.20 and Figure 1.21, can be constructed to maintain access for cyclists and pedestrians across barriers to travel. Because grade-separated crossings can be very expensive, it is recommended that more innovative and cost-effective options be initially considered. Routings for bikeways and pathways can be planned and designed to take advantage of existing grade-separated crossings, where available. Innovative at-grade crossings can also be designed to minimize delays to traffic and maximize safety for cyclists and pedestrians.



Figure 1.20: Grade-Separated Bicycle/Pedestrian Crossings

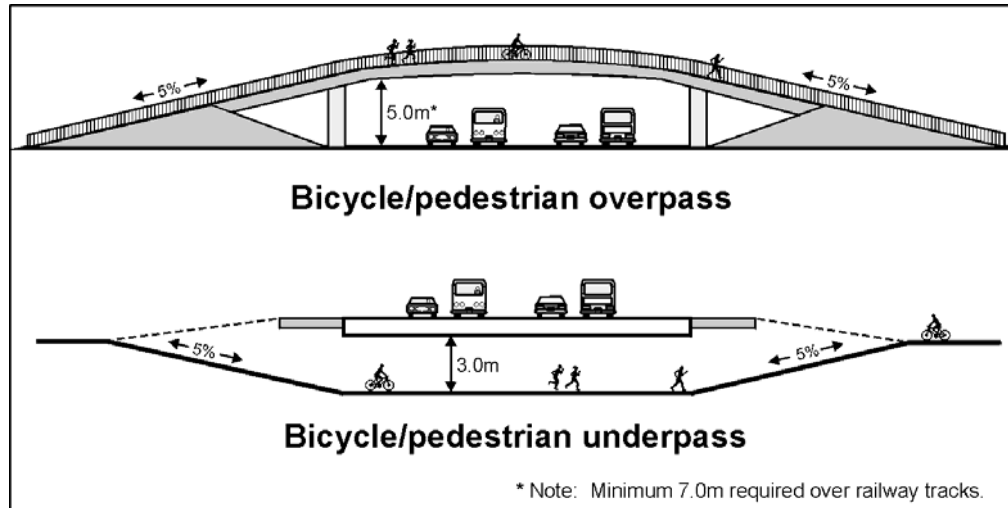
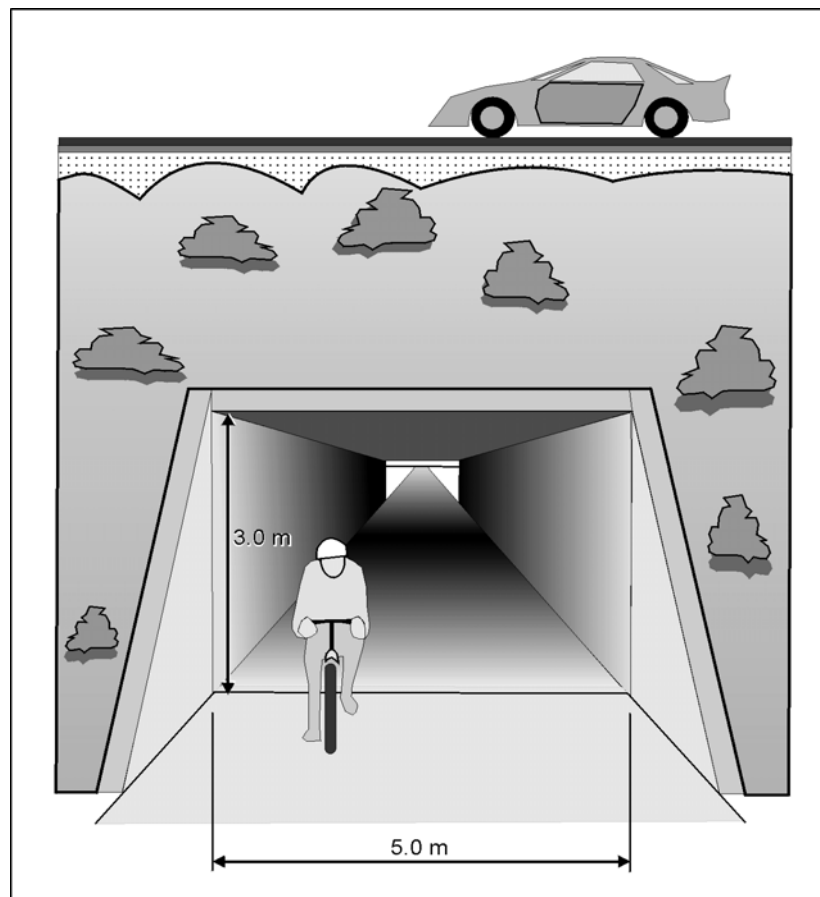


Figure 1.21: Underpass Dimensions

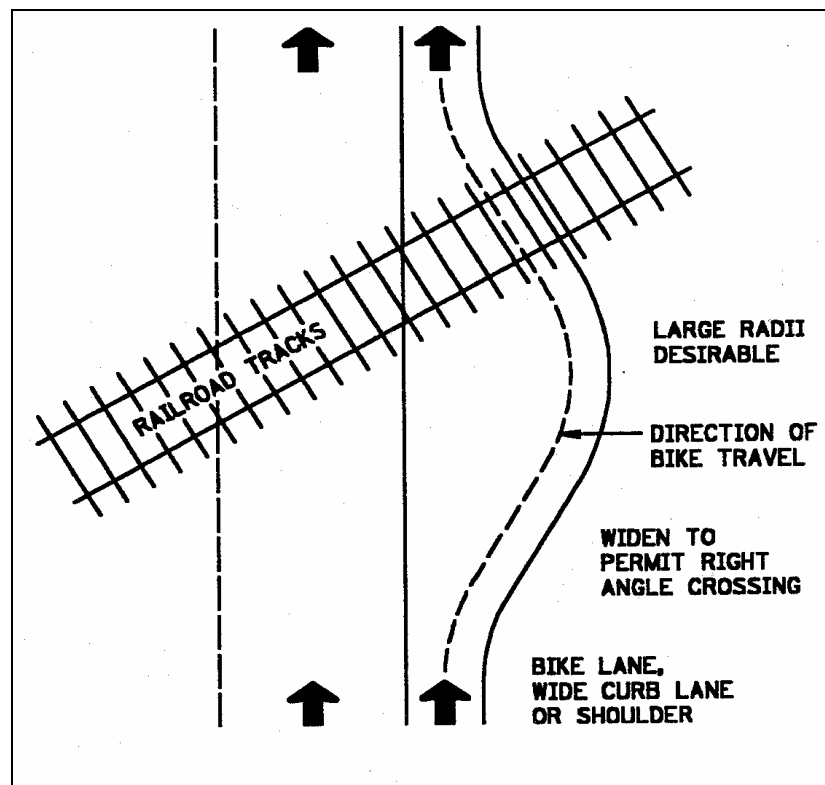




1.3.3 Railway Crossings

Special care should be taken at locations where a bicycle route crosses railway tracks at grade. Where possible, at-grade crossings of railway tracks should be designed to allow the cyclists to cross at right angles to the rails. A wide curb lane or bicycle lane should be widened to permit crossings to approach the tracks at 60 to 90 degrees, as illustrated in Figure 1.22. Where it is not possible to cross at an angle of at least 60 degrees, rubber track guards with a compressible flange filler are recommended.

Figure 1.22: Widened Shoulder at Railway Crossing



1.4 End-of-Trip Facilities

Design guidelines for specific end-of-trip facilities are presented in this section. Also, recommended development guidelines are provided, which describe desirable numbers of parking spaces, showers, and lockers for new developments, and which can be incorporated into the City of Langley's development requirements. Developers should be encouraged to provide end-of-trip facilities through bonusing, reductions in parking requirements, and other development incentives.



1.4.1 Bicycle Parking

Recommended guidelines for secure, long-term and short-term parking facilities are summarized in Table 1.1.

Table 1.1: Desirable Minimum Bicycle Parking Requirements

Use	Number of Bicycle Parking Spaces	
	Secure, Long-Term Parking	Short-Term Parking
Residential	1 stall for every residential unit	0.2 bicycle parking stalls per residential unit
Non-Residential	10% of required off-street vehicle parking	To be determined on case-by-case basis during development application process. Primarily based on building use and size.

Relevant design guidelines for bicycle racks (short-term parking facilities) include:

Selection

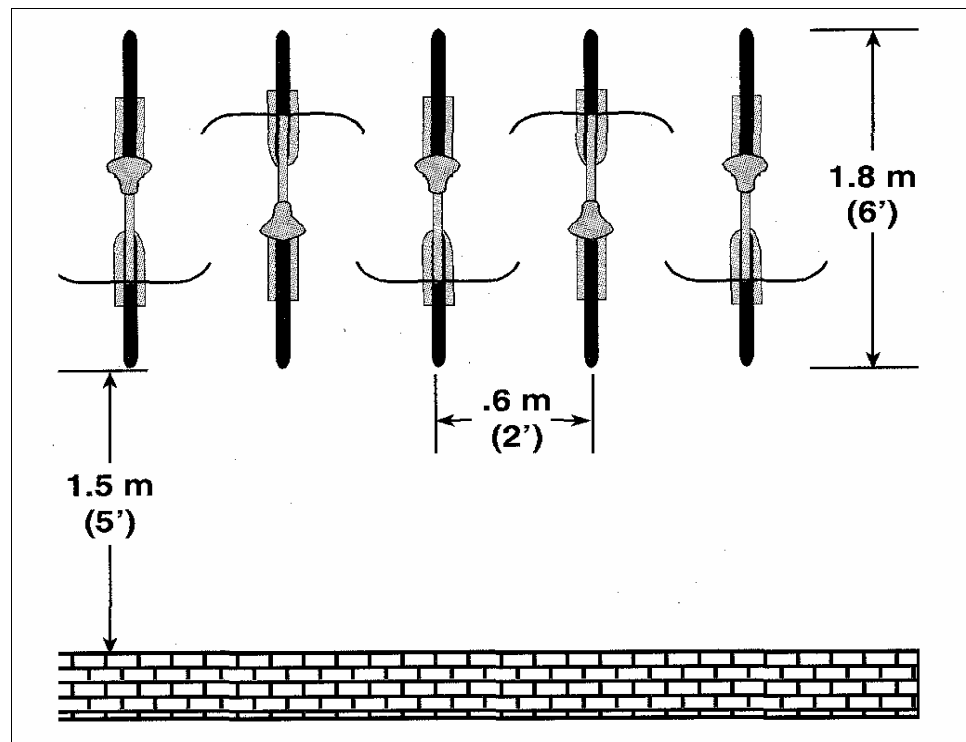
- Minimum rack height of 0.75m.
- Each bicycle stall should be accompanied by a secure bicycle parking device, which enables the user to lock the frame and at least one wheel with a 'U'-style locking device (without having to remove a bicycle wheel).
- Avoid bicycle racks that support the bicycle by a wheel rather than the frame, or support the bicycle below its centre of gravity. These designs are difficult to use, provide inadequate protection against theft, and may trip pedestrians when not in use.
- Racks should accommodate a minimum of three bicycles. Double-sided designs are preferred, whereby bicycles may be locked to the rack from two sides rather than just one side.
- Racks should be easily identifiable as a bicycle rack – avoid unusual or artistic designs.
- Racks should not present any potential hazard to pedestrians due to low projections.
- Rack should not have any sharp edges or projections where clothing could be caught or where users might suffer injury.
- Materials and paint should resist rusting, corrosion, and vandalism.
- Colours may be specified in beautification areas. Otherwise, colours can match awnings, façades, or other street furniture.



Installation

- Racks should be located within street allowances where a suitable off-street area is not available.
- Generally, racks located within the street allowance should be placed adjacent to the curb in the utility strip, where other street furniture, poles and trees are located.
- A bicycle parking stall is defined as a space measuring 1.8 m in length by 0.6 m in width, as illustrated in Figure 1.23. Vertical parking is allowable for up to 40% of the total required number of stalls and should be 1.1 m in length by 0.6 m in width.

Figure 1.23: Dimensions for Bicycle Parking Stalls



- Aisles between parked bicycles should be 1.2 m wide.
- Vertical clearance should be a minimum of 1.9 m.
- Racks should be oriented so that when placed in the rack, bicycles are positioned parallel to the curb.
- Racks should be located so as to maintain a minimum of 1.75-m clearance to the property line or nearest obstruction for pedestrian movement.



- Racks should not be placed in fire zones, loading zones, bus zones, taxi zones, etc.
- Racks should not be placed so as to conflict with other street furniture.
- Racks adjacent to parallel curb parking should be placed so as to avoid expected locations of opening car doors.
- Racks should be bolted to the sidewalk or footings.
- Racks located on public property cannot be designated for the exclusive use of patrons of one or more establishments.

Maintenance

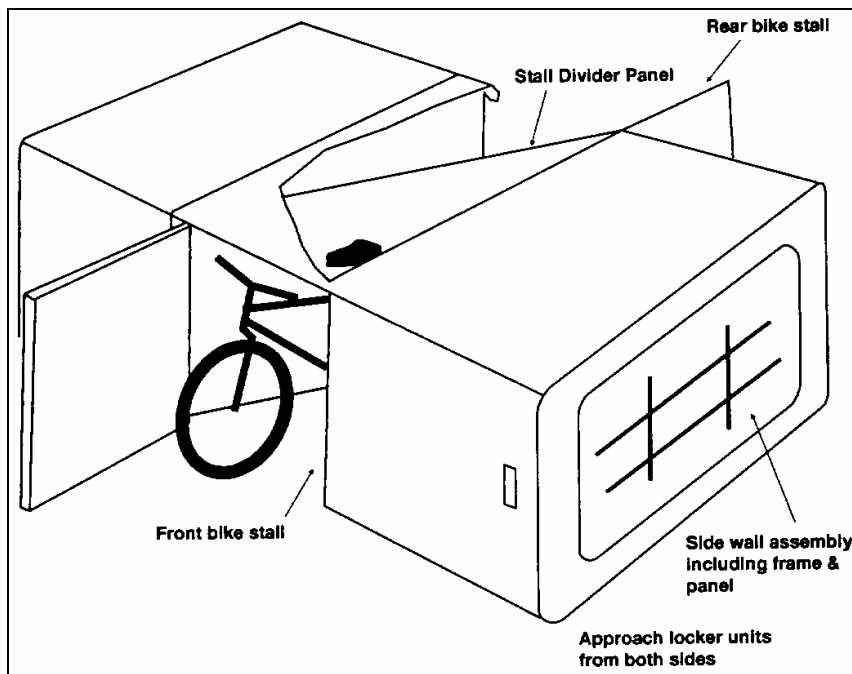
- Owners assume all liability for bicycle racks that they install.
- Owners must maintain bicycle racks that they install.

Design guidelines for secure long-term parking facilities can vary because of the many different types of long-term parking, including:

- **Controlled access parking** typically takes the form of a locked room or cage that is only accessible to the owners or operators of the bicycles. The room or cage may also contain bicycle racks to provide extra security against theft.
- **Bicycle lockers** only allow access to individual bicycle owners or operators. This type of facility is used where bicycles are commonly left unattended for an extended period of time. An example of bicycle locker parking is provided in Figure 1.24.
- **Attended bicycle parking facilities** provide an element of surveillance by having an attendant check in and check out bicycles for owners and operators. The bicycles are typically stored in a room or fenced-off area with an attendant monitoring the stored bicycles. A form of identification or ticket is presented to the attendant in order to retrieve a bicycle.



Figure 1.24: Bicycle Lockers



1.4.2 Showers and Clothing Lockers

Showers and clothing lockers are required at workplaces to accommodate cyclists and runners. Relevant development guidelines for showers and lockers include:

- The number of clothing lockers should be equal to or greater than 1.4 times the number of required bicycle parking spaces. Fifty percent of clothing lockers should be provided for women, and 50% for men.
- Generally, one shower is required for each gender for every 30 employees.
- Wash basins should be provided equalling the number of showers required.

Design guidelines for showers and clothing lockers include:

- Clothing locker facilities should be located no more than 60 m from bicycle parking. Additionally, the locker room should be located within the building in which the employee works.
- Clothing lockers should be a minimum of 45 cm deep, 30 cm wide and 90 cm high. Clothing lockers should preferably be 50 to 55 cm in depth to accommodate business clothes stored on hangers, and should be 180 cm in height so that pants and dresses can be stored without wrinkling.



- For non-residential locations with two or fewer secure long-term parking spaces, no showers or lockers are required, but may still be provided for employees. A location required to have three to six secure long-term parking spaces, as specified in Table 1.1, must have at least one shower and associated locker room for each gender. Any location required to provide seven or more secure long-term parking spaces must have one locker room per gender and at least one shower for each gender for every six secure long-term bicycle spaces.
- Showers should be located in separate men's and women's locker rooms. Locker rooms also require the following elements:
 - lockers
 - mirror
 - basin
 - countertop
 - electrical outlet
- All locker rooms should be secure and accessible solely to appropriate personnel.
- Where possible, lockers may be vented with forced air or heat-traced to dry cycle clothing for return trips home.

1.5 Signs and Pavement Markings

The application of signage and pavement markings to bikeways and pathways must be done in a uniform and consistent manner to ensure that they enhance safety and convenience for all users. Signage and pavement markings must be warranted by use and need. An over-abundance of signage and pavement markings may create a distraction and may be too confusing for motorists, cyclists and pedestrians. The application of too many signs is also unattractive when placed along roadways and pathways.

Provided in this section are some key guidelines for the use and installation of signage and pavement markings for bicycle facilities.

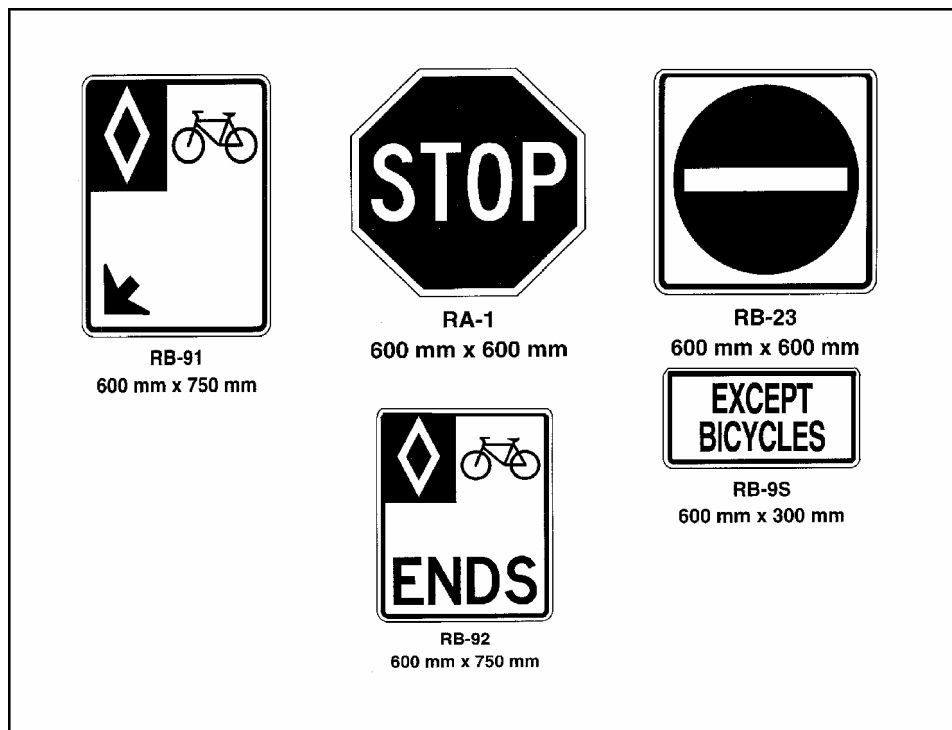
1.5.1 Signs

There are three types of signs used on bicycle routes and multi-use pathways, as identified below. The codes used to identify these signs are taken from the Transportation Association of Canada's *Bikeway Traffic Control Guidelines for Canada*.

- **Regulatory signs** indicate traffic regulations. Examples of regulatory signs are illustrated in Figure 1.25, and include stop signs, yield signs, 'Do Not Enter Except Bicycles' signs and 'No Parking' signs along roads with bicycle lanes.



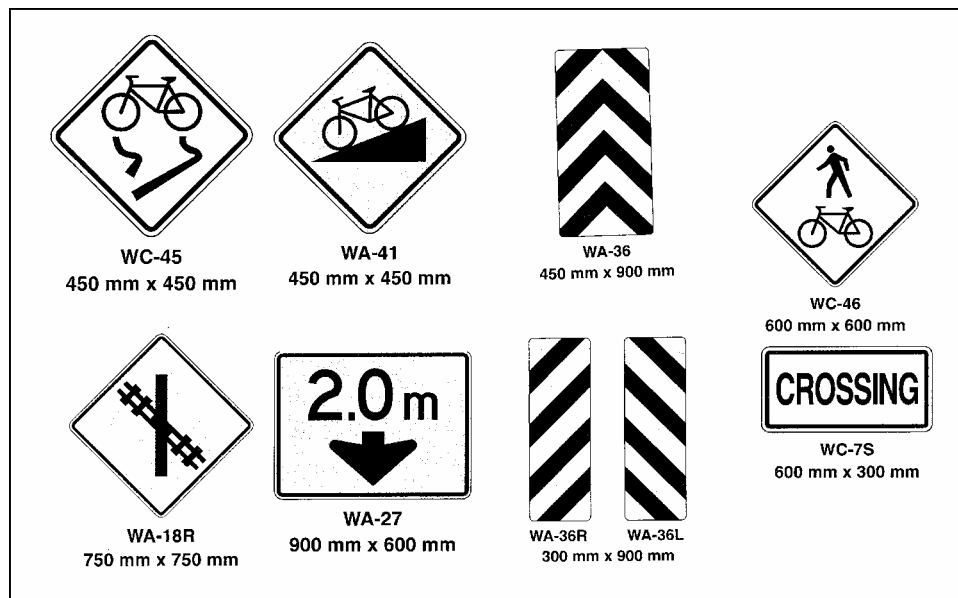
Figure 1.25: Example Regulatory Signs



- **Warning signs** advise cyclists and motorists of potential hazards or significant changes in conditions on roads and pathways. Warning signs are important for cyclists, as bicycles are more susceptible to poor road conditions than motor vehicles. Warning signs are also important in advising motorists of approaching bicycle and pedestrian crossings. Examples of warning signs include 'Railroad Crossing', 'Steep Grade', and construction detour signs. These and other warning signs are illustrated in Figure 1.26.



Figure 1.26: Example Warning Signs



- **Information signs** provide direction and information for cyclists and others, and include:
 - **Guide signs** indicate routes to major destinations, as well as parking locations, crossing locations and bicycle routes. Guide signs incorporate white text and arrows on a green background, as illustrated in Figure 1.27.
 - **Educational signs** provide information regarding appropriate use of bicycle and multi-use facilities. Examples of educational signs are illustrated in Figure 1.28. Although these signs are officially categorized as ‘warning’ and ‘regulatory’ signage, they also serve a purpose in educating the public as to the rules of the road. ‘Share the road’ signage should be used on roadways where interim bicycle facilities are provided, as discussed in Section 1.7. Other signs should be used in locations where sight distances or roadway configurations require that motorists and cyclists use caution.



Figure 1.27: Example Guide Signs

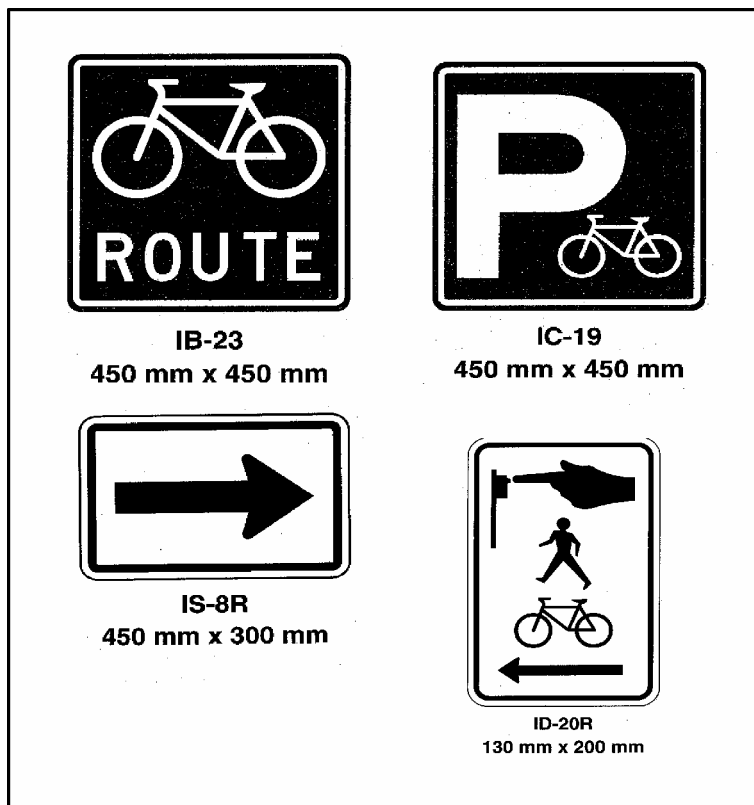
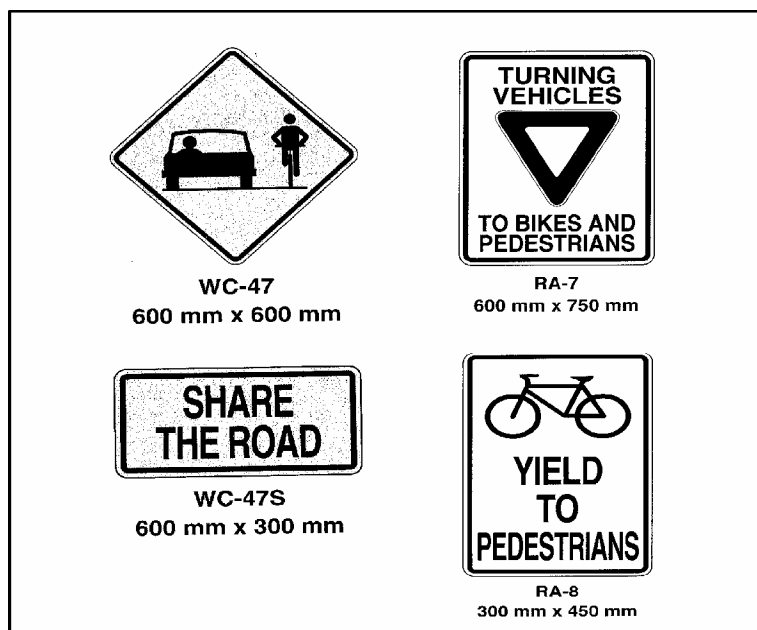


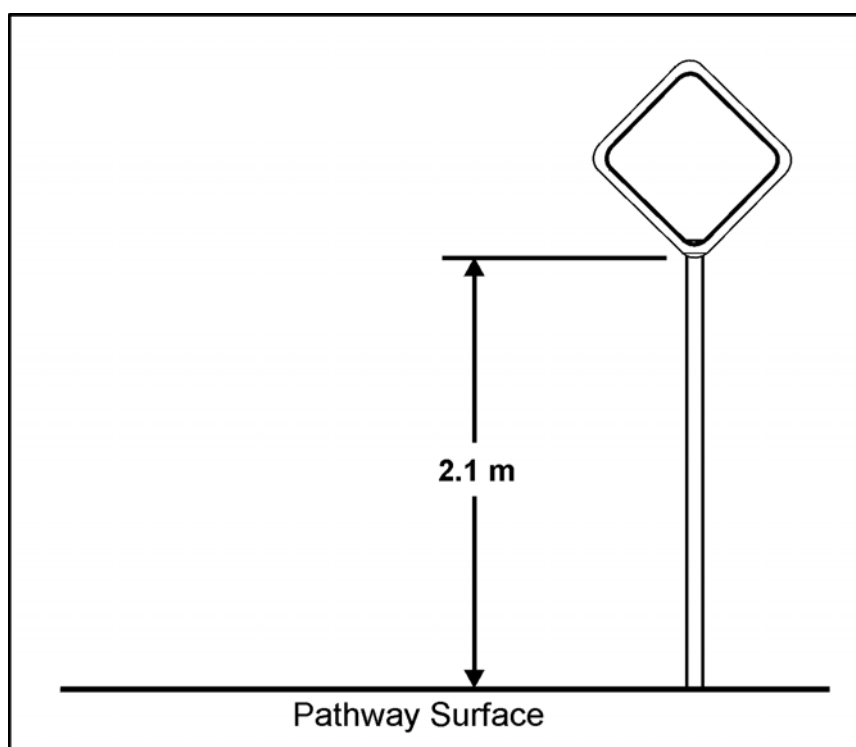
Figure 1.28: Example Educational Signs





Where applicable, the shape, colour and content of regulatory and warning signs should be consistent with standards specified in the *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC). The size of signs used on multi-use pathways can be smaller than specified in the MUTCDC – typically, signs on pathways are 45 cm by 45 cm rather than 60 cm by 60 cm. In addition, signs along multi-use pathways should be situated at a height of 2.1 m from the bottom of the sign to the pathway surface, as illustrated in Figure 1.29.

Figure 1.29: Vertical Placement of Pathway Signage



Placement of Signs

The appropriate placement of signage along a designated bikeway is an important component of the implementation of bicycle facilities. Regardless of how effective the signs themselves are in conveying a message, if they are not placed in the proper locations, they can prove to be ineffective, confusing or even hazardous for cyclists.

In general, signs are placed along the right side of a bikeway. However, in some cases, signs can be placed on a raised median island, on the left side of the bikeway, or overhead, depending on the circumstances (such as visibility and sight lines). For specific sign types, other general guidelines apply, as follows:



- **Location**

- **Warning signs** should be placed in advance of any hazard or condition to which they apply. In some cases, it is also necessary to place a sign at the point of the condition.
- **Regulatory signs**, such as stop signs, should be placed as close as possible to the location where the regulation is in effect. In some cases, as with stop signs that are not visible due to horizontal or vertical curves, advance notice of regulatory signs may be warranted.
- **Guide and information signs** are required both in advance of and at locations where conditions apply. In many cases, it may be warranted that guide and information signs are also used to re-affirm that a cyclist is on the correct route or path, particularly after a confusing intersection or junction. This practice is common with the Bicycle Route Marker Sign (IB-23), as illustrated in Figure 1.30, which is used to keep cyclists aware of the changes in route direction, as well as remind motorists of the presence of cyclists.

Figure 1.30: Directional Bicycle Route Sign



- **Orientation**

All signs should be placed in such a way that they are facing approaching cyclists at right angles to the direction of oncoming traffic. If the signs are reflectorized, they should be placed at an angle slightly away from approaching traffic. In cases where the alignment of the road or pathway is curved or winding, the angle of placement



should be determined by the angle of approaching traffic, rather than the angle of the bikeway edge where the sign is located.

- **Frequency**

Although it is important not to clutter a transportation corridor with signs, signage must appear frequently enough to provide a clear message to cyclists. In the cases where regulatory or warning signs are going unnoticed, additional signs at different locations may be required. For guide signs, such as the Bicycle Route Marker Sign (IB-23), signs should be placed at intervals frequent enough to keep cyclists aware of the changes in route direction and to remind motorists of the presence of cyclists on the road. Bicycle route signage should appear along a route at least every 100-200 metres, depending on specific circumstances. For example, an urban street with commercial uses and numerous driveways would necessitate a more frequent use of route signage than every 100 m. However, a rural cross section roadway with few driveways would only require a route sign every 200 m. These intervals do not include signage placed in advance of and after intersections.

It is important to note that signage can be used with bicycle stencils to enhance the awareness of a bicycle route at the same location. However, in most cases, the two methods can be used separately, thereby making more efficient use of resources.

- **Lateral Placement**

Signs should be placed near the edge of the nearest traffic lane, with the near sign edge no less than 2.0 m, but no more than 4.5 m, away from the nearest traffic lane. With multi-use pathways, the minimum distance can be reduced to 1.0 m.

1.5.2 Pavement Markings

Pavement markings are used to delineate bicycle lanes, to identify crossings on roadway surfaces, to separate directions of travel on multi-use pathways, and to complement regulatory and warning signs. Relevant guidelines regarding pavement markings are provided below.

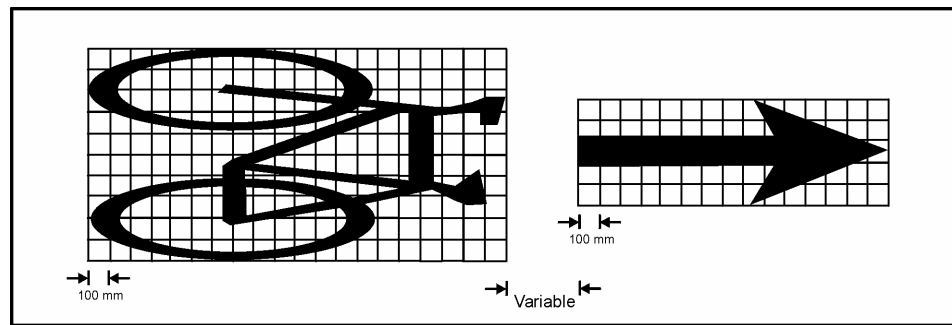
On-Road Bicycle Facilities

Pavement markings for on-road bicycle facilities can define bicycle lanes, separate opposing flows, designate lane usage, identify stop lines and supplement regulations or warnings of other devices such as traffic signals or signs. Overuse of pavement markings for on-road bicycle facilities is not recommended primarily because of the slippery conditions created during times of wet weather. Guidelines for on-road bicycle facility pavement markings include:



- Bicycle lanes are designated with a 10 cm white strip, bicycle symbols, and directional arrow stencils, as illustrated Figure 1.31, provided on the pavement.

Figure 1.31: Bicycle Lane Pavement Symbol



- Bicycle symbols should be placed at regular intervals (every 200 m), as well as in advance of all intersections and major driveways on the right side of the wide curb lanes. Bicycle symbols should be placed after most intersections not only to identify the facility to cyclists, but also to indicate the presence of cyclists to motorists.
- Bicycle symbols should not be placed in an area where motor vehicles are expected to cross a bicycle lane, such as adjacent to driveways.
- For marked wide curb lanes, bicycle symbols should be placed on the pavement adjacent the gutter or parking lane as illustrated in Figure 1.32.



Figure 1.33: 'Shared Use' Text in Marked Wide Curb Lanes

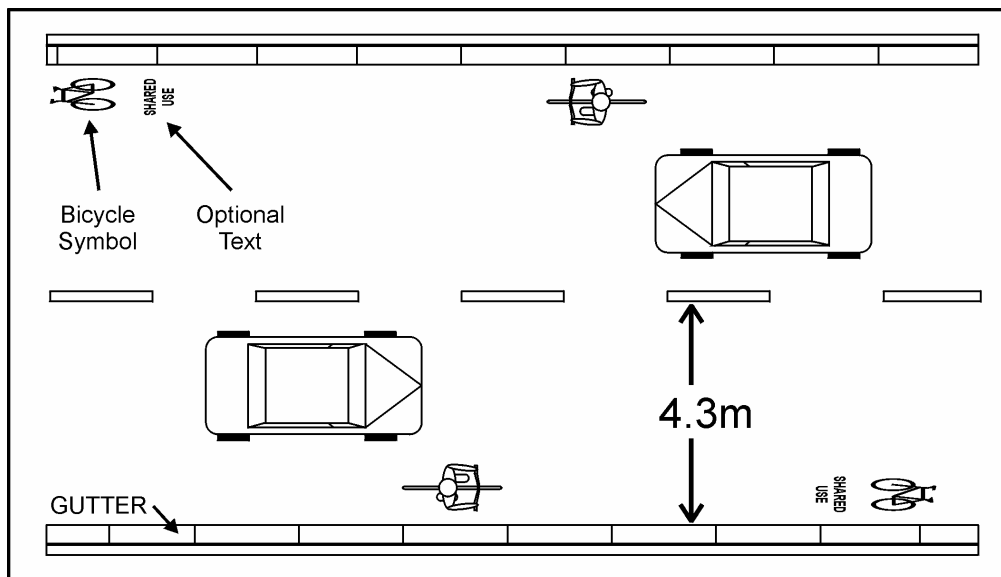


Figure 1.34: Bicycle Lane Markings at Intersections

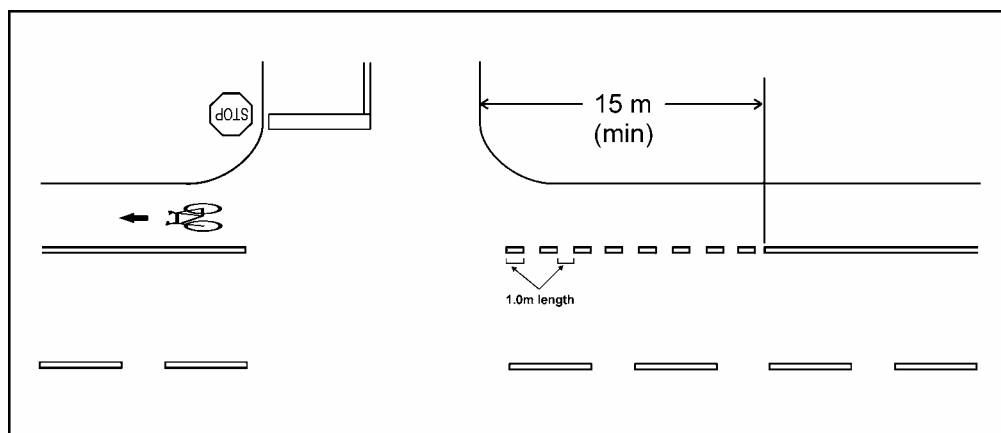
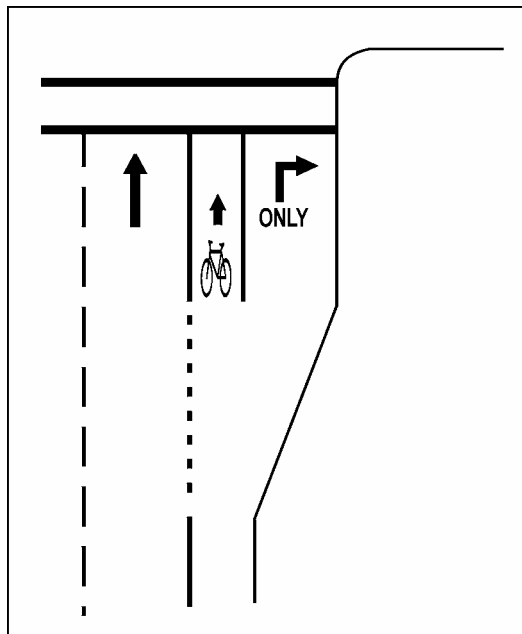




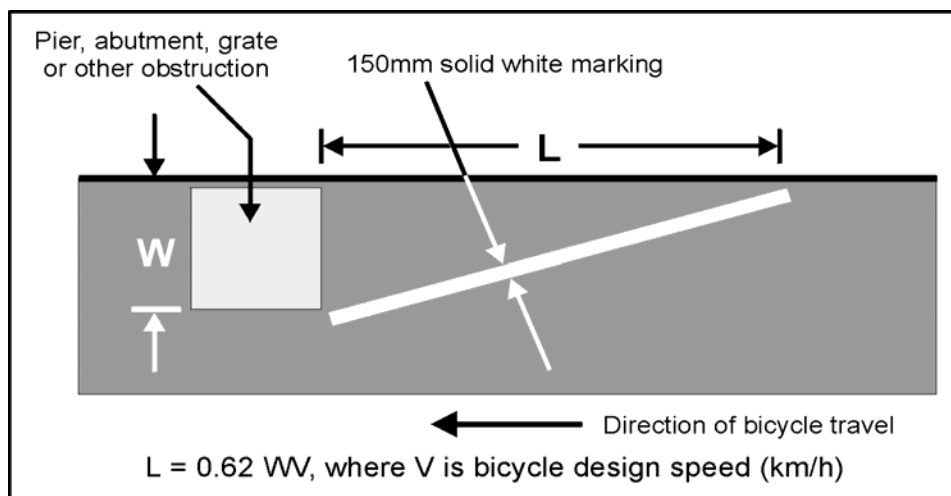
Figure 1.35: Bicycle Lane Marking at Dedicated Right-Turn Lane



Hazard Markings

Surface irregularities and obstructions should be clearly marked to gain the attention of approaching cyclists, as illustrated Figure 1.36. Signs, reflectors, object markers (WA-36) or other treatments may be appropriate to alert cyclists to potential obstructions.

Figure 1.36: Hazard Pavement Marking





1.6 Maintenance

Maintenance of bicycle facilities is neglected in many communities. Not only does this discourage cycling and walking, but it also creates a significant liability concern for municipalities.

With proper design and maintenance, liability is not an issue with respect to bicycle and pedestrian facilities. Liability concerns have been successfully addressed for automobiles and other motorized vehicles by developing appropriate design and signage standards, and implementing maintenance programs and public reporting processes. In doing so, jurisdictions have minimized the numbers and amounts of claims that might be attributed to negligence on the part of a municipality government.

Municipalities' potential liability regarding bicycle facilities can be minimized by the following actions:

- **Apply design guidelines** that accommodate cyclists on all roads, and all users on off-street facilities.
- **Install appropriate signs**, including warning signs where necessary, and ensure that signs remain visible at all times.
- **Establish a regular maintenance program** for bicycle facilities. Sufficient resources should be allocated to respond to requests that require unscheduled maintenance, as well as carrying out regular, scheduled maintenance. Key maintenance activities are as follows:
 - For all facilities, regular **inspection** and **surface repair** activities should be undertaken as needed to eliminate cracks, potholes and bumps.
 - For bicycle lanes and multi-use pathways, regular **sweeping of debris** is required to maintain the surface quality of these facilities and minimize the potential for slippage and punctured tires.
 - The **repainting of pavement markings** must be periodically undertaken to ensure visibility and clarity. Additionally, bicycle route signage should be periodically inspected to ensure that signs have not been damaged, stolen, or oriented the wrong way.
 - For multi-use pathways, the periodic **pruning of adjacent vegetation** is required to maintain the clear width of the pathway, as well as sight distance. Pruning of vegetation is also important for maintaining visibility at intersections along on-street bicycle routes.
 - **Pavement overlays** on bicycle routes should ensure that no ridges are left in the area where cyclists ride.




- **Drainage facilities** along bicycle routes should be periodically inspected to ensure that they are properly diverting storm water and not creating a hazard for cyclists.
- **Snow removal** should be undertaken on all bicycle facilities, as is done with motor vehicle facilities, to permit use of bicycles in winter.

It is possible that the level of effort required for sweeping, repainting of pavement markings, pruning and snow clearing of bicycle facilities would exceed the City's current capabilities, and would require additional budget allocation. As well, sweeping and snow clearing priorities might need to be revised to incorporate bicycle facilities. As with many items identified within the Bicycle Facility Design Guidelines, adequate funding may not be available in the short term for implementation of these initiatives. However, it is important that these initiatives be included as part of the Guidelines as opportunities for funding are made available in the future.

- **Designate responsibilities for maintenance** of specific bicycle facilities. Maintenance of on-street facilities should be the responsibility of the Operations Department, for example, whereas maintenance of off-street facilities would be the responsibility of the Parks and Leisure Services Department.
- **Establish a reporting procedure** that enables cyclists to notify the municipality of maintenance needs. Methods of reporting maintenance problems include a dedicated telephone 'hot-line', e-mail contact and pre-paid 'maintenance request' postcards, which are illustrated in Figure 1.37.

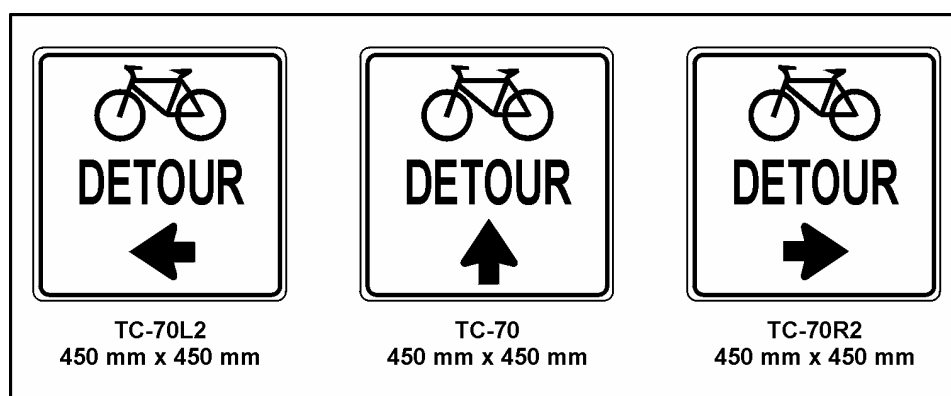
Figure 1.37: Pre-paid Maintenance Request Postcard

	Citizen Bicycling Improvement Request City of Seattle Bicycle Program
The Bike Spot Program makes low cost improvements to enhance bicycle safety and access. We do maintenance work, signs and striping, and small construction projects. Almost anything is possible!	
Location: Roadway Name _____	
Landmarks: (cross street, # of feet from curb, address). Be specific! _____ _____	
Description of Problem: (What is it, and why is it a problem) _____ _____ _____	
Reported by: Name _____	Day Phone _____
Address _____	Zip _____ Date _____
Return to: Seattle Engineering Bicycle Program, Room 708 Municipal Building, Seattle, WA 98104 For further information, call 684-7584	
Printed on recycled and recyclable paper.	



- **Respond quickly to maintenance requests.** Once a municipality has been advised of a hazardous situation, it has a duty to address the problem. Prompt follow-up avoids potential liability.
- **Consider cyclists during road construction.** Often road construction projects eliminate the travel portion at the side of roads, or place objects on sidewalks. As with motor vehicles, convenient detours must be provided for cyclists. Example bicycle detour signage is illustrated in Figure 1.38.

Figure 1.38: Bicycle Detour Signage



1.7 Interim Conditions

In most cases, designating a roadway as a bicycle route does not require significant changes to the roadway. On local streets, local collector roads, and local commercial/industrial roads, no roadway changes are required to incorporate a shared bicycle route. On arterial roads and major and minor collector roads, the roadway is often wide enough to incorporate marked wide curb lanes, sometimes with changes to other lane widths.

In a few cases, however, it may not be possible to provide a bicycle facility that meets the guidelines described in this document. This situation might arise where the roadway is not wide enough to incorporate wide curb lanes, for example, and therefore the only way to do so would be to reconstruct the roadway. If funds are not available for roadway reconstruction or if reconstruction is planned for a later date to coincide with other projects, then there is a need to do something in the interim to accommodate bicycles. In this case, an 'interim' condition can be created in order to establish a bicycle route.

Interim conditions apply to marked wide curb lanes and multi-use pathways. For these facilities, the interim conditions are simply facilities that are not as wide as the recommended minimum guidelines. Because of the reduced width, additional signage and design features are typically required. These are described on the following pages.



1.7.1 Marked Wide Curb Lanes

Most cyclists would consider any increase in the width of a curb lane to be an improvement. However, to provide sufficient width for cyclists and motorists to share the road, a minimum lane width of 4.3 m to the curb face (this dimension includes the gutter if one exists) is necessary as an interim condition. In situations where the wide curb lane is adjacent to on-street parking or a paved shoulder, the required minimum lane width can be reduced to 4.0 m as an interim condition, reflecting the reduced shy distance as a result of the absence of a curb. Where the lane is adjacent a barrier (such as no-post concrete, a railing or a wall), a minimum lane width of 4.5 m is required as an interim condition, to incorporate additional shy distance required by a roadside barrier more than 150 mm high.

Figure 1.39 provides an illustration of lane widths specified by the design guidelines in Section 1.2 and the interim conditions described above, for all applicable conditions. It should be noted that these interim dimensions for marked wide curb lanes meet the guidelines contained in the Geometric Design Guide for Canadian Roads published by the Transportation Association of Canada (TAC). The design guidelines described in Section 1.2 meet or exceed TAC guidelines, and are consistent with current state-of-the-art practices in North America.



Figure 1.39: Interim Conditions for Marked Wide Curb Lanes

Marked Wide Curb Lane		
Design Guidelines	Applications	Interim Condition
	Curb (with or without gutter)	
	On-street parking	
	No curb	
	Barrier (e.g. No-post, wall or railings)	
No extra space required for bicycles	Left turn lanes, right turn lanes, auxiliary lanes	

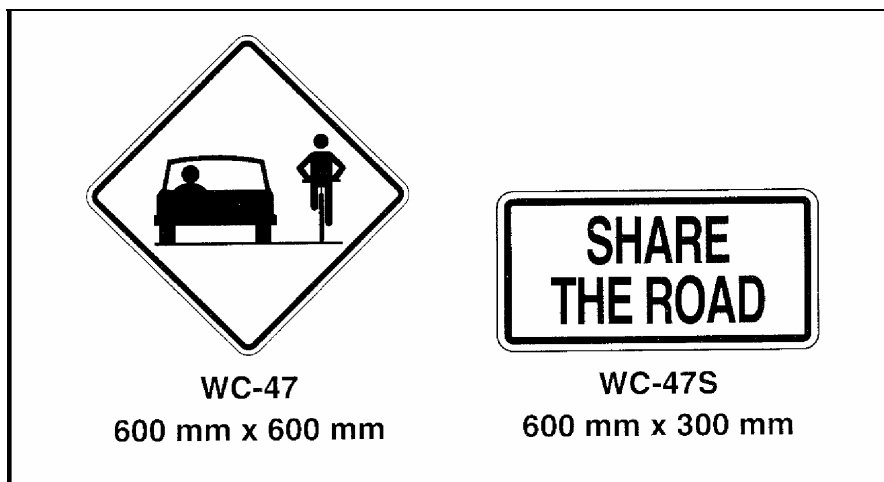
Roadways with curb lanes narrower than the interim dimensions can be designated as bicycle routes and can be signed as bicycle routes, but should not be marked with bicycle symbols on the roadway. Bicycle route signage along roads with narrow unmarked lanes should be supplemented with ‘share the road’ signage, as illustrated in Figure 1.40.

Wide curb lanes should only be marked on roadways where they are at least 100 m in length and comprise the majority of a section of roadway. This means that, on a roadway with travel lanes that alternate between the interim marked wide curb lane condition and widths that are less than the interim dimensions, it would be preferable not to mark



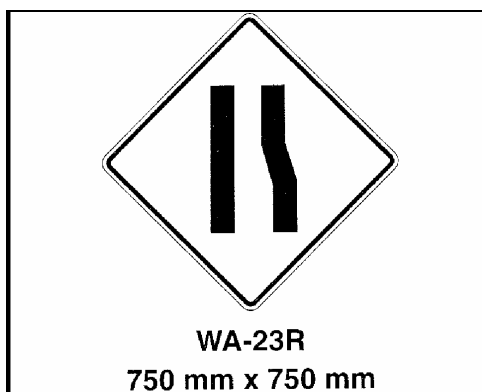
bicycle symbols on the pavement on any of the sections, rather than create a potentially confusing situation where bicycle symbols appear sporadically. In all cases, however, a designated bicycle route should be signed with Bicycle Route signs along its entire length.

Figure 1.40: 'Share the Road' Signage



Where a marked wide curb lane on a designated bicycle route transitions to a narrower unmarked travel lane, a 'Road Narrows' sign should be used as appropriate in advance of the narrower lane, as illustrated in Figure 1.41.

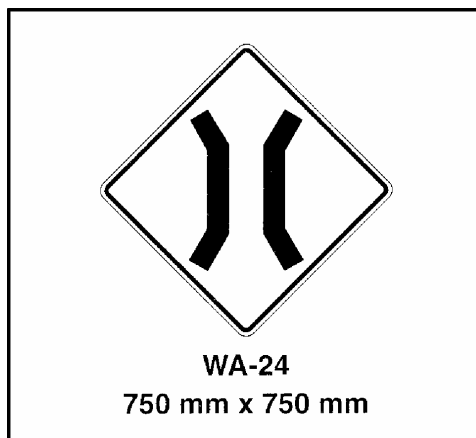
Figure 1.41: 'Road Narrows' Signage



Where a narrow bridge exists on a roadway with a designated bicycle route, and the lane widths are less than 4.0 m, the bridge becomes an interim condition until it is replaced at a future date. A 'Narrow Structure' sign should be used to alert both motorists and cyclists, as illustrated in Figure 1.42.



Figure 1.42: 'Narrow Structure' Signage



1.7.2 Bicycle Lanes

It is not desirable to create an interim bicycle lane of reduced width. Rather, where this situation arises, a marked wide curb lane should be used.

Where a bicycle lane transitions to a marked wide curb lane, or where a bicycle lane ends and the bicycle route continues without a marked lane, a 'Bicycle Lane Ends' sign should be used as illustrated in Figure 1.43. This sign should be located approximately 30 m in advance of the end of the bicycle lane as illustrated in Figure 1.44.

Figure 1.43: 'Bicycle Lane Ends' Signage

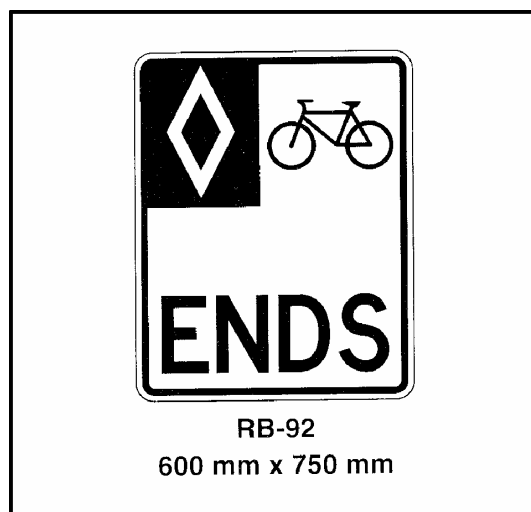
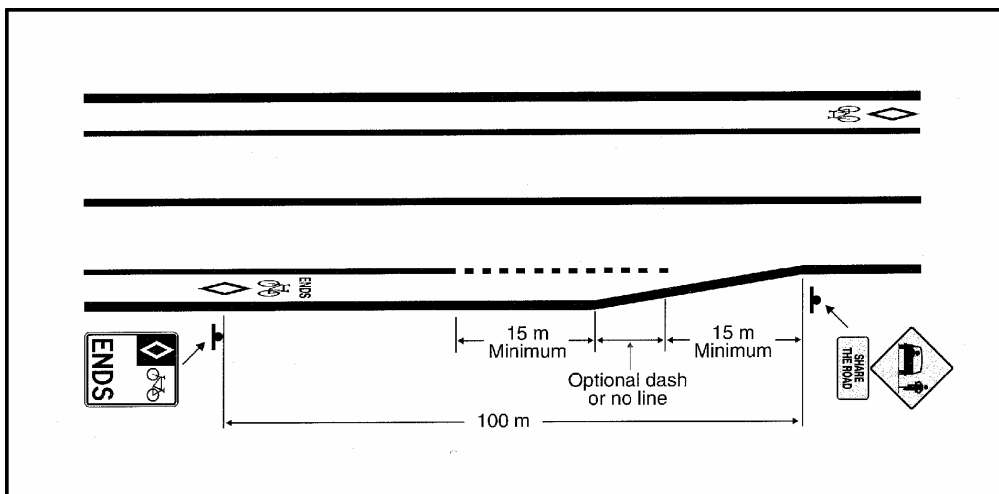


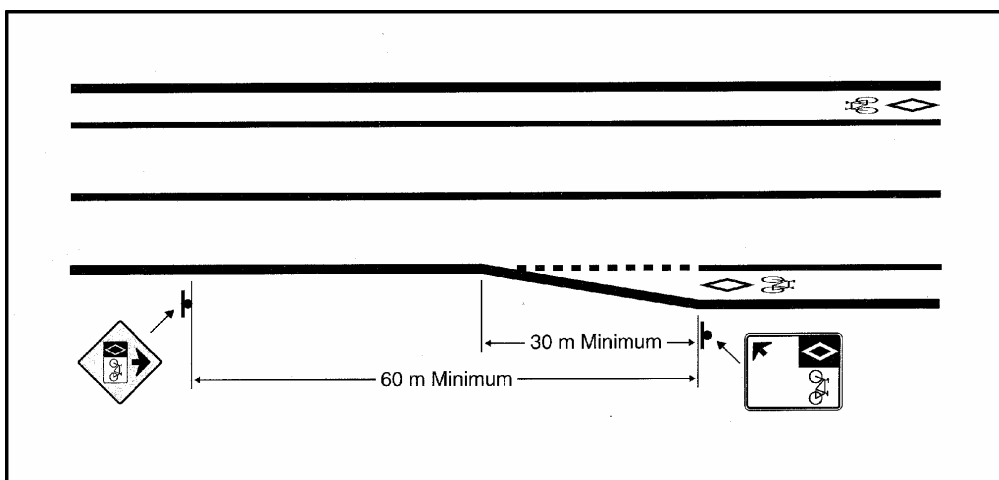


Figure 1.44: Location of 'Bicycle Lane Ends' Signage



Similarly, where a marked wide curb lane or an unmarked lane transitions to a bicycle lane, a 'Bicycle Lane Ahead' sign should be used as illustrated in Figure 1.45.

Figure 1.45: Location of 'Bicycle Lane Ahead' Signage





2.0 PEDESTRIAN FACILITY DESIGN TREATMENTS

This section provides recommended treatments for pedestrian facilities in the City of Langley. These designs have been presented to supplement existing practices in the City of Langley and further enhance the environment for pedestrians.

2.1 How the Guidelines Were Developed

The guidelines have been assembled from a variety of sources, including:

- *Design and Safety of Pedestrian Facilities*, Institute of Transportation Engineers, 1998.
- *Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, 1999.
- *Pedestrian Facilities Guidebook: Incorporating Pedestrians into Washington's Transportation System*, otak, 1997.
- *Portland Pedestrian Design Guide*, City of Portland OR, 1998.
- *Canadian Guide to Neighbourhood Traffic Calming*, Transportation Association of Canada/Canadian Institute of Transportation Engineers, 1998.
- *Pedestrian Facilities Users Guide, Providing Safety and Mobility, Draft Final Report*, Federal Highway Administration, 2000.
- *NJDOT Pedestrian Compatible Planning and Design Guidelines*, New Jersey Department of Transportation, date unknown.
- *Pedestrian Facilities: Best Practices 1999 Guide*, Mid-Ohio Regional Planning Commission, 1999.

The most recent version of the Transportation Association of Canada's *Geometric Design Guide for Canadian Roads* introduced the concept of 'design domain'. Essentially, this concept means that practitioners can and should use their judgement to determine the most appropriate design treatments for specific circumstances, rather than simply designing to a fixed standard. The concept of design domain allows practitioners to consider the needs of pedestrians as well as other road users, and modify designs accordingly.

Practitioners should recognize that in any design project, the competing needs of various road users might result in conflicts between design guidelines for pedestrians and design guidelines for automobiles, trucks, bicycles and other vehicles. The practitioner should objectively assess the relative importance of various conflicting design issues to determine which guidelines should take priority, or whether a compromise solution can



be used. If in doubt, the practitioner should always err on the side of the most vulnerable road users, which are generally pedestrians.

The treatments reviewed in this section include core pedestrian facilities – such as sidewalks and pathways – that provide pedestrians with a defined facility and route for travel, as well as support facilities that not only facilitate access, but also maximize safety, comfort, and convenience for pedestrians. Support facilities and treatments include:

- Boulevards
- Intersection treatments
- Signals
- Crosswalks and stop lines
- Raised medians and refuge islands
- Curb cuts and ramps
- Street hardware and furniture
- Parking facilities
- Grade separated crossings
- Bus stops and transit stations
- School zones
- Construction site treatments

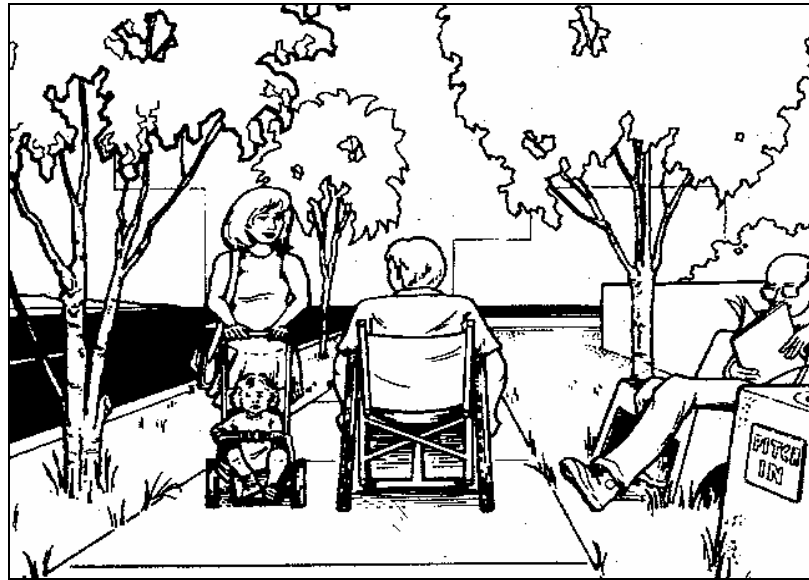
When applied in an appropriate manner, this combination of facilities and treatments will contribute to the evolution of a more pedestrian-friendly environment in the City of Langley.

2.2 Sidewalks

Properly designed sidewalks are essential to increasing pedestrian mobility, safety, and accessibility. This is especially true for persons with disabilities, the elderly, and children. Recommended widths for sidewalks depend on the locations where they are installed and the anticipated usage. Recommended minimum widths typically refer to ‘clear widths’ – the width free from all obstructions such as utility poles and fire hydrants. Wider sidewalks not only provide a more comfortable pedestrian environment for persons of all abilities, but they also send a positive message to the community regarding the status of pedestrians within the transportation system. If sidewalk widths are reduced or sidewalks are not provided at all in a residential neighbourhood, regardless of the anticipated volumes of pedestrians, residents may not feel encouraged to walk for either transportation or recreation.



Figure 2.1: Sidewalk Width to Accommodate All Users

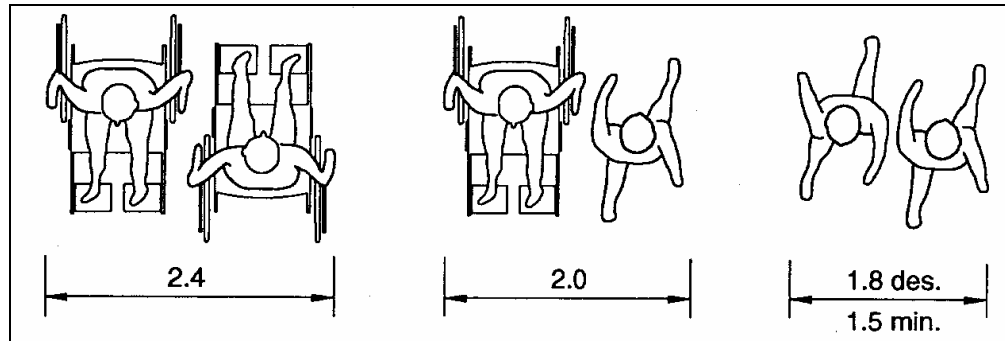


The Transportation Association of Canada's (TAC) Urban Supplement to the Geometric Design Guide for Canadian Roads recommends a desirable clear sidewalk width of 1.8 m, which is based on two pedestrians passing each other with a 'no-touch' zone of 0.9 m for each pedestrian. Although TAC indicates that the typical minimum clear sidewalk width should be no less than 1.5 m, they also provide the following guidelines:

- Sidewalk width should be increased by a minimum of 0.5 m where sidewalks are placed directly against the curb, allowing for street hardware placement, the opening of car doors and additional separation from moving traffic.
- In areas of hospitals and nursing homes, minimum sidewalk widths should be increased to 2.0 m to accommodate persons in wheelchairs (Figure 2.2).
- In commercial areas, widths of 2.4 m or more are common to allow for higher pedestrian volumes, the opening of car doors at the curb, street hardware, lateral clearances to buildings, and storefront window shopping (Figure 2.2).
- Additional width is also recommended for lateral clearance where sidewalks abut retaining walls, fences or similar structures.



Figure 2.2: Minimum Sidewalk Widths

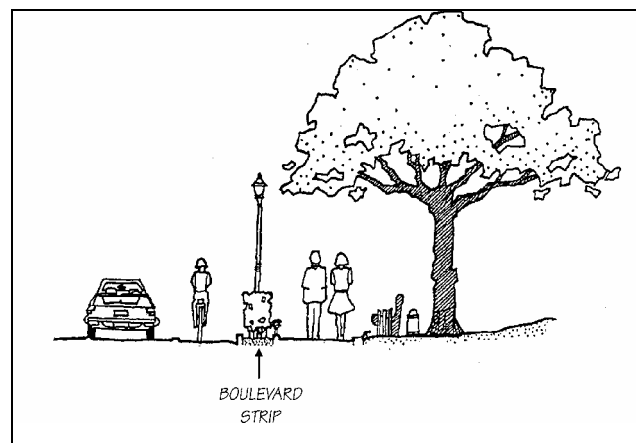


Pedestrian capacity analysis techniques provided in the Highway Capacity Manual (HCM) can be used to determine sidewalk widths required to accommodate higher levels of pedestrian flow, such as in Town Centre areas. It should be noted that the 'effective sidewalk width' does not include obstructions along the sidewalk, such as curbs, building walls, and point obstructions (hydro poles, street signs, etc.). The HCM provides guidance on the reduction in effective sidewalk width attributable to various components of the pedestrian environment.

2.3 Boulevards

Although the boulevard strip (Figure 2.3) within a road right-of-way is not considered a pedestrian facility, its presence significantly contributes to the enhancement of the pedestrian environment. In addition to providing a location for surface and underground utilities, street furniture, traffic signs and other control devices, boulevards – the area between the curb and the sidewalk – provide an important buffer zone between pedestrians and vehicular traffic along roadways.

Figure 2.3: Boulevard Strip





Boulevards are desirable for the following reasons:

- They provide increased safety for pedestrians and children at play by separating them from vehicular traffic.
- The probability of vehicle/ pedestrian collisions is reduced in the instance that a vehicle travels outside the roadway and up onto the curb.
- The boulevard provides an area in which to store street hardware such as utility poles, signs, transit shelters, fire hydrants, and newspaper boxes, thereby maintaining minimum clear distances for pedestrians on sidewalks.
- Landscaping can be added to the boulevard to enhance the walking environment for pedestrians.
- Where driveways intersect the sidewalk, the boulevard provides an adequate slope zone for driveway ramps between the curb and the sidewalk. Where sidewalks are provided right up to the curb, sloped driveways create an inconvenience and potential hazard for wheelchair users and elderly pedestrians.
- In situations where sidewalk widths are insufficient to allow a number of pedestrians or wheelchair users to pass, boulevards provide additional width to allow users to comfortably pass each other.
- An area is provided for the storage of snow plowed off of the roadway and sidewalk.
- Pedestrians are less likely to be splashed by passing vehicles in wet weather.

As with sidewalks, recommend widths for boulevards vary with street classification and land use designation. TAC recommends boulevard widths of 3.0 m along arterial streets and 2.0 m along collector and local streets. Along streets with design speeds of 60 km/h or greater, TAC indicates that the incorporation of boulevards is particularly important. In areas where space is limited and sidewalk widths need to be increased to accommodate high volumes of pedestrians – such as in commercial areas – boulevards may be narrower than the recommended dimension.

2.4 Intersections

Due to the complexity of movements, problems with sight distance and interaction of different modes travelling at different speeds, intersections will always be a relatively uncomfortable environment for pedestrians. A variety of measures and treatments, however, can be applied to new designs or existing arrangements to minimize the potential for conflict between pedestrians and vehicles where these modes intersect. Provided below are the key components of intersections that can be improved through specific treatments:

- **Sight distance.** The provision and maintenance of adequate sight distance is a key element in the planning and design of intersections. While adequate sight distance is important in minimizing vehicle-vehicle and vehicle-pedestrian conflicts from the



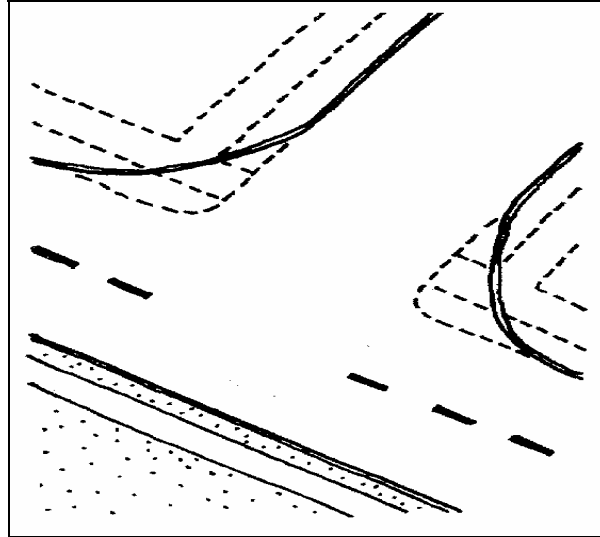
perspective of drivers, it is equally important to maintain adequate sight distance for pedestrians. It is important to remember that many features associated with the design and operation of intersections can contribute to a reduction in visibility and sight distance. Items such as signal poles, signage, landscaping, utility poles, and bus shelters can block the sight lines between pedestrians and motorists. Parked cars situated too close to the intersection can also reduce visibility and create a hazard.

Although many of these measures are associated with horizontal sight distance, vertical sight distance is also a major consideration at intersections. Vertical sight distance can be a problem in cases where intersections are located on steep grades, and where drivers of large trucks may have their line of sight to pedestrians obscured by tree branches, signage, or street banners. Therefore, it is important to consider sight distance not only during the initial design phase of an intersection, but also during its operational life to maintain visibility as other features are added.

- **Alignment.** Guidelines for the design of intersections recommend that intersecting roadways meet at 90-degree angles to minimize conflicts between roadway users. This standard provides optimal sight lines and crossing distances for pedestrians. In situations where this alignment standard cannot be achieved, extra precautions must be taken to ensure that potential sight lines are unobstructed.
- **Turning Radii.** The dimensions of curb radii at intersections have a significant effect on the speed of turning vehicles and pedestrian crossing distance. The design of curb radii does not typically consider the needs of the pedestrian; often curb radii are designed to allow for high volumes of traffic to turn quickly. For visually impaired pedestrians, smaller radii are preferred to give them a better indication of direction at the intersection, as well as to slow speeds of turning vehicles. However, curb radii that are too small may result in vehicles mounting the curb, endangering pedestrians waiting to cross at the corner and creating maintenance problems over the long term as deterioration of the curb is accelerated. Thus, a balance must be achieved that serves both pedestrians and motorists.



Figure 2.4: Effect of Reduced Curb Radii



Large corner radii encourage higher speeds by turning vehicles and increase the distance pedestrians must travel to cross the roadway at an intersection. Larger curb radii are typically used to provide for the turning paths of large trucks and buses.

Reduced curb radii improve the pedestrian environment by:

- Slowing right-turning vehicles, minimizing the potential consequences of vehicle/pedestrian collisions.
- Reducing the crossing distances for pedestrians, minimizing pedestrians' exposure to vehicle/pedestrian collisions.
- Improving sight distance between pedestrians and motorists, decreasing the risk of vehicle/pedestrian collisions.
- Providing more pedestrian area at the corner.
- Allowing more flexibility in the placement of curb ramps.

Other benefits include:

- Decreasing the length of the pedestrian phase at signalized intersections.
- Decreasing the time a turning vehicle has to wait for a pedestrian to cross at unsignalized intersections.
- Enabling street-sweeping operations.

In many cases, large corner radii are not necessary – as long as motorists can make the turn comfortably without driving over the curb or travelling outside their lane –



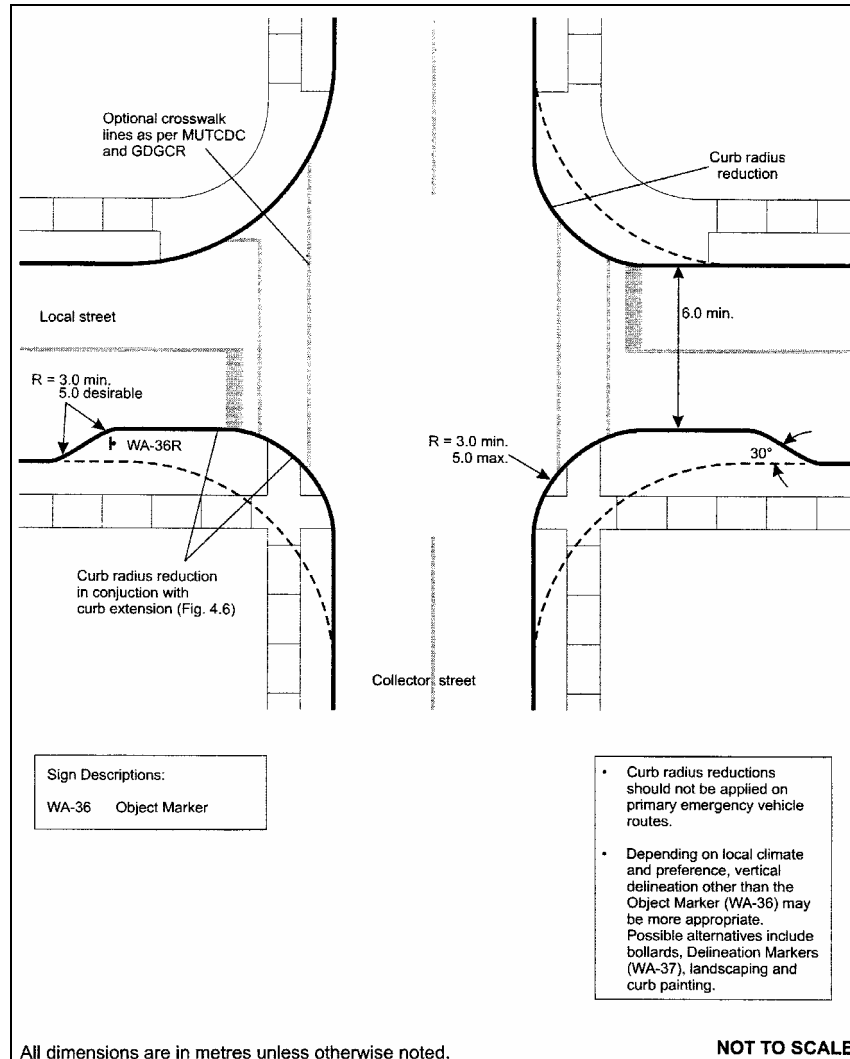
and should be reduced to provide for pedestrians. Reductions in curb radii should be considered on local and collector residential streets, particularly where there are significant pedestrian crossing volumes. This principle can also be applied when designing driveways. However, it may not be appropriate to reduce curb radii where there are significant numbers of large vehicles turning, such as on designated truck routes, at right-turn locations on bus routes with frequent service, and on primary emergency vehicle routes.

The Canadian Guide to Neighbourhood Traffic Calming provides curb radius reduction design details, as shown in Figure 2.5. The radius chosen should be the smallest possible for the circumstances. The smallest radius required to accommodate a passenger vehicle is 3.0 m to 5.0 m. As noted above, the implications of the smallest radius on the operation of larger vehicles should be considered. Factors that influence the selection of a turning radius include:

- **Available width of departing lane(s):** Low frequency encroachments into opposing lanes by larger transit, service, or emergency vehicles may be tolerable in some areas depending on the volume of opposing traffic.
- **Effective curb radius:** As shown on Figure 2.6, if a parking lane is provided, the effective curb radius may be sufficient for larger turning vehicles.
- **Impact of larger vehicles off-tracking onto the curb:** If insufficient turning radii are provided, larger vehicles – particularly articulated trucks – may off-track on to the curb. The frequency at which this might occur, sight distances and numbers of pedestrians should be considered in determining whether this would present an unacceptable risk to pedestrians, as compared with the additional risk associated with a wider curb radius. Where it is determined that it is acceptable for large vehicles to infrequently off-track on to the curb, the sidewalk should be sloped so as to reduce to the curb height at the corner to 75 mm or less, and the sidewalk should be constructed to support heavier vehicle weights.



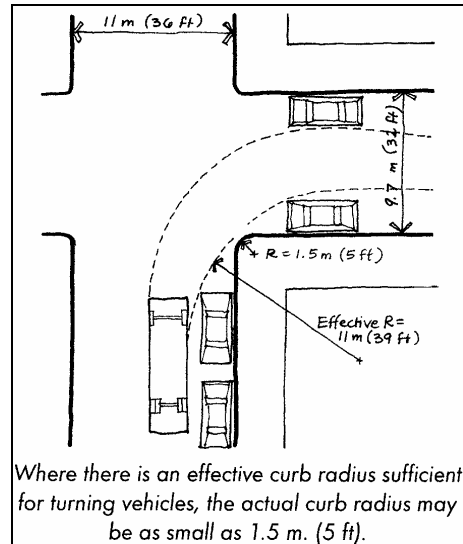
Figure 2.5: Curb Radius Reduction Guidelines



Source: Figure 4.7, Canadian Guide to Neighbourhood Traffic Calming, Transportation Association of Canada, December 1998.



Figure 2.6: Effective Curb Radius



Source: Portland Pedestrian Design Guide, City of Portland, June 1998.

- **Channelized right turns.** Channelized right-turn lanes are intended to reduce traffic delays by allowing right-turning traffic to bypass a signalized intersection. A raised triangular island, sometimes called a 'pork chop' separates the right-turn lane from the originating street. Channelized right-turn lanes are typically designed for unimpeded vehicular movement, and automobiles can often turn right at a reasonably high speed.

The benefits of channelized right-turn lanes are as follows:

- Reduced traffic congestion for heavier right-turn movements
- Reduced pedestrian crossing time for the intersection traffic signals

The drawbacks of channelized right-turn lanes include:

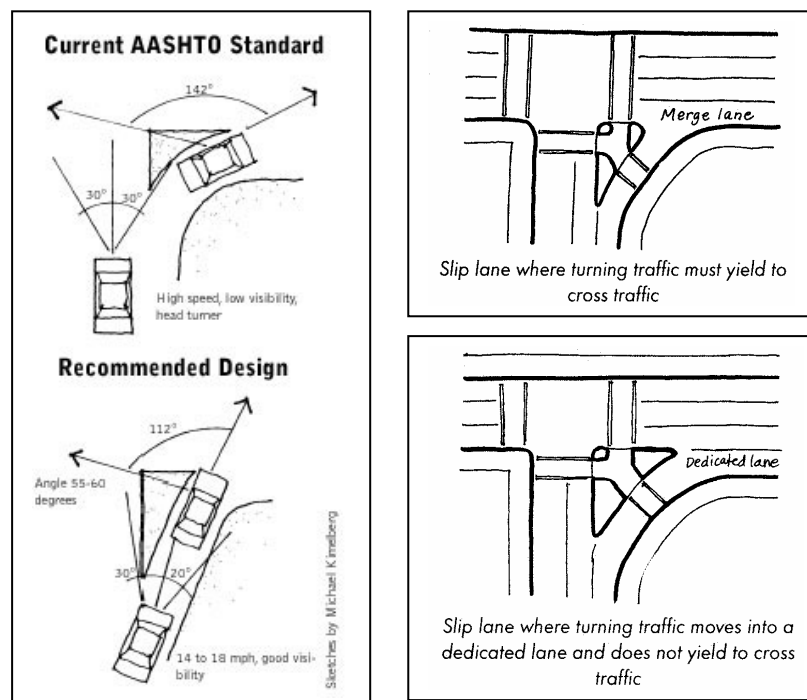
- Increased speeds for right-turning vehicles, increasing the potential for and consequences of vehicle-pedestrian collisions
- Decreased visibility of pedestrians
- Increased crossing distance for pedestrians
- Only minor benefits to vehicles when the storage length for the right-turn lane is minimal. Access to channelized right turn lanes can be blocked by traffic in the outside through lane.



Channelized right-turn lanes are not recommended in urban areas and other areas of significant pedestrian use. However, channelized right-turn lanes may be necessary to alleviate significant traffic congestion, or when curb return radii of larger than 9.1 m are unavoidable. If channelized right-turn lanes are provided, they should be designed so that high-speed turns are discouraged, thereby improving pedestrian safety, while accommodating trucks and buses. Methods of improving channelized right-turn lanes include the techniques illustrated in Figure 2.7 and described below.

- Providing raised pedestrian crossing islands within the intersection as a refuge island for pedestrians, ensuring that sufficient curb ramps are provided.
- Optimizing right-turning motorists' view of the pedestrian and the vehicles to their left by orienting the 'pork chop' so that the tail points to approaching traffic.
- Ensuring that the right-turning traffic must yield to the cross-street traffic, reducing vehicular speeds.
- Providing pavement markings to indicate the crosswalk location in the right turn lane.
- Placing the crosswalk where the driver has good visibility of the pedestrian, and is still looking ahead, rather than looking to the left for a gap in traffic.

Figure 2.7: Channelized Right-Turn Design

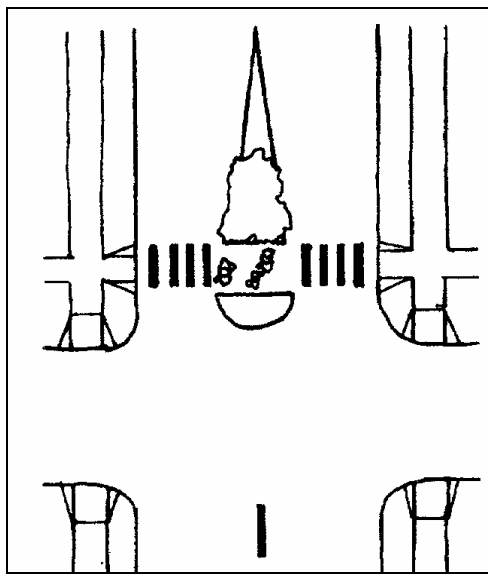


Sources: Pedestrian Facilities Users Guide, Providing Safety and Mobility, Draft Final Report, FHWA, McLean, VA, August 2000; Portland Pedestrian Design Guide, City of Portland, June, 1998.



- **Islands** provide a place of refuge for pedestrians where crossing distances are wide. They protect pedestrians in cases where there may be complicated or confusing traffic flow patterns or segregated, high-volume vehicle movements, such as with turn lanes. At wide signalized intersections, where crossing times are constrained, median refuges allow slower pedestrians to cross one direction of traffic each interval (Figure 2.8). It is important to provide adequate ramping or cuts in the islands to allow use by persons in wheelchairs. Additional information on median islands is provided in Section 2.8.

Figure 2.8: Median Refuge

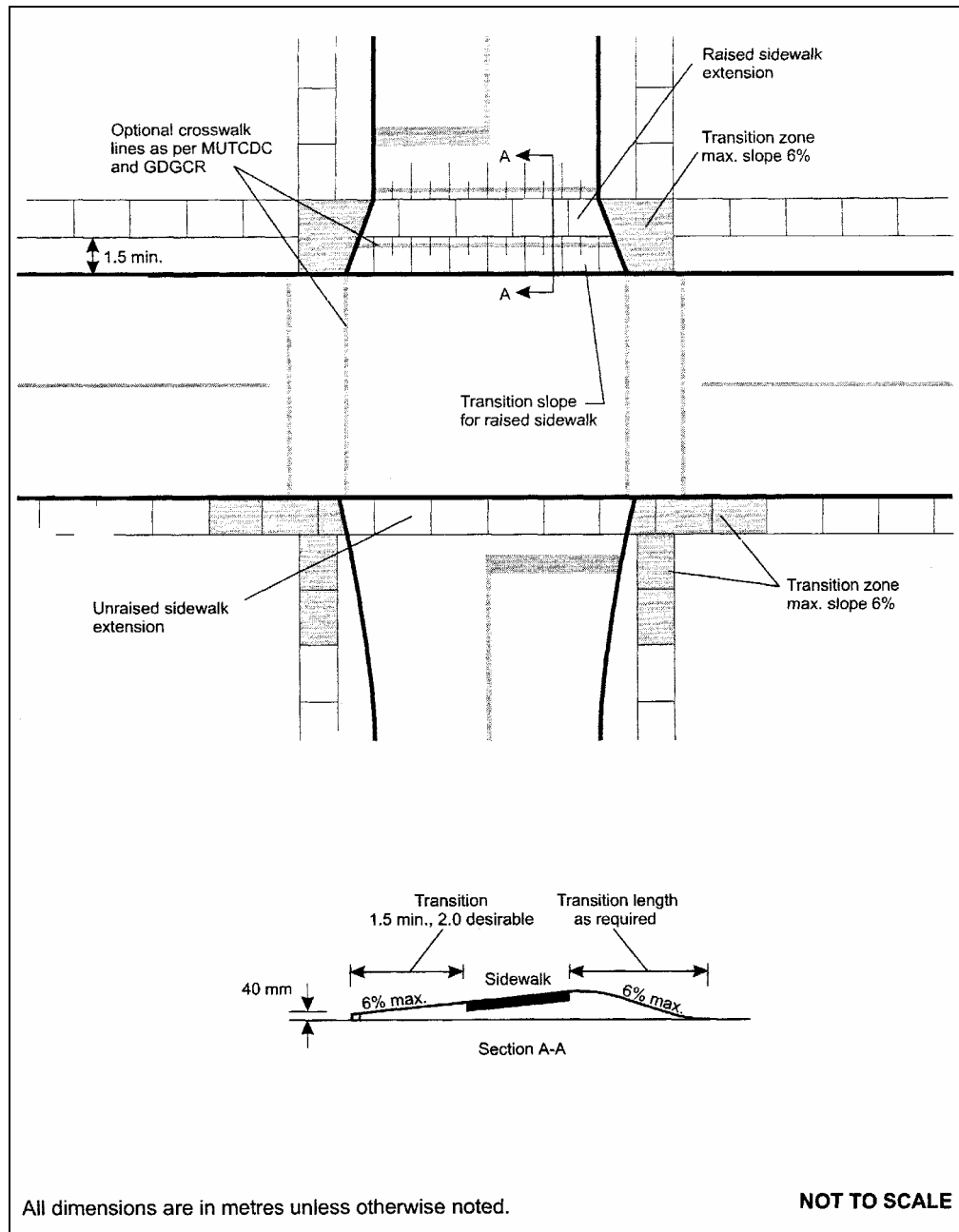


- **Sidewalk extensions.** Intersections are typically designed so that vehicles are given priority over pedestrians. To make pedestrian crossings more prominent, sidewalks can be extended across local street intersections. Sidewalk extensions can be either raised (road raised to level of sidewalk) or unraised (sidewalk lowered to level or roadway). Raised sidewalk extensions have the additional benefit of reducing vehicle speeds.

Sidewalk extensions are most suitable on local street intersections with collector or arterial streets. Design details for sidewalk extensions are provided in the Canadian Guide to Neighbourhood Traffic Calming, as shown on Figure 2.9.



Figure 2.9: Sidewalk Extension



Source: Figure 4.3, Canadian Guide to Neighbourhood Traffic Calming, Transportation Association of Canada, December 1998.



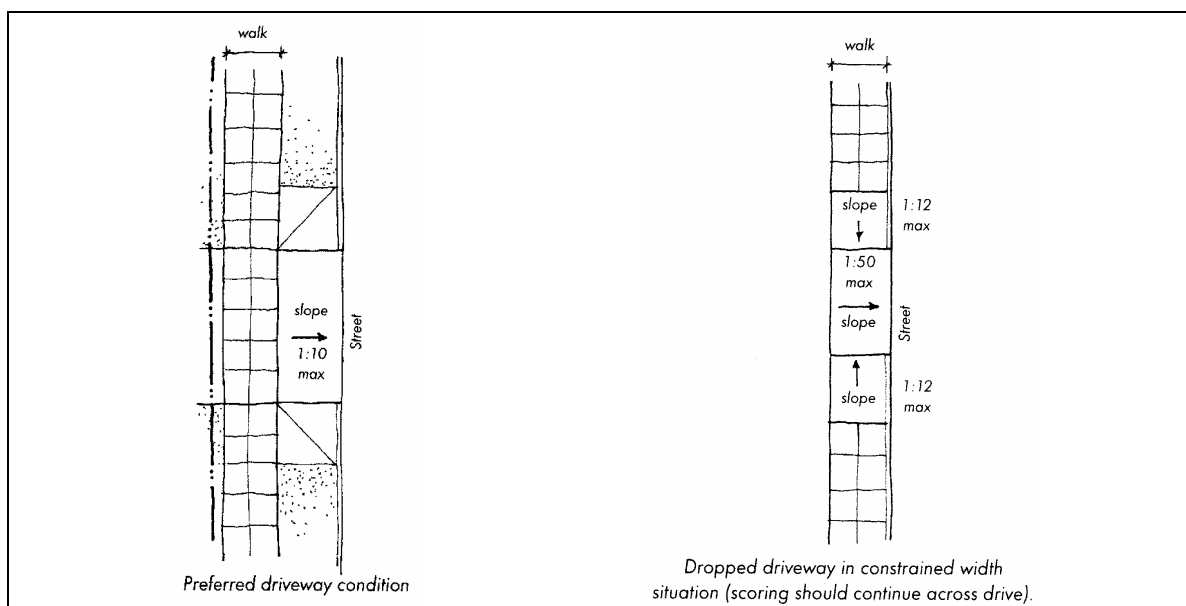
2.5 Driveways

Sidewalks that cross driveways are often sloped. This leads to the potential for wheelchairs to become unstable and tip over, and for other pedestrians to lose their balance. In addition to getting injured by falling, pedestrians could tumble into the roadway, exposing the pedestrian to the potential of a vehicle/pedestrian collision.

When driveways cross sidewalks, it is recommended to maintain the sidewalk level across the driveway, maintaining the two percent cross-slope, as per the Americans with Disabilities Act requirements. To make the sidewalk more prominent, the sidewalk material should extend across the driveway rather than the driveway material extending across the sidewalk.

Two design options are shown in Figure 2.10. As shown, the preferred driveway condition is to maintain the sidewalk cross-slope across the driveway, and score the sidewalk with a pattern to make the sidewalk more prominent. When sidewalk widths are more constrained, a dropped driveway may be used, typically where the sidewalk corridor width is less than 2.4 m. The third option is to provide a bypass walk at the top of the driveway. However, this results in a slight detour for the pedestrian, and should only be considered where there are problems with the dropped driveway, such as steep grades, or when the dropped driveway results in stormwater drainage problems. Three alternative design treatments to maintain the 2% cross-slope are provided in Figure 2.11.

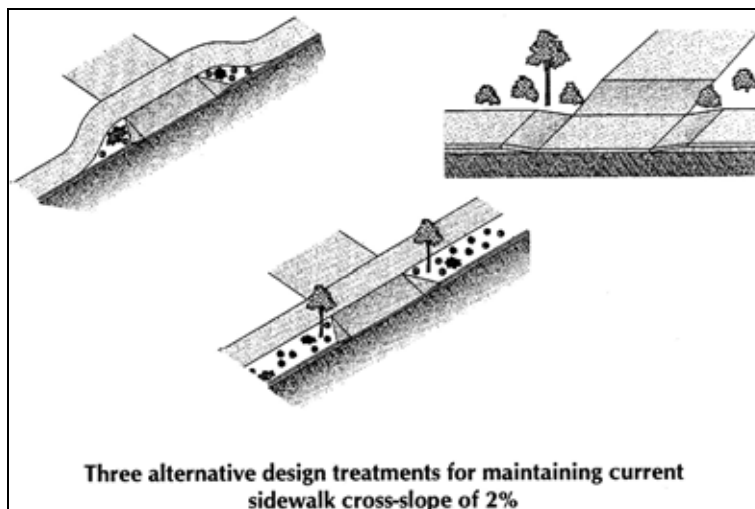
Figure 2.10: Driveway Crossing Options



Source: Portland Pedestrian Design Guide, City of Portland, June 1998.



Figure 2.11: Driveway Crossing Design Treatments



Source: Portland Pedestrian Design Guide, City of Portland, June 1998.

2.6 Signals

In addition to assigning right-of-way to motor vehicle traffic, signals provide an interruption in motor vehicle traffic to allow pedestrians to cross at intersections or at mid-block locations. Where installed properly, traffic signals can provide an effective means of controlling and managing vehicle and pedestrian flows at intersections. However, if a signalized intersection is complex and confusing for motorists and/or pedestrians, or an unwarranted traffic signal is installed, the potential for collisions is heightened. Treatments at signalized intersections must not only be easily understandable to both pedestrians and motorists, but they should also encourage predictable behaviour on the part of all users.

The lack of pedestrian signals at certain signalized intersections can serve as a barrier to pedestrian access by forcing some individuals to take unnecessary risks to cross traffic. Pedestrian signals include the white 'walking person' and red 'stopping hand' symbols to control pedestrian movements in conjunction with traffic signals. The steady 'hand' message indicates when pedestrians should not be in the crosswalk. The flashing 'hand' is a clearance interval – pedestrians are informed not to step into the crosswalk, but they may finish crossing if they are already in the crosswalk. The 'walking person' symbol indicates that pedestrians may cross the street in the direction of the signal. Pedestrian signal indications are recommended in the Manual on Uniform Traffic Control Devices (MUTCD) under the following conditions:

- Multi-phase signals are being used
- Complex intersection geometry (more than four legs, wide streets, refuge islands)



- Elderly pedestrians and young children are present
- Pedestrian push-buttons are in use

Studies have shown that many pedestrians do not understand the meaning of pedestrian signals and indications, particularly the flashing 'stopping hand'. Some municipalities have used educational pedestrian signs (Figure 2.12), although no formal sign of this kind has been incorporated into the MUTCD. In areas where pedestrian signals are not provided, and pedestrians are required to obey vehicular traffic signals, visibility of the vehicular signal heads may be obscured due to the geometry of the intersection. To maximize pedestrian compliance with signals at these locations, pedestrian signals should be provided.

Figure 2.12: Educational Pedestrian Crossing Signage



Pedestrian signal timings should allow sufficient time for pedestrians to cross from one end of a street to the other, without feeling unnecessarily rushed. While the MUTCD recommends at least a 4 to 7 second walk interval, some intersections may require significantly more walk time. Pedestrian signal timings are typically based on a walking speed of 1.2 m/sec (4 ft/sec). However, not all pedestrians, including elderly persons and small children, have the ability to walk at this speed. Pedestrian signal timings of 0.9 to 1.1 m/sec (3 to 3.5 ft/sec) should be applied to reflect the speed of the slowest pedestrians, and not a 'typical' pedestrian. At wide intersections, where pedestrian crossing times may vary, median refuges should be provided to allow pedestrians to cross one direction of traffic per signal interval.



2.7 Crosswalks and Stop Lines

Crosswalks are areas of the roadway designated for use by pedestrians in crossing the street. Crosswalks may be marked or unmarked, yet there is no legal difference between these two treatments. At intersections, where sidewalks meet the street, a legal crosswalk is defined, regardless of whether or not it is marked. Where crosswalks are marked, a number of different treatments may be used. The standard crosswalk markings consist of two parallel white lines, but diagonal and longitudinal lines have been used to enhance visibility of the crosswalk.

Because an overuse of marked crosswalks can reduce motorist compliance and, hence, the effectiveness of the crosswalk, this treatment should be used sparingly and strategically. Marked crosswalks are generally recommended in the following situations:

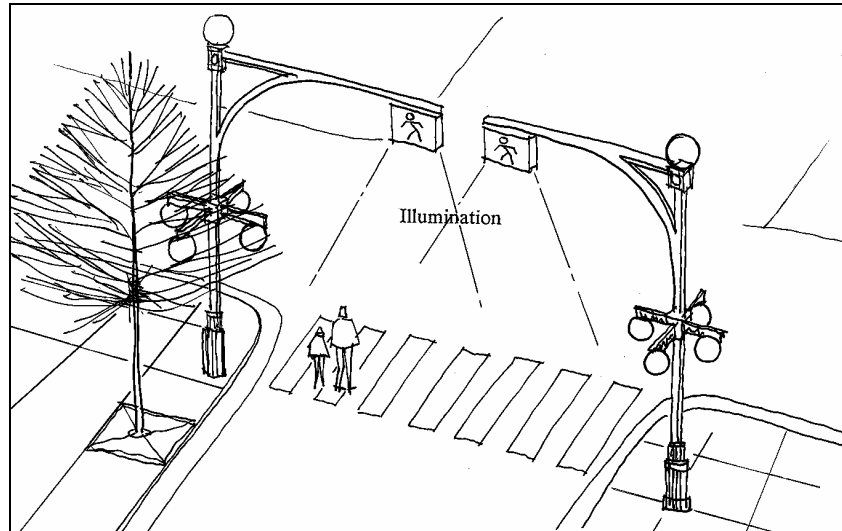
- Signalized intersections where pedestrian access is accommodated with pedestrian signal indications or pedestrian crossings.
- Where a marked crosswalk can concentrate or channel multiple pedestrian crossings to a single location.
- Where confusing geometrics or traffic operations necessitate the delineation of the optimal crossing location and path.
- At approved school crossings or along recommended safe school routes.
- At specific locations with significant pedestrian crossings and pedestrian/vehicle conflicts.

At locations where marked crosswalks are being considered for installation, the following issues should be considered:

- Adequate sight lines between motorists and pedestrians should be maintained. This may involve an examination of on-street parking, street hardware (utility poles, mailboxes, trash receptacles, etc.), and landscaping.
- Crosswalks should not be situated immediately downstream from bus stops.
- Illumination at the location of the crosswalk should be evaluated to ensure that adequate visibility is provided for non-daylight hours (Figure 2.13).
- Crosswalks should be marked at 90 degrees to vehicle traffic to designate the shortest path for pedestrians and to avoid having pedestrians' backs turned to oncoming traffic.



Figure 2.13: Illumination at Crosswalks



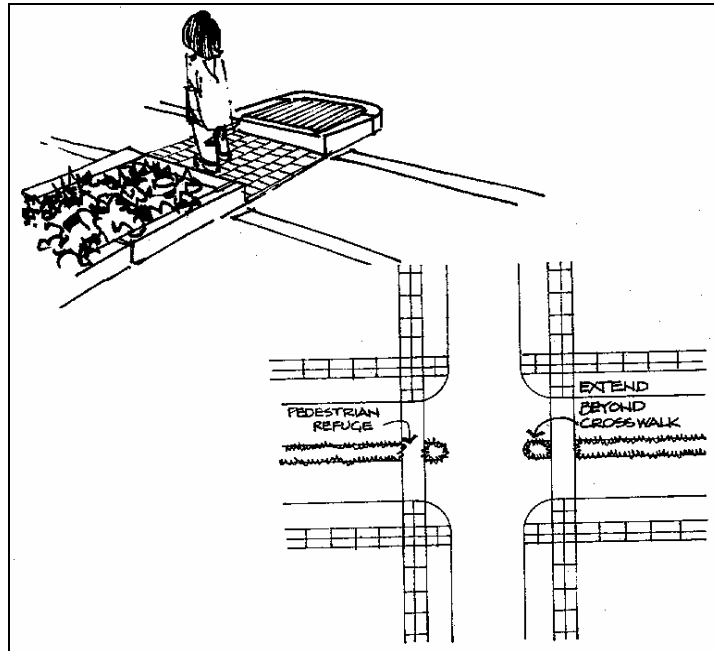
Stop lines are used to indicate the desired stopping point at a crosswalk for motorists. They should be installed 1.2 m (4 ft) in advance of and parallel to the nearest crosswalk line. In some jurisdictions, stop lines have been placed well in advance of the crosswalk – by as much as 12 m (40 ft) for a mid-block crosswalk – to improve visibility between pedestrians and vehicles approaching the crosswalk. This is especially important on multi-lane roads where a vehicle in one lane stops and obscures the sight lines of other oncoming motorists in the adjacent lanes.

2.8 Raised Medians and Refuge Islands

Raised medians and refuge islands (Figure 2.14 and Figure 2.15) enhance a pedestrian's ability to cross a roadway by allowing the pedestrian to cross one direction of traffic at a time. At wide signalized intersections, median refuges may be provided where one signal interval cannot accommodate walking speeds, thereby allowing pedestrians to cross the entire roadway – one direction at a time – over the duration of two signal intervals. At unsignalized mid-block crossings, median refuges simplify the crossing procedure by allowing pedestrians to look in one direction at a time to identify an acceptable gap in traffic before crossing. A number of studies have shown that pedestrians crossing an undivided, multi-lane street may experience delays up to 10 times longer than that incurred crossing a street with a median refuge.



Figure 2.14: Median Refuge Design Features



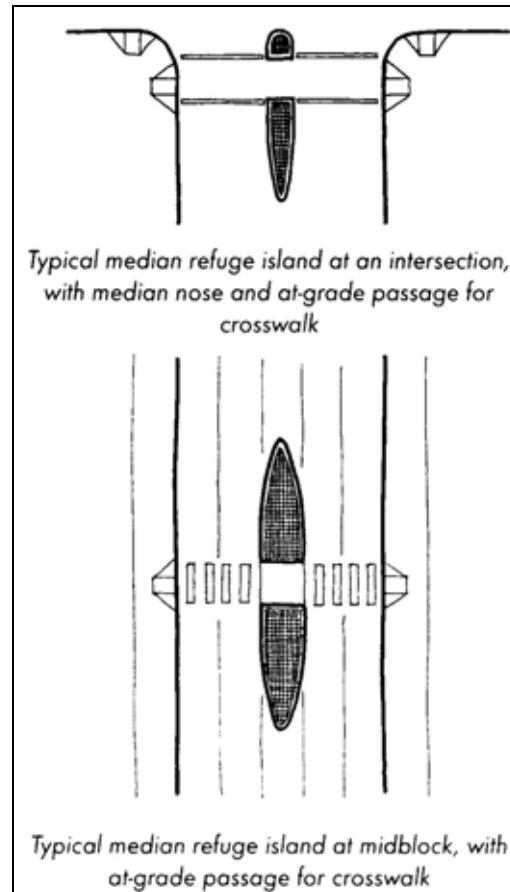
Planning and design considerations for median refuges should include the following:

- At signalized intersections, where a large number of elderly pedestrians and/or persons with disabilities will be crossing, median refuges should be installed.
- Median refuges should have cut-through ramps at pavement level or curb ramps for wheelchair users (Figure 2.14).
- Median refuges should be at least 1.5 m wide (absolute minimum width 1.2 m) and no less than 3.7 m long or the width of the crosswalk – whichever is greater (Figure 2.16). Where median refuges will be accommodating bicycles in addition to pedestrians, design dimensions should conform to standards for bicycle median refuges. If the median island can only be installed on the upstream end of the crosswalk (at intersections), the island should be at least 2.0 m long (Figure 2.17).
- A tapered approach nose, offset from the edge of the traffic, should be provided in accordance with local standards for medians. A minimum 30:1 taper is recommended.
- Object markers should be provided on the island approach noses to indicate the presence of a raised curb. The signs must not obstruct sight lines for pedestrians using the island.
- At signalized intersections, pedestrian push buttons and associated signage should be provided with median refuges.
- Unsignalized, mid-block median refuge ramps should be cut through at 45 degrees so that crossing pedestrians are facing in the direction of approaching traffic.



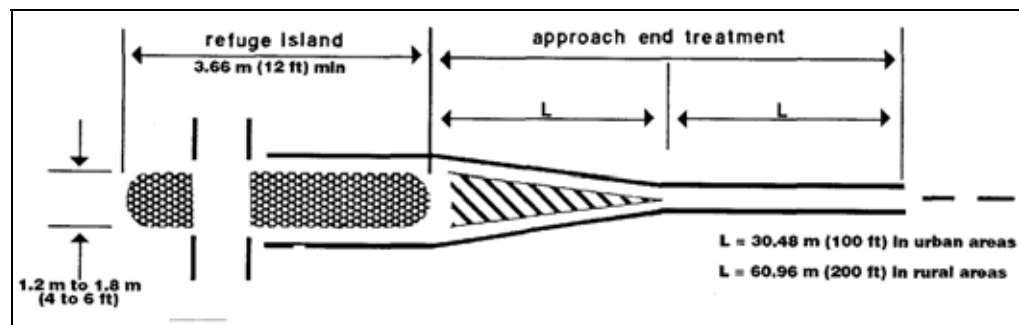
- Any potential obstructions to visibility, such as foliage, signage (aside from object markers), or barriers, should not be included in the design of median refuges.

Figure 2.15: Median Island Configurations



Source: Portland Pedestrian Design Guide, City of Portland, June 1998.

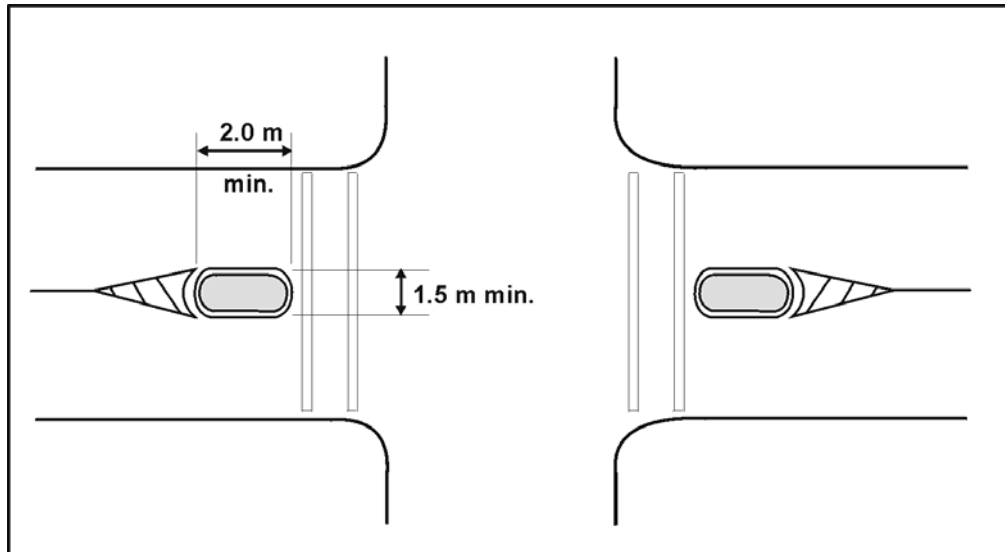
Figure 2.16: Median Island on Both Sides of Crosswalk



Source: NJDOT Pedestrian Compatible Planning and Design Guidelines, New Jersey Department of Transportation.



Figure 2.17: Median Island on One Side of Crosswalk



There are a few situations where median islands would not be beneficial, and should not be used, including:

- On narrow streets where the island would be narrower than 1.2 m.
- Where the island would interfere with a high turning volume of large trucks.
- Where roadway alignment obscures the island so it is not easily seen and motorists might drive into it.
- In areas where the presence of a safety island hampers snowplowing.

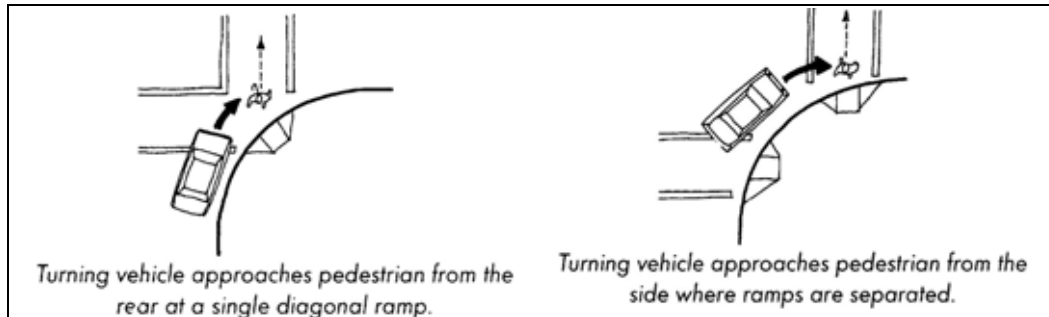
2.9 Curb Cuts and Ramps

Sidewalk curbs are barriers to some pedestrians. However, sidewalk curb ramps eliminate this barrier by providing a transition in grade between the street and the raised sidewalk. Curb ramps expand the walking opportunities available to people and make walking a more viable means of transportation.

Currently, single curb ramps are often provided at each corner of an intersection, producing a total of four ramps per intersection. However, a single curb ramp directs pedestrians directly into the intersection, which can be hazardous, particularly to visually and physically challenged pedestrians. In addition, if a single diagonal curb ramp is provided, turning vehicles approach pedestrians from the rear, making it more difficult for pedestrians to see the vehicle. As shown on Figure 2.18, if two separate ramps are installed, the turning vehicle approaches the pedestrian from the side, where it is more visible to the pedestrian.



Figure 2.18: Comparison of Single and Separated Ramps



Source: Portland Pedestrian Design Guide, City of Portland, June 1998.

Curb ramps provide the following benefits to pedestrians:

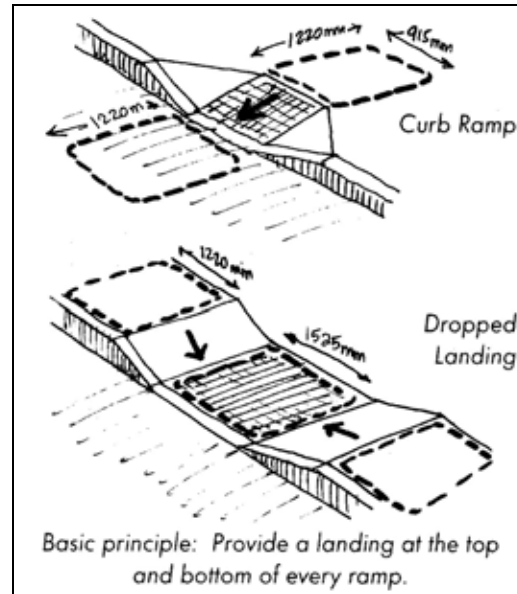
- Provide access to persons in wheelchairs.
- Provide access to pedestrians with mobility problems who find it difficult to step up and down curbs.
- Provide access to pedestrians using strollers, walkers, carts and bicycles, and to in-line skaters.
- Reduce the injuries resulting from trips and falls due to vertical changes in a pedestrian route.

There are two basic types of curb ramp systems as shown in Figure 2.19:

- Perpendicular ramps have a ramp into a crosswalk.
- Parallel ramps have a ramp into a dropped landing that is flush with the street surface.



Figure 2.19: Perpendicular and Parallel Curb Ramps



Source: Portland Pedestrian Design Guide, City of Portland, June 1998.

In addition to parallel and perpendicular curb ramps, there are diagonal curb ramps, which are located at the midpoint of a curb and projected curb ramps, which have a curb ramp that is extended into the gutter. Regardless of the ramp type, as shown on Figure 2.19, every ramp must have a landing at the top and at the bottom.

Perpendicular curb ramps are the preferred method of accommodating a grade change, provided that adequate right-of-way is available for its construction.

Sidewalk curb ramps should be designed in accordance with the Americans with Disabilities Act, which include the following guidelines:

- Flare curb cuts into the street surface – any sudden drop-off in a ramp descent by as little as one-quarter inch may cause a wheelchair to tip over.
- Minimum width of curb ramp: 0.915 m
- Maximum running slope of any curb ramp: 1:12
- Maximum cross slope: 1:50
- Surface: should contrast visually with the adjoining sidewalk and roadway surfaces, and have surface treatment on ramps to allow visually challenged people to detect the ramps
- Maximum rise for any run: 0.760 m
- Landing at the top and bottom of ramps: at least 1.220 m long and at least the same width as the ramp itself



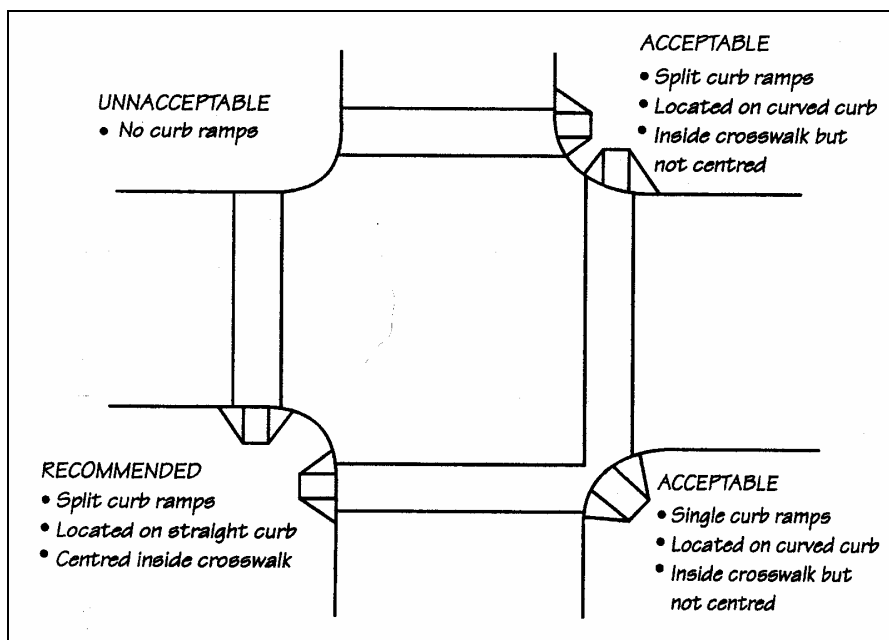
Additional guidelines for curb ramps at intersections include:

- Align curb ramps in the direction of crosswalks.
- Locate curb ramps in the centre of the crosswalk when possible.
- Provide a smooth transition so the low end of the curb ramp meets the grade of the street with a smooth transition, without a lip.
- Provide curb ramps at channelization islands in an intersection and median refuge islands, unless full cut-through openings are provided at-grade with the street.
- Provide good drainage at intersection corners so that water and ice do not accumulate within the crossing area.

Although the current tendency is to install a single ramp per corner, it is recommended that two ramps be installed on each corner to help pedestrians cross the street more safely. Installing two ramps on each corner will help reduce the risk of vehicle/pedestrian collisions, particularly for people in wheelchairs. As shown in Figure 2.20, the following guidelines are recommended:

- Two ramps per corner: separate sidewalks are constructed and the road skew angle is large enough to make a single ramp difficult to install safely
- One ramp per corner: in very low traffic situations, or where geometrics and physical constraints do not allow the construction of two ramps in retrofit situations

Figure 2.20: Guidelines for Curb Ramp Provision and Location





2.10 Street Hardware and Furniture

Street hardware and furniture have created many problems for pedestrians – especially pedestrians with disabilities. The design and location of these items determines not only how well they are used, but also whether or not they add to or detract from the pedestrian environment.

Street hardware consists of regular fixtures found along and within a street right-of-way, including:

- Traffic signs and signals
- Utility and lighting poles
- Utility cabinets
- Hydrants
- Mail boxes
- Newspaper vending boxes
- Parking meters

Examples of street furniture, which are objects intended to enhance the pedestrian environment, include:

- Contrasting and decorative surface materials
- Benches/seating areas
- Trash receptacles
- Planters
- Bollards and fencing
- Pedestrian lighting
- Transit shelters
- Phone booths
- Information kiosks
- Bicycle racks
- Sculptures, fountains and other architectural features
- Sidewalk cafes

Placement of street furniture should be tailored to specific locations and not placed in a regimented pattern (such as every 20 or 30 m along a street). This practice will ensure that these items are provided to serve the needs of pedestrians, rather than creating an obstruction to pedestrian mobility and visibility. This is especially important at



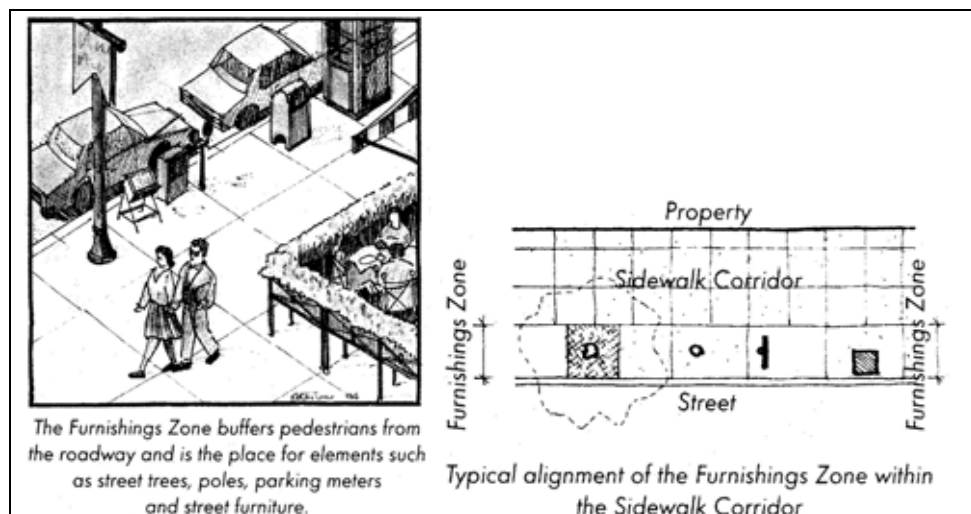
intersection locations, where sight lines must be maintained and access to pedestrian push-buttons should not be obstructed.

For persons with disabilities, improper placement of street furniture can create a significant obstruction to mobility, as well as a potential hazard. The following guidelines are recommended for the placement of street hardware and furniture:

- Place hardware/furniture out of the normal travel path in the ‘furnishings zone’, providing a clear travel way for pedestrians. This is particularly important for visually impaired people and people in wheelchairs.
- Maintain walkways so that hazards (such as debris, tripping hazards and areas of water accumulation) do not impede pedestrians.
- Ensure that hardware/furniture is far enough away from on-street parking so that access to vehicles is not blocked. This is particularly important for people in wheelchairs and for wheelchair lift-equipped vehicles.
- Where street furniture infringes on the pedestrian path, high contrast colours such as yellow, red and black should be used whenever possible to increase visibility of these objects.

Figure 2.21 and Figure 2.22 illustrate the placement of street hardware/furniture in the ‘furnishings zone’, and the provision of a clear travel way for pedestrians.

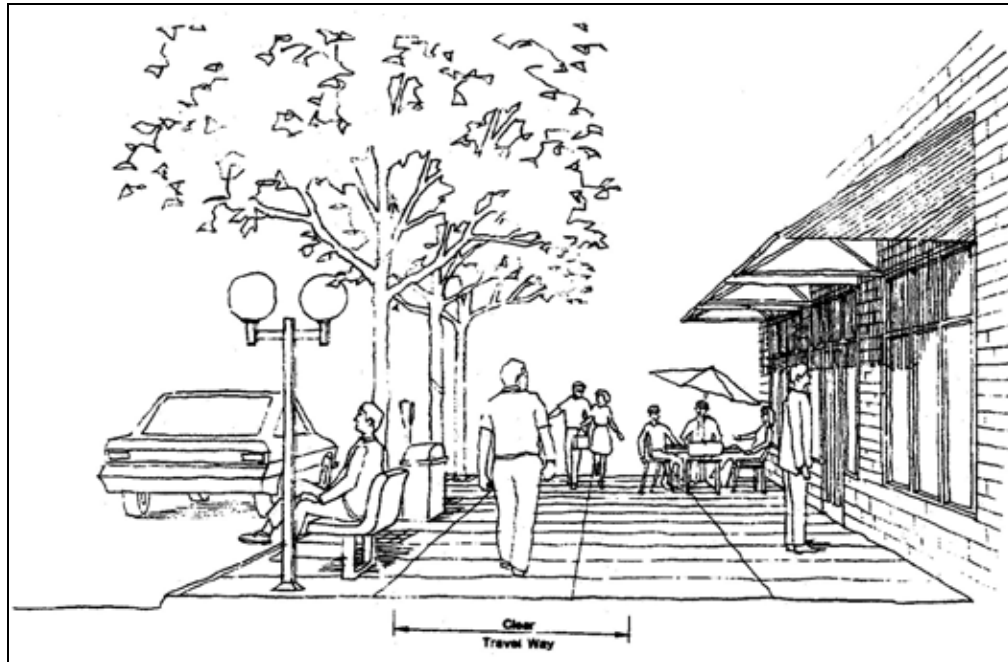
Figure 2.21: The Furnishings Zone



Source: Portland Pedestrian Design Guide, City of Portland, June 1998.



Figure 2.22: Pedestrian Travel Way



Source: Figure 56, Pedestrian Facilities Guidebook: Incorporating Pedestrians into Washington's Transportation System, otak, September 1997.

The ITE Design and Safety of Pedestrian Facilities handbook provides additional guidelines for the positioning of street furniture:

- No street furniture should hang less than 80 inches high over a circulation path.
- No object mounted on a wall or post should have a clear open area under it higher than 27 inches off the ground.
- No object higher than 27 inches, attached to a wall, should protrude from that wall more than four inches.
- No protruding object should reduce the clear width of the circulation path to less than 36 inches.

2.11 Grade Separated Crossings

Pedestrian overpasses and underpasses are used in high pedestrian demand areas where acceptable gaps in traffic are not provided or where interruptions in traffic – through the use of signals – cannot be accommodated. Grade separated facilities not only maximize pedestrian safety, but also minimize vehicle delay and maximize roadway capacity.



Grade separated crossings are typically used in situations where high-volume and/or high-speed roadways obstruct pedestrian travel to significant pedestrian destinations such as shopping centres, recreational facilities, schools, or parking facilities, for example.

If grade separated crossings are not planned and designed appropriately, they may not be used by pedestrians. Because these facilities do not typically provide as direct a crossing as a conventional at-grade crossing, they must be applied under very specific circumstances to be effective. Studies have shown that grade separated crossings should be located along, and constructed to reflect, the normal path of pedestrian movement. Where an overpass or underpass provides a less direct crossing of a roadway, fences, medians, railings or other barriers may be required to prevent pedestrians from crossing at-grade.

Overpasses are more commonly used than underpasses, due to the complications and concerns that are involved with the construction and use of an underpass. Construction of an underpass may involve relocation of utility lines and possible drainage problems. In addition, underpasses are generally viewed as presenting security problems, and are often avoided by pedestrians, especially during non-daylight hours.

2.12 Transit Stops

Because all transit users are pedestrians at either end of their transit trip, transit stop planning and design must be pedestrian friendly. To complement transit-oriented land use patterns, transit stops should be located and designed to provide maximum comfort, security, and convenience for users. From bus stops to commuter rail stations, pedestrian treatments play a significant role in an individual's decision to take transit over another mode of travel.

Guidelines for the spacing of bus stops should reflect the need to provide a balance. Too many bus stops spaced too close together cause delays that discourage transit ridership. Conversely, long distances between bus stops discourage ridership by making pedestrian access to bus stops difficult. Thus, bus stops should be located so as to minimize delays and maximize pedestrian access. Ideally, stops in residential areas should be located to ensure that 90% of residents are within 400 m walking distance to transit, and that 65% of residents are within 200 m walking distance to transit.

Because all round-trip bus passengers have to cross the street at least once, either to catch the bus or get to their destination, bus stops should be located as close as possible to pedestrian crossings, either marked or unmarked. At intersections, far-side stops are usually preferred because they provide fewer traffic delays, provide optimal auto and pedestrian sight distances, and result in fewer conflicts between buses and pedestrians. Studies have shown that converting to far-side stops can significantly reduce hazardous pedestrian crossing behaviour.



For pedestrian convenience and safety, paved landing surfaces are recommended at all bus stops. At locations where more than 50 passengers board per day, or where high concentrations of elderly pedestrians or persons with disabilities exist, bus shelters should be provided. Other amenities, such as newspaper boxes and trash receptacles, should be located to provide adequate space for waiting and boarding passengers. Lighting should also be sufficient at all transit stops to deter criminal activity and maximize safety of pedestrians.

For exclusive right-of-way transit, such as commuter trains, subways, light rail, and rapid busways, station and platform areas should be designed to accommodate peak pedestrian loads. Another important consideration in the design of these facilities is the creation of a secure environment for pedestrians. Lighting should be adequate, and waiting areas should be open, inviting, and easily accessed by both pedestrians and police or security personnel.

2.13 School Zones

Because schools generate a significant number of pedestrian trips and increasing pick-up and drop-off automobile traffic, special care must be taken to ensure that the potential for pedestrian-vehicle conflicts is reduced. Child pedestrians do not possess the ability to judge vehicle speeds and acceptable gaps in traffic, and their peripheral vision is not as well developed as adults'. Physical treatments, together with special safety programs, should be used to maximize child pedestrian safety around schools.

Physical treatments that can be used to maximize child pedestrian safety around schools and along designated school routes are discussed below.

- On streets with high traffic volumes and high vehicle speeds, standard traffic signals may be used to create adequate gaps in vehicle traffic to allow school children to cross safely. Crossing signals may still require the use of adult crossing guards to ensure that signals are used effectively.
- Sight distance at intersections must be maintained, taking into consideration the smaller stature of child pedestrians. Improvements may involve restricting on-street parking near intersections, relocating street hardware or 'bulbing' out curbs to improve visibility.
- Traffic calming measures such as speed humps, raised crosswalks, and curb extensions may be used in the vicinity of schools to reduce vehicle speeds, and raise the awareness of motorists as to the presence of child pedestrians. Although reduced speed limits and marked crosswalks are typically used for school zones, these measures are not often complied with and require a consistent police presence in



order to be effective. Self-enforcing measures, such as the ones indicated above, have proven to be a more cost-effective means of calming traffic.

Many programs have been developed to provide safe pedestrian routes to school, promote awareness and education, and provide alternative methods of getting children to school safely. Provided below is a list of some of the programs that are being used throughout Greater Vancouver and North America to increase safety for school children:

- **Safe Routes to School.** This program involves the designation of specific routes for child pedestrians to use on their way to and from school. Developed in co-operation with school officials, parents and local police, a Safe Routes to School program can provide students with pedestrian network plan designed to route children to low volume streets and designated crossing locations. Safe Routes to School programs also include significant awareness and education components directed towards school children.
- **School Safety Patrols.** Adult guards or members of a school safety patrol may carry out supervision of crossing school children. Organized by the administration of a school, the school safety patrol also provides a way of extending traffic safety education beyond the classroom.
- **Parent Parking Patrol.** Developed in Edmonton, Alberta by a former police officer, the Parent Parking Patrol provides a means of controlling drop-off and pick-up traffic at schools through an educational and non-confrontational approach. In this program, groups of parents work as a patrol to ensure that unsafe driving practices are monitored and discouraged. The main intent of this program is safety prevention and driver education. It has been found in many schools throughout BC and Alberta that, once drivers become aware of the Parent Parking Patrol, their driving habits significantly improve.
- **Walking School Bus.** This program was developed to provide an alternative means of getting young children to and from school. In the program, parents, police, and school officials map where each participating child lives in relation to the school, and identify the safest routes for these children to use on their trips to and from school. Volunteers (including senior citizens) are asked to become walking school bus 'drivers' that walk a fixed route, similar to a conventional school bus, collecting children along the route and delivering them safely to school. The driver would also be equipped with a first aid kit, a reflective vest, and a walking cart to hold school bags.



2.14 Construction Sites

Accommodating the needs of pedestrians at or near work sites is an issue that cannot be treated lightly. When one considers the wide range of pedestrians that may encounter a work site, including the visually impaired, the hearing impaired, and persons in wheelchairs, the provision of a safe, smooth and clearly delineated pathway becomes a significant challenge. Every effort must be made to adequately separate pedestrian traffic from both work site activity and adjacent traffic. Provided below is a list of key measures that must be undertaken to maximize pedestrian safety:

- Pedestrians should be appropriately diverted from direct encounters with work site activity by advance signage, as provided for in the MUTCD. For mid-block location work sites, signs should be placed at intersections so that pedestrians are not forced to cross the street mid-block (Figure 2.23).
- Where pedestrian routing must be provided through a work site, a separate, safe footpath should be constructed free of any abrupt changes in grade or terrain.
- Movement across designated pedestrian paths by work vehicles and other equipment must be kept to a minimum. Where necessary, such movements should be controlled by a flagger or temporary signalization.
- At work sites where equipment and materials are being used above the ground floor level, it may be necessary to create a canopied walkway to protect pedestrians from falling debris. These structures should be sturdy and sufficiently illuminated for non-daylight hours.
- Where pedestrians are in danger of being impacted by errant vehicles from the work site or adjacent traffic lanes, paths must be separated and protected by appropriately sturdy longitudinal barriers.



Figure 2.23: Pedestrian Facilities at Construction Sites (Seattle WA)

