4 Sidewalk Corridors

Chapter

Sidewalk Corridors

"The Sidewalk Corridor is the portion of the pedestrian system from the edge of the roadway to the edge of the right-of-way (i.e., property line), generally along the sides of streets, between street corners" (Portland, Oregon, 1998). For the purpose of this guidebook, the width of the sidewalk corridor extends to the edge of the roadway, even if part of that area is not paved. Some other terms for the sidewalk corridor used in design manuals and legal documents include *border area, border width,* and *sidewalk*. Sidewalk corridors that promote access include the following characteristics:

Figure 4-1. *Wide sidewalk corridors significantly enhance pedestrian networks.*

- Wide pathways;
- Clearly defined pedestrian, furniture, and frontage zones;
- Minimal obstacles;
- Minimal protruding objects;
- Moderate grades and cross slopes;
- Rest areas outside of the pedestrian zone;
- Minimal changes in level;
- Firm, stable, and slip resistant surfaces; and
- Good lighting.

In new construction, the commitment to create sidewalk corridors that meet the needs of people with disabilities should be made during the planning stages of the development process. For example, if sufficient right-of-way is not allocated to the sidewalk corridor during the planning process, it is harder for designers to construct curb ramps with level landings.

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When access improvements are made to existing sidewalk corridors, designers should prioritize needs with available resources and try to make the most significant changes possible with the funds available.

4.1 Sidewalk corridor width

The width of the sidewalk corridor is one of the most significant factors in determining the type of pedestrian experience that the sidewalk provides (see Section 3.7.1). In many locations, the sidewalk corridor is paved from the curb to the property line. In other areas, the paved portion of the sidewalk corridor is set back from the street by a surface, such as grass, which is not intended for pedestrian travel. Planting strips (sidewalk setbacks that are grass or another type of vegetative cover) provide:

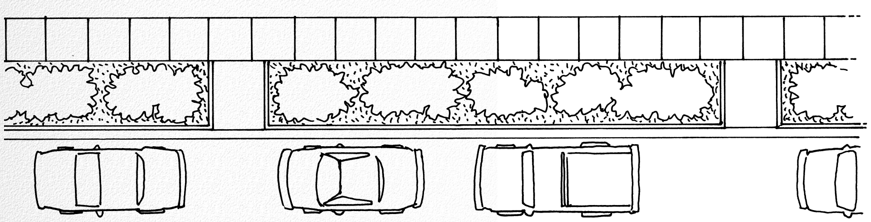

Figure 4-2. *If on-street parking is permitted, periodic curb ramps along a planting strip can facilitate pedestrian access onto the sidewalk.*

- Shade
- Space for utilities and traffic control equipment and signs
- Space for trash cans and newspaper boxes
- Separation from roadway; and
- Asthetic relief

Communities and individual property owners within residential areas are often willing to take responsibility for maintaining planting strips. However, if routine maintenance cannot be arranged, alternatives to planting strips, such as rock installations, are often used. Curb ramps should be provided along the planting strip accessible to on-street parking spaces.

Narrow sidewalk corridors are unsatisfactory because they limit the number of pedestrians that can use the area, require pedestrians to travel single file, and force pedestrians to travel uncomfortably close to buildings and/or automobile traffic. Access is easily

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Figure 4-3. *Permanent obstacles, such as fire hydrants and street signs, should be relocated to improve a narrow sidewalk.*

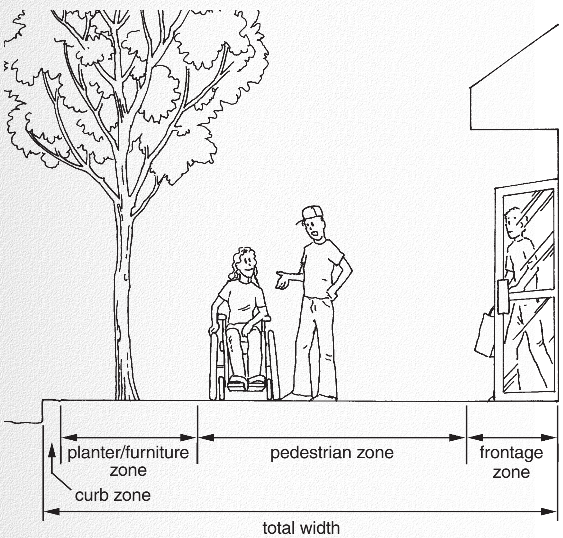

Figure 4-4. *The zone system divides the sidewalk corridor into four zones to ensure that pedestrians have a sufficient amount of clear space to travel.*

compromised on narrow sidewalk corridors by objects, such as utility poles, that create even narrower spaces. Sometimes, narrow sidewalks do not provide enough clear space for people who use walking aids or wheelchairs to travel down the length of the sidewalk. In addition, narrow sidewalk corridors often have driveway crossings with steep cross slopes and curb ramps with insufficient landings and/or steep ramp grades. Sidewalk corridor width is determined during the planning stage of a project. To develop a successful pedestrian network, that includes wide sidewalk corridors, the needs of pedestrians should be institutionalized into the project planning process (Chapter 3).

4.1.2 The zone system

To ensure that the needs of the pedestrian are prioritized, Portland, Oregon, has developed a design system that divides the sidewalk corridor into four zones (Portland Pedestrian Design Guide, 1998).

The zone system should be used to determine the width of the sidewalk corridor and to ensure that obstacles, such as newspaper boxes or utility poles, will not limit pedestrian access. The four zones within the sidewalk corridor are the:

1. Curb zone;
2. Planter/furniture zone;
3. Pedestrian zone; and
4. Frontage zone.

The width of the sidewalk corridor will be determined primarily by the width of the planter/furniture, pedestrian, and frontage zones. The size of the curb zone is generally constant throughout a municipality. Taking into account the minimum width of each zone, at least 2.59 m (8.5 ft) of right-of-way should be allocated to the sidewalk corridor. However, additional space is often needed to accommodate items such as pedestrian crossings, on-street parking, street cafés, and high pedestrian volumes. Table 4-1 contains recommendations for the minimum widths of each zone.

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Table 4-1

Zone	Minimum Width
Curb Zone	152 mm (6 in)
Planter/Furniture Zone	610 mm (24 in) [1.22 m (48 in) if planting trees]
Pedestrian Zone	1.525 m (60 in)
Frontage Zone	760 mm (30 in) *
Total Sidewalk Corridor	3.10 m (10 ft) *

* If at least 760 mm (2.5 ft) of open space is available between the sidewalk corridor and the property line, no frontage zone is needed and the minimum recommended width for the sidewalk corridor is 2.285 m (7.5 ft).

At pedestrian crossings (e.g., midblock crossing or street intersections), the sidewalk corridor should be wide enough to install curb ramps with level landings. If the ramp is primarily in the planter/furniture zone, the pedestrian zone remains level. Although a variety of designs may be considered, a perpendicular curb ramp that is oriented at a 90 degree angle to the curb is recommended for access from the pedestrian zone to the street (see Section 7.2.1).

4.1.2.1 Curb zone

The curb zone is the first 152 mm (6 in) of the sidewalk corridor immediately adjacent to the roadway. It is an integral part of the drainage system and prevents excess water from collecting in the sidewalk corridor. The curb zone also discourages motor vehicles from driving onto the sidewalk corridor and is a valuable cue used by people with vision impairments to identify the border between the sidewalk corridor and the roadway.

4.1.2.2 Planter/furniture zone

The planter/furniture zone lies between the curb and pedestrian zones and is intended to house utilities, such as traffic poles and fire hydrants, and pedestrian amenities, such as benches and bus shelters. The purpose of the

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***Figure 4-5.** A minimum width of 1.525 m (60 in) is recommended for the pedestrian zone. This width should be completely free of obstacles and protruding objects.*

planter/furniture zone is to ensure that the pedestrian zone will be free of obstacles. Depending on the design of the sidewalk corridor, the planter/furniture zone may or may not be paved. On sidewalk corridors where the sidewalk is set back from the street, such as when a planting strip is provided, the planter/furniture zone consists of the width of the unpaved area. On sidewalks that are paved from the curb to the property line, the planter/furniture zone is not as clearly defined.

If movable objects are originally placed in the planter/furniture zone, they may migrate into the pedestrian zone. Therefore, any movable objects should be chained or otherwise secured in place so that they cannot impede the flow of pedestrian traffic.

In addition to providing a location for sidewalk infrastructure, the planter/furniture zone also serves as a buffer between the pedestrian zone and the roadway. As a rule, pedestrians tend to avoid this area, even when it is free of obstacles, because it is uncomfortable for most people to walk near traffic. To provide a sufficient buffer for pedestrians, the minimum recommended width is 610 mm (24 in). However, many cities with on-street parking allocate at least 915 mm (36 in) to the planter/furniture zone to separate objects from the curb face and to allow car doors to open and people to exit from the vehicle without entering or blocking the pedestrian zone. The planter/furniture zone next to on-street parking should have the areas adjacent to the vehicle doors free of obstacles.

If the sidewalk corridor is large enough or additional space is required for infrastructure, the width of the planter/furniture zone should be increased. Locations with transit stops will also require a larger planter/furniture zone. Transit requirements vary, however, the boarding pad is typically 1.525 m x 2.44 m (60 in x 96 in) and should be connected to an accessible pedestrian path of travel. Additional space may be required because wheelchair lifts on transit vehicles may extend up to 1.22 m (48 in) beyond the side of the vehicle. In addition to the boarding pad, an accessible bus shelter

The planter/furniture zone buffers pedestrians from traffic and provides space for:

- *Utilities;*
- *Sidewalk furniture;*
- *Trees and grass; and*
- *Other sidewalk amenities.*

may require an additional space up to 2.44 m x 3.96 m (96 in x 156 in) in size.

Areas that have significant accumulations of snow during the winter will also require a wider planter/furniture zone. A minimum width of 1.83 m (72 in) is recommended for areas where significant amounts of snow will be plowed onto the planter/furniture zone. This additional width will help keep the pedestrian zone free of obstacles, such as piles of snow.

In areas where all of the street planter/furniture and utilities can be placed away from the street in the adjacent property (e.g., on the front lawn in a residential area), the size of the planter/furniture zone may be reduced to 610 mm (24 in). The planter/furniture zone should not be completely eliminated because many pedestrians are not comfortable walking directly adjacent to the roadway. At a pedestrian crossing area, a planter/furniture zone is needed to ensure sufficient space between the curb and pedestrian zones for two perpendicular curb ramps. In very confined existing facilities, a reduction in the width of the planter/furniture zone can be combined with the installation of parallel curb ramps (see Section 7.2.3 for information on parallel curb ramps). Trees need room to grow and spread roots (minimum 48 in). Trees should be selected for the space provided, and surface roots should not be removed. Realigning the sidewalk (see Figure 4-42) or ramping over the roots will provide access and protect the tree. See Section 4.4 for more information on trees.

4.1.2.3 Pedestrian zone

The pedestrian zone is the area of the sidewalk corridor that is specifically reserved for pedestrian travel. It should be completely free of obstacles, protruding objects, and vertical obstructions because they can be hazardous to pedestrians, particularly for individuals with vision impairments who may not be able to detect or avoid the hazard.

The pedestrian zone should be at least 1.525 m (60 in) wide. This provides sufficient space for two pedestrians to travel side by side without passing other

Table 4 - 2. Guidelines for New Sidewalk Installation

Roadway Classification and Land Use	Sidewalk Requirements	Future Phasing
Highway (rural)	Min. of 1.525 m (60 m) shoulders required.	Secure/preserve ROW for future sidewalks.
Highway (rural/suburban — less than 1 d.u./acre)	One side preferred. Min. of 1.525 m (60 m) shoulders required.	Secure/preserve ROW for future sidewalks.
Suburban Highway (1 to 4 d.u./acre)	Both sides preferred. One side required.	Second side required if density becomes greater than 4 d.u./acre.
Major Arterial (residential)	Both sides required.	
Collector and Minor Arterial (residential)	Both sides required.	1.525 m (60 in)
Local Street (Residential — less than 1 d.u./acre)	One side preferred. Min. of 1.525 m (60 m) shoulders required.	Secure/preserve ROW for future sidewalks.
Local Street (Residential — 1 to 4 d.u./acre)	Both sides preferred. One side required.	Second side required if density becomes greater than 4 d.u./acre.
Local Street (Residential — more than 4 d.u./acre)	Both sides required.	
All Streets (commercial areas)	Both sides required.	
All Streets (industrial areas)	Both sides preferred. One side required.	

Final Draft: *Priorities and Guidelines for Providing Places for Pedestrians to Walk Along Streets and Highways.* FHWA (1999).

Case Study 4-1

In New York City, if a new building is installed, the property owner is responsible for allocating a sidewalk area in front of the building that will accommodate the increased pedestrian traffic the new building will generate.

pedestrians, or for two people going in opposite directions to pass one another. In commercial and urban areas, pedestrian volumes are often much higher than in residential areas. The pedestrian zone should be expanded according to the Highway Capacity Manual based on the anticipated volume of users. In areas with heavy pedestrian traffic, the sidewalks should be wide enough to accommodate groups of pedestrians traveling in both directions. The expanded area should still remain free of obstacles. If additional utilities are necessary in an urban setting, the planter/furniture zone should also be expanded.

The pedestrian zone should never be less than 915 mm (36 in), which is the minimum width required for an accessible route (ADAAG 4.3.3, U.S. Access Board, 1991). The minimum width provides sufficient space for people who use mobility aids to travel within the restricted space, since most mobility devices have a maximum width of 710 mm (28 in). However, restricting the pedestrian zone to 915 mm (36 in) prevents passing and does not account for two-way travel, traveling with a sighted guide 1.22 m (48 in) or with a guide animal. This minimum width is only acceptable when:

1. A wider width is impossible;
2. The narrow width continues for as short a distance as possible; and
3. Passing spaces are provided at intervals of no more than 61.0 m (200 ft).

4.1.2.4 Frontage zone

The frontage zone is the area between the pedestrian zone and the property line. Pedestrians tend to avoid walking close to barriers at the property line, such as buildings, storefronts, walls, or fences, in the same way that they tend to avoid walking close to the roadway. This is especially true in areas with many doorways that swing open into the sidewalk corridor. In most situations, the width of the frontage zone should be at least 305 mm (12 in). However, if the sidewalk corridor is adjacent to a wide open or landscaped space, such as in

Minimum Clear Width:

At least 915 mm (36 in) of clear space is necessary for people who use assistive devices such as wheelchairs, walkers, and crutches to maneuver along the sidewalk.

The frontage zone separates pedestrians from store fronts and provides space for:

- *Sidewalk cafes;*
- *Window sills;*
- *Store entrances;*
- *Street vendors; and*
- *Doorways.*

residential areas, the frontage zone can be eliminated.

Typically, the frontage zone is also the area in which sidewalk entertainment, such as street cafes and vendors, are located. Unless the frontage zone is physically separated from the pedestrian zone, it should be free of obstacles and protruding objects. People with vision impairments often travel in the frontage zone in order to use sound from the adjacent building for orientation. In general, pedestrians with vision impairments travel between 305 mm and 1.22 m (12 in and 48 in) from the building. Older pedestrians with vision impairments may travel closer to the building as their hearing deteriorates.

Any items in the frontage zone should be detectable by people with vision impairments who use long white canes for mobility. Obstacles that cannot be detected may result in a loss of balance or embarrassment when they are encountered unexpectedly. In the worst case, the collision could result in serious injury to the pedestrian. It is preferable for sandwich boards or other objects to be solid and continuous with the ground surface throughout their length. In addition, solid barriers should be provided around street planter/furniture such as café umbrellas, tables, and chairs. Small chains suspended from intermittent posts are not sufficient because the long white cane can easily pass under the chain and between the posts. People using canes will detect barriers at ground level. These barriers should extend up from ground level less than 305 mm (12 in) and continue around the obstacle without any breaks or openings. Items that are wall or pole mounted must comply with ADAAG specifications for protruding objects (see Section 4.1.3).

4.1.3 Protruding objects

Objects that protrude into the sidewalk corridor but are higher than 2.03 m (80 in) are not a problem for people with vision impairments because most pedestrians require less than 2.03 m (80 in) of headroom. In addition, people with vision impairments who use long white canes to navigate (if they are of adult

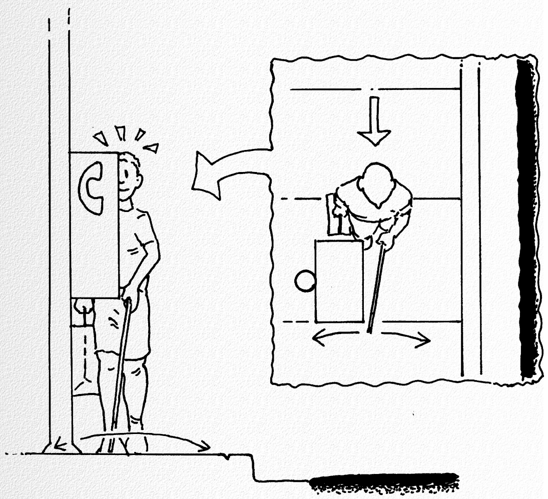

Figure 4-6. POTENTIAL PROBLEM: This pedestrian who is blind is approaching the telephone kiosk from the side. When obstacles mounted on posts can be approached from the side they should not protrude more than 101mm (4 in). This pedestrian does not detect the obstacle, which could cause him to collide with the obstacle.

stature and using their canes skillfully) will usually detect and avoid objects on the sidewalk that extend below 685 mm (27 in). However, obstacles that protrude into the sidewalk between 685 mm (27 in) and 2.03 m (80 in) and do not extend to the ground, are more difficult to avoid because the long white cane is unlikely to contact the object before the person contacts the object. Guide dogs take their owners around obstacles.

Pedestrians with vision impairments often travel close to the building line.

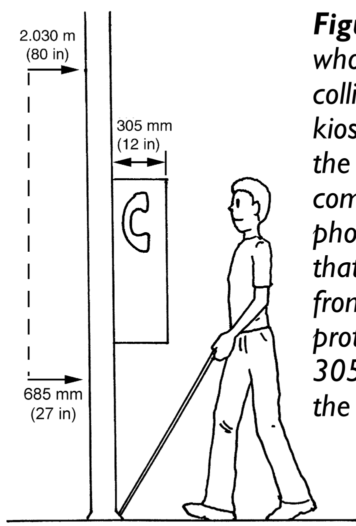

Figure 4-7. This pedestrian who is blind is able to avoid colliding with this telephone kiosk because he detects the pole with a cane before coming in contact with the phone. Pole mounted objects that can only be approached from the front should not protrude more than 305 mm (12 in) into the sidewalk corridor.

Therefore, according to ADAAG Section 4.4, if an object is mounted on a wall or the side of a building, it should not protrude more than 101 mm (4 in) into the sidewalk corridor (ADAAG 4.4, U.S. Access Board, 1991). If an object is mounted on a post that can only be approached from the front, it can protrude up to 305 mm (12 in) because the angle of the long white cane allows a pedestrian who is blind to identify the post before bumping into the protruding object. However, if the post-mounted object can be approached from the side, it should protrude no more than 101 mm (4 in) into the sidewalk corridor. Signs mounted on two posts should have a crossbar at 305 mm (12 in) above the walking surface so that a pedestrian using a long white cane can readily detect the sign. Stop signs mounted on a single post should be no lower than 2.03 m (80 in) or be placed outside of the paved portion of the sidewalk corridor (e.g., in a planting strip).

The least possible amount of protrusion should be used in each situation. Furthermore, because pedestrians with

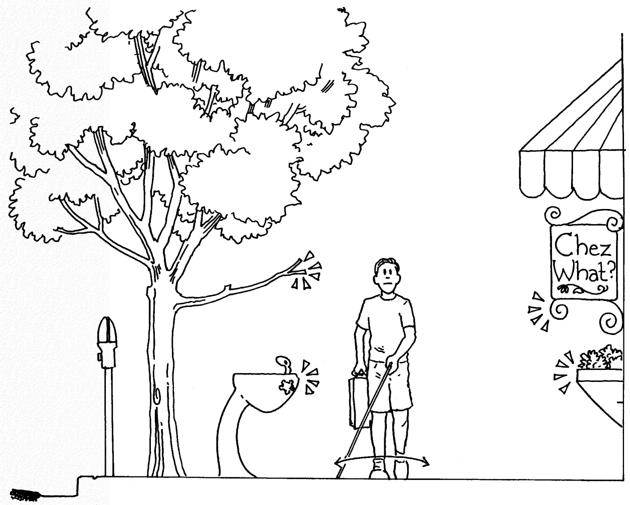

Figure 4-8. *This pedestrian, who is blind, is walking down a sidewalk that contains a number of obstacles that are difficult to detect using a long white cane, because they protrude into the path of travel between 685 mm (27 in) up from ground level and below 2.03 m (80 in) in height.*

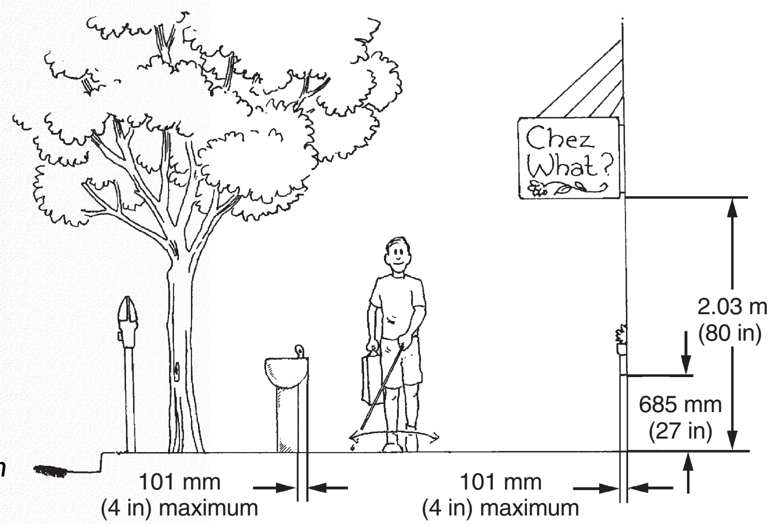

Figure 4-9. *This pedestrian, who is blind, will have a much easier time traveling on this sidewalk because there are no walls or post-mounted obstacles that protrude more than 101 mm (4 in).*

vision impairments do not always travel in the pedestrian zone, protruding objects should be eliminated from the entire paved portion of the sidewalk corridor. Protruding objects do not need to be eliminated from the planter/furniture zone if it is separated from the sidewalk with a planting strip or other type of setback.

4.1.4 Improving access on narrow sidewalks

During new construction, at least 2.59 m (102 in) of public right-of-way should be dedicated to the sidewalk corridor. A minimum width of 2.285 m (90 in) should be allocated if at least 760 mm (30 in) of open space is available between the property line and the sidewalk corridor. However, if a narrow sidewalk corridor already exists, it can be improved. The highest priority should be to increase the pedestrian zone to at least 915 mm (36 in). The following solutions can help improve conditions for pedestrians with mobility and vision impairments. Additional solutions for installing curb ramps on narrow sidewalks are included in Section 7.4.5.

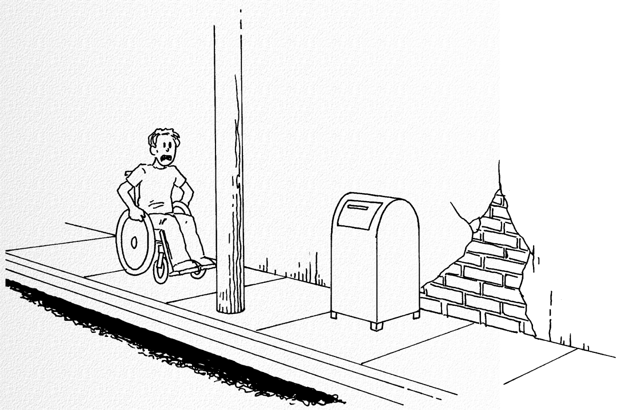

Figure 4-10. Obstacles in the pedestrian zone limit the clearance width of the sidewalk.

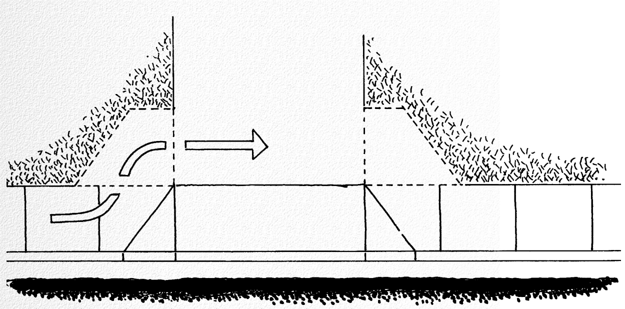

Figure 4-11. Additional right-of-way allows the sidewalk to be jogged back, providing level landings at driveway crossings and curb ramps.

SOLUTION 1 — Eliminate any removable and protruding obstacles, such as newspaper stands or tree branches, that limit the clear width of the sidewalk and/or protrude into the path of travel.

The first priority for improving a narrow sidewalk should be to eliminate any removable obstacles, such as trash receptacles and newspaper stands, from the pedestrian zone. Tree branches, overgrown shrubs, and other protruding objects should also be eliminated. Objects that are removed should be secured in their new location to prevent them from being moved back into the pedestrian zone.

SOLUTION 2 — Eliminate permanent obstacles and protruding objects that limit the clear width of the sidewalk and/or protrude into the path of travel.

Whenever possible, permanent obstacles and protruding objects should be removed from the pedestrian zone. Locations where the passage width is less than 915 mm (36 in) should be prioritized.

SOLUTION 3 — Secure additional right-of-way at driveway crossings and curb ramps to provide jogged landings.

Narrow sidewalks tend to have driveway crossings and curb ramps without level landings. These types of ramps are very difficult for people with mobility impairments to negotiate because of the severe change in cross slope across the flare (Section 5.1). Therefore, whenever possible, additional right-of-way should be purchased, or an easement should be

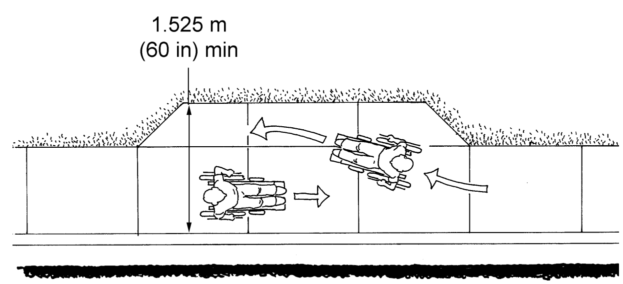

Figure 4-12. Additional right-of-ways provide passing spaces on narrow sidewalks.

> ***Passing Space:***
>
> *Passing spaces should be provided at intervals no less than 61.0 m (200 ft) apart and should be at least 1.525 m x 1.525 m (60 in x 60 in).*

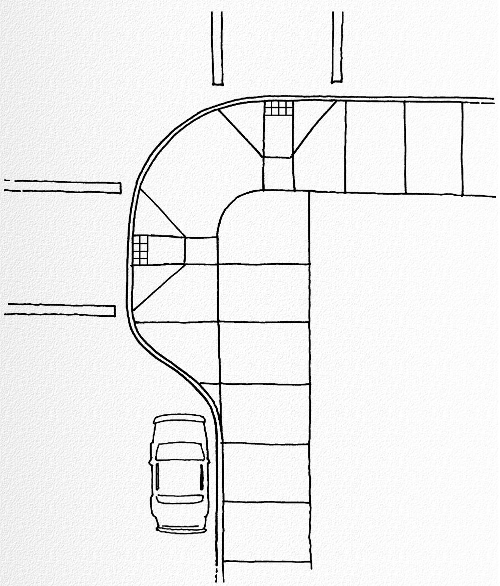

Figure 4-13. *Curb extensions improve pedestrian visibility and provide additional space for level landings at curb ramps.*

obtained from the property owner, at driveway crossings and curb ramps to add a level landing to existing elements. The purchase of additional right-of-way should also be considered at all locations where the pedestrian corridor is not large enough to provide an accessible path of travel.

SOLUTION 4 — Secure additional right-of-way to create periodic passing spaces which are at least 1.525 m x 1.525 m (60 in x 60 in).

If the sidewalk is less than 1.525 m (60 in) for an extended length, periodic passing spaces should be added to allow two wheelchair users to pass one another or to allow a single wheelchair user to turn around. Passing spaces should be provided at intervals no less than 61.0 m (200 ft) apart and should be at least 1.525 m x 1.525 m (60 in x 60 in). Driveway crossings and curb ramps with level landings can also serve as passing spaces.

SOLUTION 5 — Extend the curb into the parking lane to generate more space for curb ramps.

Curb extensions provide a location for curb ramps on narrow sidewalks by expanding the width of the sidewalk at the corner. Curb extensions also prevent cars from parking in front of the curb ramp and improve visibility between motorists and pedestrians waiting to cross the street. Table 7-1 and Section 8.9 contain more information about curb extensions.

SOLUTION 6 — Replace curb ramps and driveway crossings without level landings with parallel ramps.

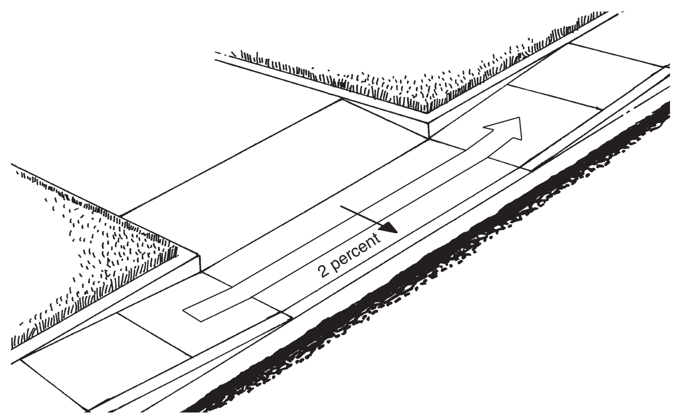

Figure 4-14. *Parallel ramps are an effective way to improve access at curb ramps and driveway crossings if additional right-of-way cannot be purchased. There needs to be adequate drainage for this type of installation.*

If additional right-of-way cannot be obtained, designers should consider replacing driveway crossings and curb ramps that do not have level landings with a style of ramp that is parallel to the curb. Although parallel ramps are more desirable than curb ramps or driveway crossings without level landings, they are not an ideal solution because they force users to go down and then up a ramp just to continue along the sidewalk. In addition, parallel ramps do not drain as well as other types of ramps. Section 7.2.3 contains more information about parallel curb ramps and Section 5.5 contains information about parallel driveway crossings.

SOLUTION 7 — Borrow from the street width to extend the sidewalk and create a wider path of travel for pedestrians.

Occasionally, additional width for a sidewalk can be created by reducing the width of the motor vehicle lanes. This

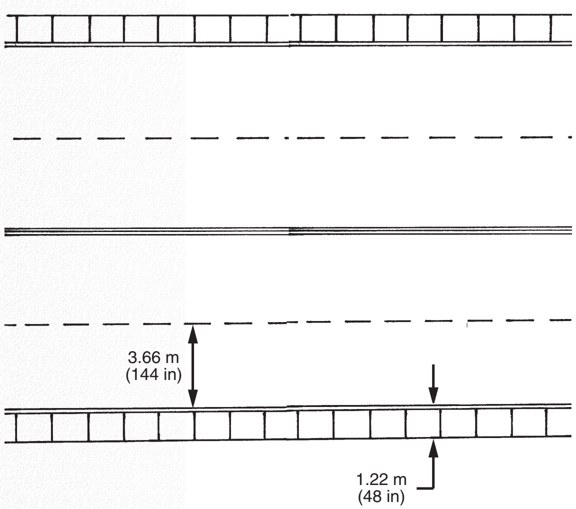

Figure 4-15. *BEFORE: This roadway has very narrow sidewalks with wide motor vehicle lanes.*

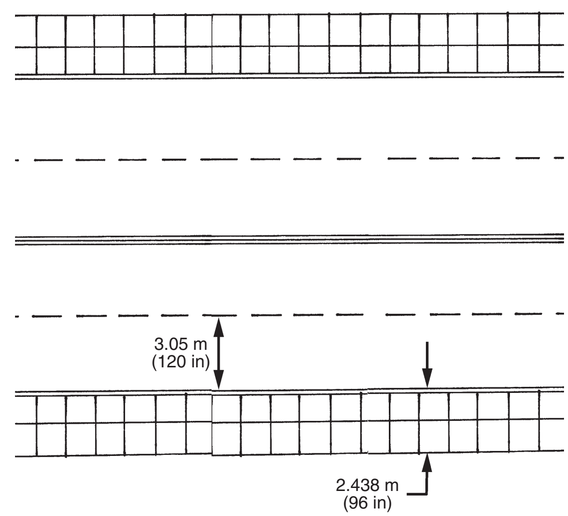

Figure 4-16. *AFTER: If the motor vehicle lanes are narrowed, additional right-of-way can be added to the sidewalk. However, narrowing the outside lane is not recommended on streets used by bicyclists.*

> **Case Study 4-2**
> Seattle, Washington, has recently evaluated a series of four-lane to three-lane conversions to determine if traffic volumes were reduced. The results of the study showed that traffic volumes were not reduced and in several instances traffic volumes even increased.

solution should not be done without a careful operational analysis. On a four-lane road, reducing each traffic lane from 3.66 m to 3.05 m (12 ft to 10 ft) generates 2.44 m (8 ft) of additional space for the sidewalk. In addition, in residential areas, reducing the lane width will have a traffic calming effect because motorists tend to travel slower on narrower streets. In some situations, it may not be appropriate to reduce the outside lane to 3.05 m (10 ft) because of the negative impact on bicyclists.

SOLUTION 8 — Convert a four-lane road to a three-lane road and create a bike lane and a wider sidewalk.

A few cities have begun to experiment with four-lane to three-lane conversions to improve traffic flow and generate additional right-of-way for other users, such as bicyclists and pedestrians. This solution should not be done without a careful operational analysis. Converting to a three-lane road may not reduce the level of service the road provides to

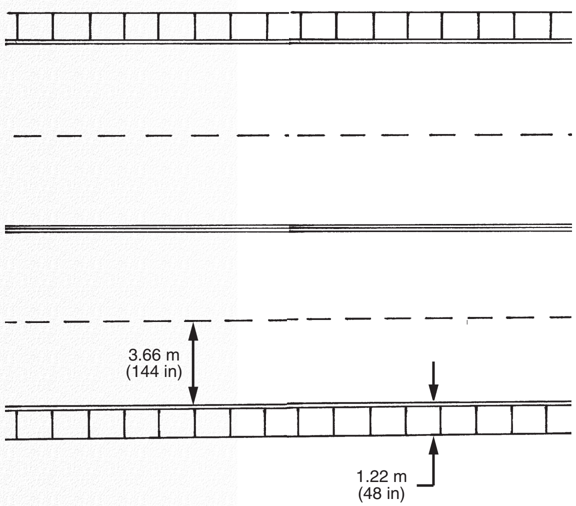

Figure 4-17. *BEFORE: This roadway has very narrow sidewalks with wide motor vehicle lanes.*

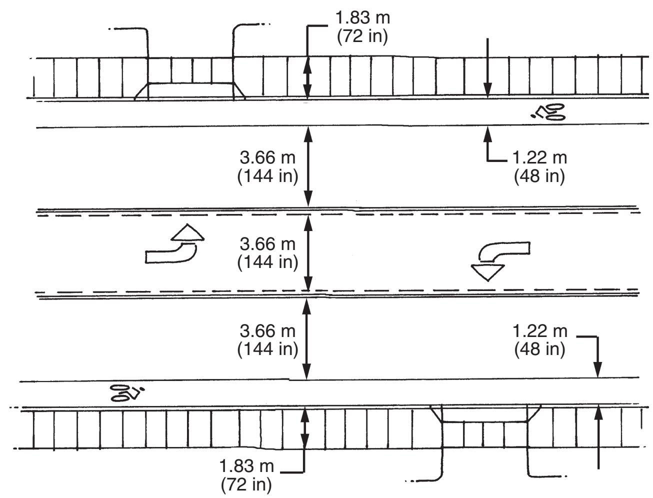

Figure 4-18. *AFTER: Converting the four-lane road to a three-lane road will allow for the addition of bicycle lanes and the widening of sidewalks.*

> **Grade:**
>
> *The grade of the sidewalk corridor is often determined by the grade of the street. Whenever possible, however, the grade of the sidewalk corridor should not exceed 5.0 percent.*

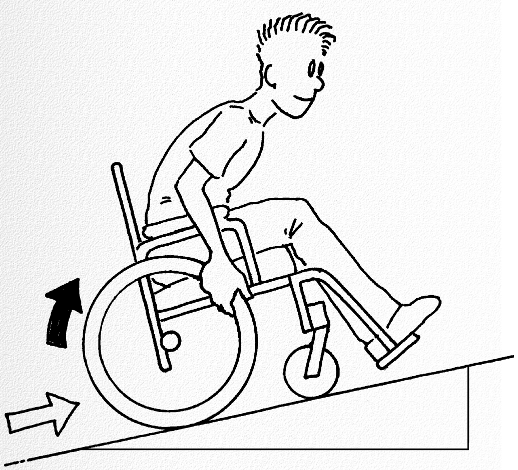

Figure 4-19. *Steep sidewalk grades are a significant barrier to access for many pedestrians.*

motorists. In addition, the extra lane width can be used to expand existing sidewalks that are too narrow and to add bicycle lanes. It is often beneficial to provide a median within the center lane where vehicles will not be making left turns to provide refuge for pedestrians crossing the street and to break up the lane so that it will not be used as a through lane.

4.2 Sidewalk grades and cross slopes

Grades and cross slopes are very difficult for some people with mobility impairments to negotiate because it is harder to travel across sloped surfaces than horizontal surfaces. People with mobility impairments who are ambulatory or use manual wheelchairs must exert significantly more energy than other pedestrians to traverse sloped surfaces. Powered wheelchairs are affected by the additional work required on steep grades because more battery power is used. This reduces the travel range of a powered chair. Both powered and manual wheelchairs can become unstable and/or difficult to control on sloped surfaces. Whenever possible, slopes should be minimized to improve access for people with mobility impairments.

4.2.1 Grade

Additional effort is required for mobility on steep grades. Manual wheelchair users may travel very rapidly on downhill pathways, but will be significantly slower on uphill segments. Steep running grades can be better tolerated by providing level segments at intervals. In addition, less severe grades that extend over longer distances may not tire users as much as shorter, steeper grades.

Grades are often difficult to control in the sidewalk environment because sidewalks follow the path of the street. In new construction, pedestrian use should be factored into the design plans. Where possible, routes should be designed with the least amount of grade in the terrain to minimize regrading. Sidewalk grades

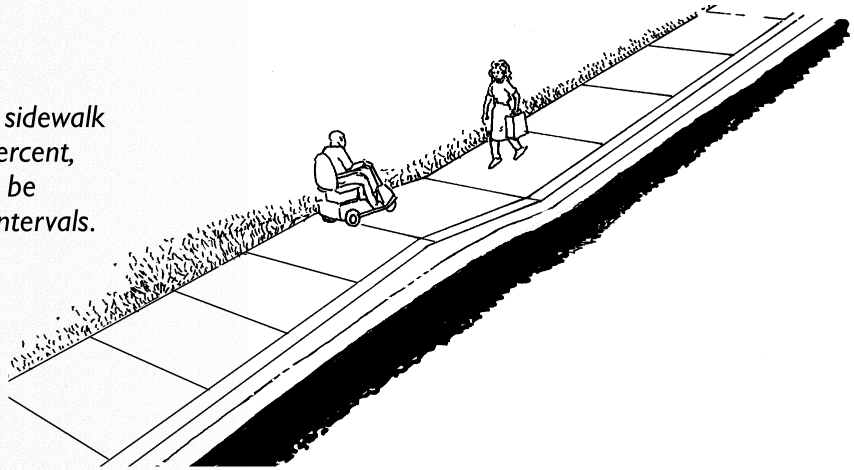

Figure 4-20. If the sidewalk grade exceeds 5.0 percent, level landings should be provided at regular intervals.

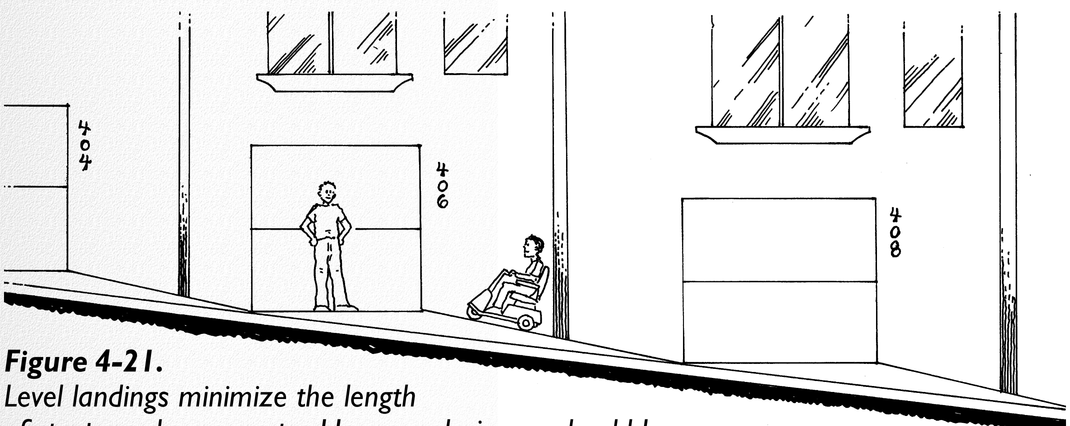

Figure 4-21. Level landings minimize the length of steep grade segments. However, designers should be aware that level landings will increase the grade in between landings and, as a result, the sidewalk grade will be greater than the grade of the street.

ideally should not exceed 5.0 percent, and the most gradual possible slope should be used at all times.

If excessive grades cannot be avoided, the following steps will help reduce the negative impacts of steep terrain:

> **SOLUTION 1** — Limit the distance and magnitude of the grade segment and provide periodic level landings between segments of steep grades.

The distance and the magnitude of the grade segment are significant factors in determining who will be able to access the sidewalk. At a site, ADAAG allows a maximum ramp grade of 8.3 percent for a distance of 9.14 m (30 ft) before a level landing must be installed (ADAAG, U.S. Access Board, 1991). On sidewalks, however, it may not be possible to limit the sidewalk grade to 8.3 percent. At a building entrance, elevation changes are small and the duration of a maximum grade is relatively short. Maximum grades on sidewalks often continue for several blocks. Even if pedestrians can negotiate an 8.3 percent grade for short distances, they may not be able to continue on this grade for longer distances.

> ***Level Landings:***
>
> *The slope of a level landing should not exceed 2.0 percent in any direction and should be installed at the top and bottom of steep grade segments.*

To limit the length of a grade segment, level landings should be provided periodically. The slope of a level landing should not exceed 2.0 percent in any direction. Level landings provide users with a place to rest and gain relief from the demands of the prevailing grade and cross slope. Although providing this resting space between steep grades is important, designers should be aware that level landings will increase the magnitude of the grade segments between the level landings. This problem can be avoided if the level landings are placed adjacent to the pedestrian zone (see Solution 3 in this chapter) and are required at building entrances, bus stops, and intersections.

Pedestrians who have low stamina also rely heavily on level landings to negotiate steep sidewalks. When installing level landings, the following criteria should be met:

- The width of the landing should extend across the full width of the pedestrian zone. On narrow sidewalks, extra width is recommended to allow faster travelers to pass slower travelers.
- The landing should be at least 1.525 m x 1.525 m (60 in x 60 in) to allow enough space for a wheelchair user to stop and rest without blocking the flow of other pedestrians who may or may not be using wheelchairs. It is also necessary if a pedestrian is expected to change directions or maneuver around objects.
- The slope of the landing should be designed to be 2.0 percent in any direction to facilitate drainage and to prevent water and debris from collecting on the landing surface.

If level landings are added to existing facilities with narrow pathways, additional right-of-way may need to be purchased or the sidewalk may need to be extended into the roadway.

SOLUTION 2 — Avoid other factors such as minimum clear widths and cross slope over 2.0 percent. This combination of conditions compound the impact of the steep grade and make the sidewalk more difficult to negotiate.

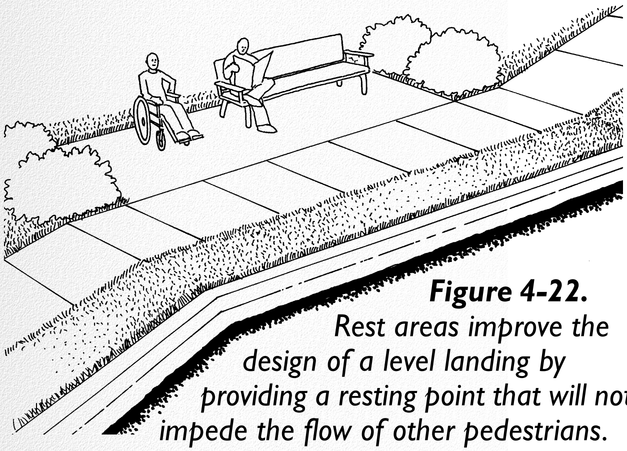

Figure 4-22. *Rest areas improve the design of a level landing by providing a resting point that will not impede the flow of other pedestrians.*

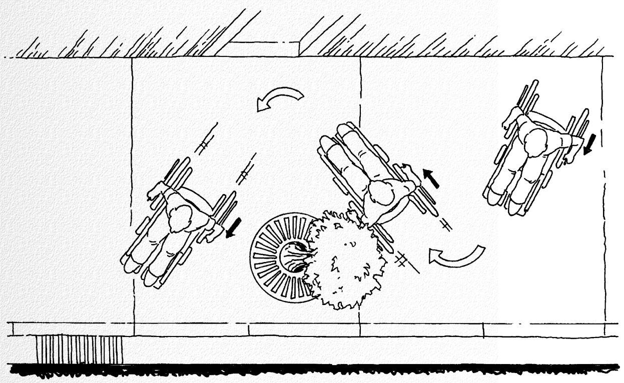

Figure 4-23. *In areas of steep terrain, a wide sidewalk allows wheelchair users to travel in a zigzag motion which reduces the grade they must travel, although the overall distance of their trip is increased.*

The effects of steep terrain are often compounded because of other factors such as cross slope, narrow widths, and changes in level. Whenever possible, these other factors that impact access for people with mobility impairments should be minimized, but especially when steeper grades can not be completely eliminated. When the grade is steep, surfaces should be firm, stable, and free of changes in level. The pedestrian corridor should be wide enough to allow users to pass one another, and cross slopes should be no greater than 2.0 percent.

SOLUTION 3 — Provide rest areas with benches and spaces for wheelchair users.

Rest areas are level landings located outside of the pedestrian zone that house additional pedestrian amenities such as benches, shade, and drinking fountains. Rest areas provide users on steep or exposed sidewalks with an opportunity to rest from their exertions. Benches are the most common amenity for rest areas on sidewalks. Benches should be installed according to ADAAG Section 4.32 in order to accommodate wheelchair users and other people with mobility impairments. In regions with very hot or cold climates, shade and shelter are important rest area amenities because many types of impairments cause people to have difficulty tolerating extreme climates.

SOLUTION 4 — Install wide sidewalk corridors whenever possible.

Wide sidewalk corridors ensure that people can travel at slower speeds and still feel comfortable knowing that other sidewalk users can easily pass by. In addition, installing wider sidewalk corridors in areas with steep terrain allows wheelchair users to travel in a zigzag pattern. This reduces the grades over which wheelchair users must travel. However, this is not an ideal solution because the added distance a wheelchair user must travel using this technique also requires extra work.

Figure 4-24. *Pedestrian sign indicating upcoming steep grade.*[1] *This could be useful for determining least grade route. This information could be combined with information on alternative routes.*

[1] *This sign is not currently included in the Manual on Uniform Traffic Control Devices (MUTCD). Before using any traffic control device that is not included in the MUTCD, the interested State or locality should submit a request for permission to experiment to FHWA's Office of Transportation Operations, 400 Seventh Street, SW, Washington, DC 20590 (see www.mutcd.fhwa.dot.gov). Guidelines for conducting an experiment can be found in Part 1A-6 of the MUTCD.*

SOLUTION 5 — Provide handrails where appropriate.

ADAAG specifies that any accessible route with a slope greater than 5.0 percent is a ramp and must have handrails. In the sidewalk environment, it is not common practice to install handrails. However, handrails may be a viable solution in some situations; for example, where steep grades occur over very short distances, at drop-offs, or near built facilities such as transit stops.

SOLUTION 6 — Provide signs that indicate the sidewalk grade and informs users of alternate routes with lesser grades.

In addition to making architectural modifications on sidewalks with steep grades, transportation agencies should consider providing users with objective information about existing grades. This type of information is most effective when it is supplemented with information about alternative routes. Information should only be provided in addition to, rather than instead of, architectural improvements. More information on pedestrian signs is located in Section 6.2.

4.2.2 Cross slope

Severe cross slopes make it difficult for wheelchair users and other pedestrians to maintain their lateral balance because they must work against the force of gravity. People using crutches or canes may be forced to turn sideways in order to keep their base of support at a manageable angle. Cross slopes can also cause wheelchairs to veer to the side which increases their risk of rolling into the street. The impacts of cross slopes are compounded when combined with steep grades and uneven surfaces.

Designers must balance the negative effects that cross slopes have on pedestrian mobility against the necessity of including cross slopes to provide adequate drainage. The recommended cross slope for sidewalks is 2.0 percent. The ADA Accessibility Guidelines confirms the need for construction tolerances by specifying that "all dimensions are

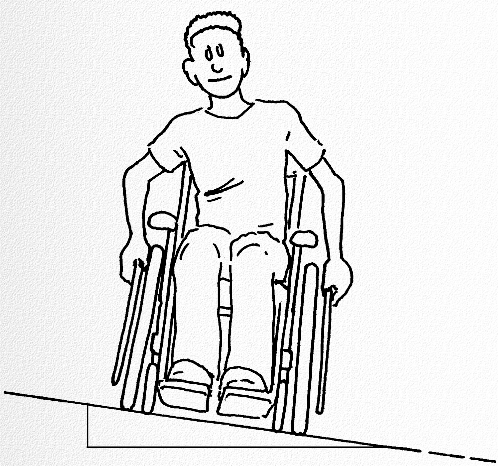

Figure 4-25. *Wheelchair users traveling on a sidewalk with a cross slope have to use more energy to travel in a straight line to offset the force of gravity that directs them sideways.*

subject to conventional building industry tolerances for field conditions" (ADAAG 3.2, U.S. Access Board, 1991). Contractors must understand the impact of cross slope on people with disabilities to ensure that sidewalk cross slope stays within the recommended 2.0 percent during the installation process.

Once the sidewalk has been constructed, an objective review process needs to be in place to verify that the installed cross slope matches the design plans. Simply eyeballing a project to see if the cross slopes appear to be in compliance is not sufficient. Oftentimes, sidewalk cross slopes are not built to the engineer's design specifications, and the resulting sidewalk has a greater cross slope than the designer intended. Cross slopes designed to be 2.0 percent that end up as 4.0 percent, are not acceptable. To verify that the cross slope does not exceed the design specification, an objective measurement device, such as a digital level, should be used to check the cross slope after the installation process is complete. It may be advisable to calibrate digital levels before each inspection to maintain accuracy.

4.2.2.1 Grade and cross slope construction tolerances

The ADA Guidelines confirm the need for construction tolerances by specifying that "all dimensions are subject to conventional building industry tolerances for field conditions" (ADAAG 3.2, U.S. Access Board, 1991). Contractors must understand the impact of grade and cross slope on people with disabilities to ensure that sidewalk and curb ramp grades and cross slopes stay within the recommended construction tolerances during the installation process. The construction tolerance for Portland Cement Concrete is based on 1/4 inch per 10 ft. (+ 0.2 percent). Research, done by Space Options® in Hawaii, has concluded that failure to build ADA compliant curb ramps is not due to problems with concrete but the lack of training of masons and form carpenters in the precision needed to build accessible curb ramps. Masons and carpenters may need to employ digital levels such as Smartool, and masons a digital level and trowel at the same time to achieve accuracy.

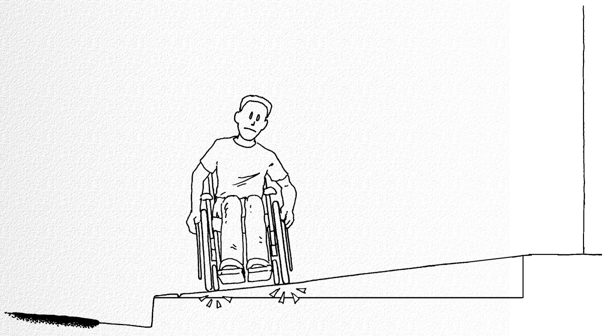

Figure 4-26. *POTENTIAL PROBLEM: Using steep cross slopes to mitigate between building and street elevations should be avoided because steep cross slopes make it difficult for wheelchair users and others to travel on the sidewalk.*

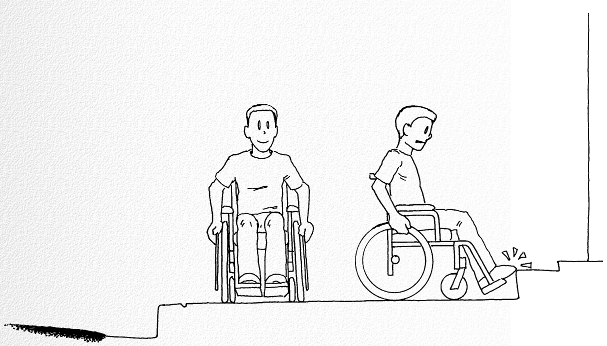

Figure 4-27. *When the street elevation is lower than the building elevation, buildings often have stairs which prevent people who use wheelchairs from accessing the building.*

4.2.2.2 Elevation difference between street and building

In new construction, the elevation of the street should be coordinated with the elevation of the sidewalk and surrounding buildings. If the elevations are not coordinated, the buildings may be at a higher elevation than the street, and a ramp will be necessary to bridge the elevation difference to provide the required level landing at the entrance. If a step system is installed, people who use wheelchairs will not have access into the building.

During new construction, transportation agencies can avoid elevation differences by coordinating their efforts with other key parties including site developers and building architects. A review process that includes input from a variety of interest groups should also be in place to ensure that construction plans for sidewalks will meet the needs of pedestrians.

In many existing situations, the building entrance elevation was not coordinated with the street elevation. The results are either:

- Sidewalks with excessive cross slopes; or
- Building entrances with steps.

Either scenario impedes access. Therefore, whenever possible, locations with elevation differences should be retrofitted. The ADA requires both private and public sector entities to mitigate inaccessible entrances.

Solutions for improving situations where the street elevation is different than the building elevation include:

SOLUTION 1 — Create a level area at least 915 mm (36 in) in the center of the sidewalk and slope the edges to make up the elevation difference.

The best way to improve a sidewalk with a steep cross slope is to create a level area at least 915 mm (36 in) wide within

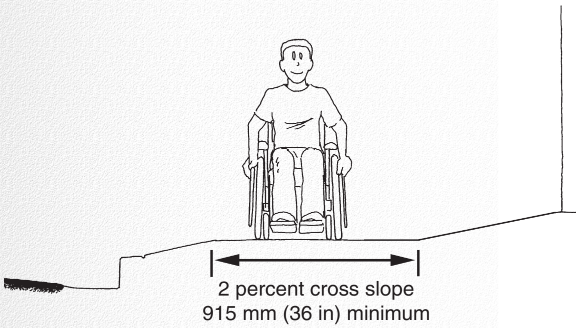

Figure 4-28. *GOOD DESIGN: A level area at least 915 mm (36 in) wide improves access when the street elevation is lower than the building elevation.*

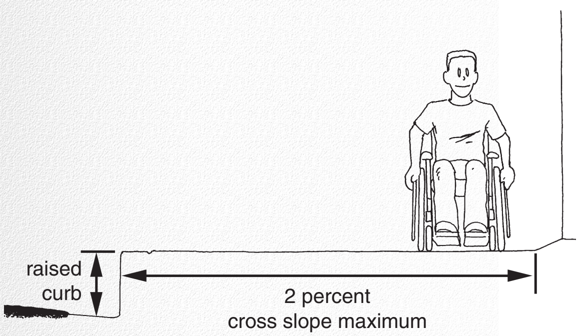

Figure 4-29. *ACCEPTABLE DESIGN: Increasing the height of the curb provides a level pathway when the street elevation is lower than the building elevation. This solution is not ideal because it is more difficult to install well-designed curb ramps at corners with high curbs.*

the pedestrian zone. The slope of the frontage and the planter/furniture zones may be increased to accommodate the additional elevation change. However, these slopes should be minimized in areas where pedestrian travel is anticipated, such as at doorways. This solution works best when the sidewalk corridor is wide because the additional width helps to keep the overall cross slopes to a minimum. Using this method on narrower sidewalks may cause the slope of the planter/furniture and the frontage zones to be too steep.

SOLUTION 2 — Raise the sidewalk and create a higher curb.

Another possible solution for a sidewalk with a severe cross slope is to raise the curb height to level the sidewalk. This solution is desirable because it works on both narrow and wide sidewalks. However, high curbs can make curb ramp design more difficult (see Section 7.4.4). A curb higher than 200 mm (8 in) also creates a problem for on-street parking because car doors cannot swing over the curb.

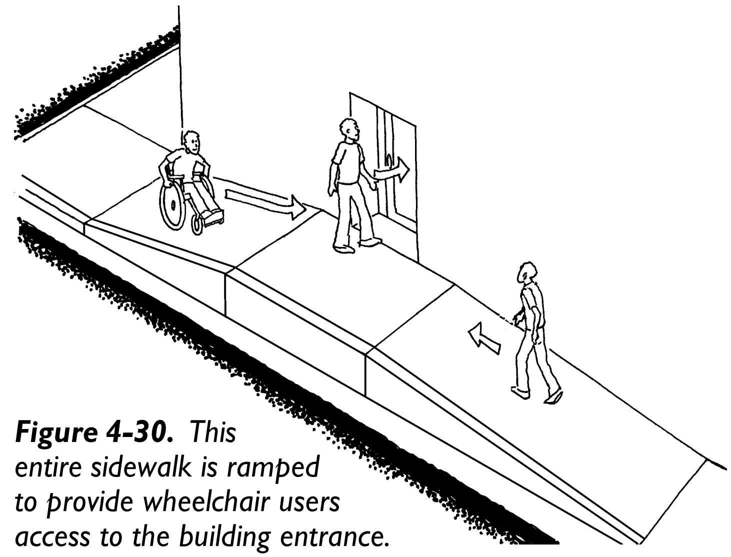

Figure 4-30. *This entire sidewalk is ramped to provide wheelchair users access to the building entrance.*

SOLUTION 3 — Retrofit the building entrance by replacing the steps with a ramp.

Ramps should replace stairs at building entrances to allow people who use wheelchairs access into the building.

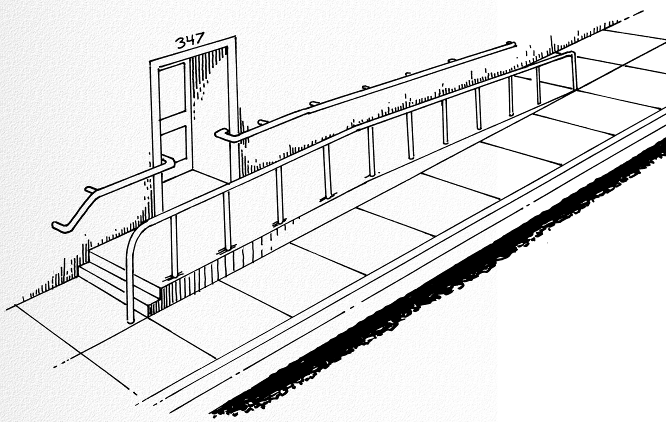

Figure 4-31. *GOOD DESIGN: This sidewalk has been ramped to provide access to the building entrance. This creative design is possible only on wide sidewalks where pedestrians will be given the option to either continue in a straight path or enter the building using the ramp or stairs.*

On wider sidewalks, the ramps should not interfere with the pedestrian zone. On narrower sidewalks, designers may have to employ creative solutions, such as ramping the entire sidewalk up to the building to allow for wheelchair access. In most situations, on-street parking will have to be restricted if the entire sidewalk is raised.

4.3 Sidewalk surfaces

Factors that affect the usability of the sidewalk surface are:

- Surface material;
- Firmness, stability, and slip resistance;
- Changes in level; and
- Dimensions of gaps, grates, and openings.

Each of these surface factors work in conjunction with the other to determine how easily pedestrians can use the sidewalk.

4.3.1 Surface material

Sidewalk surfaces generally consist of concrete or asphalt; however, tile, stone, and brick are also common. Most common sidewalk materials are firm, stable, and slip resistant when dry.

4.3.1.1 Firm and stable

Typically, sidewalks constructed of asphalt or concrete are firm and stable.

Firmness is the degree to which the surface resists deformation by indentation when, in this case, a person walks or wheels across it. A firm surface would not compress significantly under the forces exerted as a person walks or wheels on it.

Stability is the degree to which the surface remains unchanged by contaminants or applied force, so

> **Surface Material:**
>
> *Sidewalk surfaces should be firm and stable. They should also be slip resistant under dry conditions.*

when the contaminant or force is removed, the surface returns to its original condition. A stable surface would not be significantly altered by a person walking or maneuvering a wheelchair on it.

Surfaces that are firm and stable resist deformation, especially by indentation or the movement of objects. For example, a firm and stable surface such as concrete resists indentation from the forces applied by an ambulatory pedestrian's feet or a wheelchair user's wheel; it also reduces the rolling resistance experienced by a wheelchair user.

4.3.1.2 Slip resistant

Under dry conditions, most asphalt and concrete surfaces are fairly slip resistant.

Slip resistance is based on the frictional force necessary to permit a person to ambulate without slipping. A slip resistant surface does not allow a shoe heel, a wheelchair tire, or a crutch tip to slip when ambulating on the surface.

A broom finish should be used on concrete sidewalks to increase the slip resistance for pedestrians. Decorative paints and surfaces, such as polished stones or exposed aggregate rock, are not as slip resistant and should be avoided.

Some asphalt sealants decrease the slip resistance of asphalt. In addition, the specification of the aggregate sieve spectrum has a significant impact on the slip resistance of the final surface. In general, brushed concrete is more slip resistant than asphalt, depending on the type of aggregate used. The U.S. Access Board Technical Bulletin #4 (1994a) addresses slip resistance in further detail.

Thermoplastic materials, commonly used to mark lines on asphalt or concrete at crosswalks, are generally not as slip resistant as the roadway surface. The problem is exaggerated when the surface is wet. Whenever possible, a texture should be added to thermoplastic materials to improve slip resistance. Some research suggests that additives, such as crushed

Slip Resistant Surface:

A broom finish should be added to concrete sidewalks to create a slip resistant surface.

Figure 4-32. *Bad weather conditions create wet and slippery surfaces that can be hazardous for pedestrians.*

glass will improve the slip resistance of thermoplastics. Further research is necessary to identify more effective materials to mark crosswalks. More information about crosswalks is included in Section 8.5.

4.3.1.3 Wet or icy surfaces

Slip resistant surfaces are more difficult to achieve when the sidewalk material is wet or icy. Surfaces that are wet or icy are difficult for all pedestrians to travel across, but they are especially difficult for people who use wheelchairs or walking aids. Crutch users, for example, rely on being able to securely plant their crutch tip to travel effectively on the sidewalk. If the surface is icy, it creates a major safety problem.

Solutions for preventing water and ice from collecting on the sidewalk include:

SOLUTION 1 — Design the sidewalk so that only water that falls directly onto the sidewalk and not water that falls onto adjacent surfaces requires management;

SOLUTION 2 — Create drainage systems to prevent water from settling on the sidewalk; or

SOLUTION 3 — Establish a regular maintenance program to remove snow and add salt or sand to slippery sidewalk areas.

4.3.1.4 Decorative surface materials

Asphalt and concrete are the most common surfaces for sidewalks; however, some sidewalks are designed using decorative materials, such as brick or cobblestone. Although these surfaces may improve the aesthetic quality of the sidewalk, they may also increase the amount of work required for mobility. For example, tiles that are not spaced tightly together can create grooves that catch wheelchair casters. These decorative surfaces may also create a vibrating bumpy ride that can be uncomfortable and painful for those in wheelchairs. Thus, the surface texture should be vibration free wih a limit of 1/4 inch or less of rise not more than every 30 inches. In addition, brick and

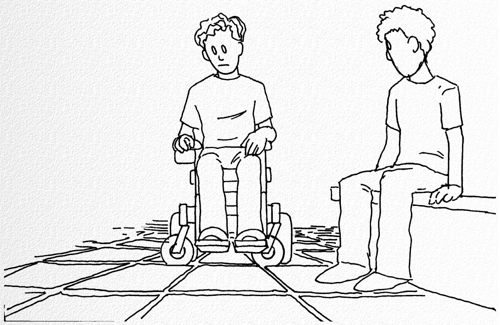

Figure 4-33. *This wheelchair user is having difficulty negotiating this decorative surface because his wheelchair caster is stuck between the tiles.*

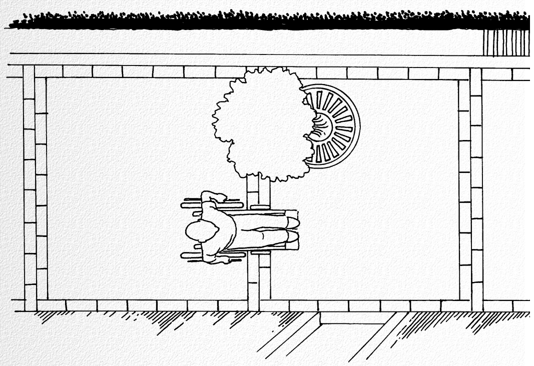

Figure 4-34. *Cement with brick trim is an alternative to decorative sidewalk materials that are difficult for people with mobility impairments to negotiate.*

cobblestone have a tendency to buckle creating changes in level. This creates a tripping hazard for people with vision impairments and for ambulatory pedestrians with mobility impairments. Finally, decorative surface materials can make it more difficult for pedestrians with vision impairments to identify detectable warnings which provide critical information about the transition from the sidewalk to the street.

For these reasons, brick and cobblestone sidewalks are not recommended. Creative alternatives to brick sidewalks include:

- Concrete sidewalks with brick trim, which preserves the decorative quality of brick but is an easier surface to negotiate; or
- Colored asphalt or concrete (stamped to look like brick). Although preferred in comparison to using actual decorative surface material, this option can also create a bumpy surface. Consequently, people with mobility impairments may experience some difficulty when traveling over these surfaces. The surface texture should be vibration free with a limit of 1/4 inch or less rise not more than every 30 inches.

Many historic districts use decorative surface materials for pathways. Access to historic districts is critical, because they provide cultural enrichment and a sense of connection with the past. Oftentimes, historic districts are not accessible to people with disabilities and therefore require novel solutions to improve access. In downtown Seattle, for example, Pioneer Square is designated as a historic

Figure 4-35. *In Pioneer Square in Seattle, Washington, an additional pathway was created using smoother and larger pavers with fewer changes in level.*

Figure 4-36. Changes of level in sidewalks caused by tree roots are potentially hazardous for pedestrians.

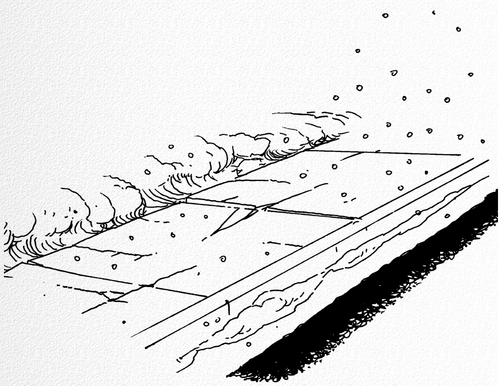

Figure 4-37. Changes of level in sidewalks can be caused from heaving and settling due to frost.

district. The majority of pathways are surfaced with an uneven cobblestone. To accommodate people with mobility impairments in this park, an additional pathway was created using smoother and larger pavers with fewer changes in level. The look of the park was preserved and people with mobility impairments are accommodated.

4.3.2 Changes in level

Changes in level are vertical elevation differences between adjacent surfaces. Changes in level are relatively common on sidewalks, particularly in residential areas. Causes of changes in level in the sidewalk environment include:

- Tree roots pushing up from beneath the pavement;
- Heaving and settling due to frost;
- Brick surfaces buckling;
- Uneven transitions between streets, gutters, and curb ramps; and
- Lips at the bottom of curb ramps (not allowed by ADAAG).

Changes in level can cause the following difficulties for people with disabilities:

- Many ambulatory pedestrians with mobility impairments have difficulty lifting their feet off the ground. Abrupt changes in level can easily cause these users to trip or fall.
- People with low vision may have difficulty detecting changes in level, such as a buckling sidewalk, which puts these pedestrians at risk of tripping. Some people with vision impairments manage changes in level through cane techniques that detect small changes.
- People using wheeled devices, such as wheelchairs and scooters, can catch their wheels in a sidewalk crack, lose their balance, and propel forward.
- Wheelchair users may also have a difficult time rolling over larger changes in level because of the work required to propel the wheelchair up and over the elevation change.

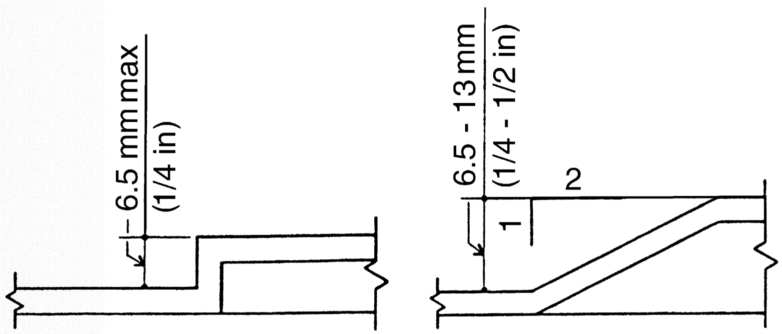

Figure 4-38. *Beveling or ramping changes in level that exceed 6 mm (0.25 in) can minimize the work a wheelchair user must exert during travel.*

Changes in Level:

- *Up to 6 mm (0.25 in) — no treatment*
- *6 to 13 mm (0.25 to 0.5 in) — bevel the surface with a maximum grade of 50 percent*
- *Greater than 13 mm (0.5 in) — install a ramp with a maximum grade of 8.3 percent*

Most changes in level are a result of poor maintenance. Some changes in level, such as a lip at the bottom of a curb ramp, are no longer recommended as a detection of the street ending and the sidewalk beginning. Any existing elevation changes should be ramped with smooth transition points. In addition, maintenance programs should be established for new construction to address future changes in level as they occur.

Changes in level that currently exist should be addressed through a maintenance program. Whenever possible, the cause of the change in level should be removed. For example, if the cause of the change in level is an overgrown tree root, the sidewalk should be rerouted around the tree with additional right-of-way or ramp up and over the roots. (Section 4.4 contains information on how to plant trees so that they will not push up through the sidewalk.) If rerouting is not a viable solution, changes of level should be ramped to provide a smooth surface. The following ADAAG guidelines for buildings should be used when addressing changes in level for sidewalks:

- Small changes in level up to 6 mm (0.25 in) may remain vertical and without edge treatment;
- A beveled surface with a maximum slope of 50 percent should be added to small changes in level between 6 mm (0.25 in) and 13 mm (0.5 in); and
- Changes in level such as curbs that exceed 13 mm (0.5 in) should be ramped or removed.

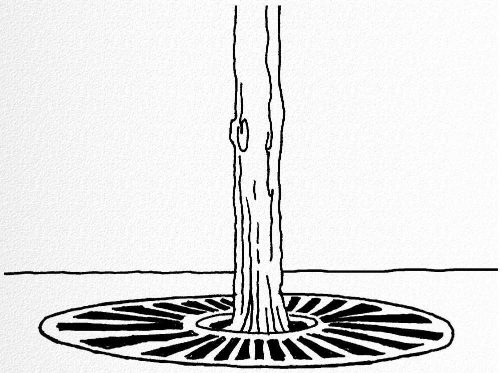

Figure 4-39. *Grates around sidewalk trees allow water to reach tree roots and should be located outside the pedestrian zone.*

Gaps and Grates:

- *Openings should not allow the passage of a 13 mm (0.5 in) sphere*
- *The long dimension of the opening should be perpendicular or diagonal to the dominant direction of travel*

4.3.3 Gaps, grates, and openings

A gap is a single opening embedded in the travel surface. Railroad tracks are a common gap that pedestrians must negotiate (see Section 8.11). Other examples include sections of the sidewalk where the surface material has broken off over time. A grate is an open framework of latticed or parallel bars embedded in the travel surface designed to prevent large objects from falling through the opening. Grates are also placed over vents in the sidewalk corridor, over drainage inlets to permit water and some sediment to fall through the slots, and around sidewalk trees to allow water to reach the tree roots.

Wheelchair casters, inline skating wheels, and bicycle tires can all easily get caught in poorly placed openings. If a wheel gets caught suddenly, the user will be pitched forward. The tips of walking aids, such as canes, can also get caught in grates and gaps. When a cane tip slips through an opening, the user can become unstable and risks falling.

Many grates and gaps serve a vital purpose in the transportation system. However, they should always be located in areas where they will have the least impact on pedestrians. All tree and storm water grates should be sited in the planter/furniture zone and should never be placed in the pedestrian zone. Designers and engineers should also avoid placing grates in a crosswalk or at the bottom of a curb ramp. Gaps that can be repaired should be improved through a maintenance program. Gaps and grates should be designed using the following guidelines:

- Openings should not allow the passage of a 13 mm (0.5 in) sphere; and
- Openings should be oriented so that the long dimension is perpendicular or diagonal to the dominant direction of travel.

4.4 The impact of trees on the sidewalk corridor

Trees are generally installed because they improve the pedestrian experience

Figure 4-40. *If tree roots cannot be removed, the sidewalk should be rerouted around the tree.*

along the street. Trees serve as a visual and auditory buffer between pedestrians and automobile traffic. They also improve the aesthetic appearance of a street and provide shade or shelter in warm or windy regions. In urban areas, trees provide needed green space and break up the monotony of the public right-of-way. In some residential areas, large trees that extend over the street may have a traffic calming effect by creating a sense of enclosure. According to urban design research, visual enclosure is required to transform streets into pedestrian places, which results in increased comfort for pedestrians and decreased comfort for speeding motorists (Institute of Transportation Engineers, 1999).

Trees need a minimum of 1.22 m x 1.22 m (48 in x 48 in) planting area (Craul, Phillip J., 1999). If improperly planted or maintained, trees can be very problematic in the sidewalk environment. Tree roots are one of the most common causes of sidewalk cracks and small changes in level. Trees that are planted too close together, or without grates or grass, will have insufficient water. When water is limited, tree roots tend to push through the surface and spread out rather than down to look for new water sources. Sidewalks and curbs should not be installed too close to the tree, which will hamper the tree's natural trunk and root growth.

Trees should be chosen with care for their branch patterns, leaf and fruit litter (some fruits and leaves are slippery when dropped). Choose trees that are appropriate for the site with the assistance of a certified arborist or urban forester.

Above the surface, tree branches can be vertical obstructions and protruding objects if they extend horizontally into the sidewalk corridor. People with vision impairments may not be able to detect tree branches that protrude into the travel route. Some people with mobility impairments who have difficulty bending may also have problems with low tree branches. In addition, taller pedestrians are inconvenienced by poorly maintained trees. Tree branches hanging lower than 2.03 m (80 in) should be trimmed away.

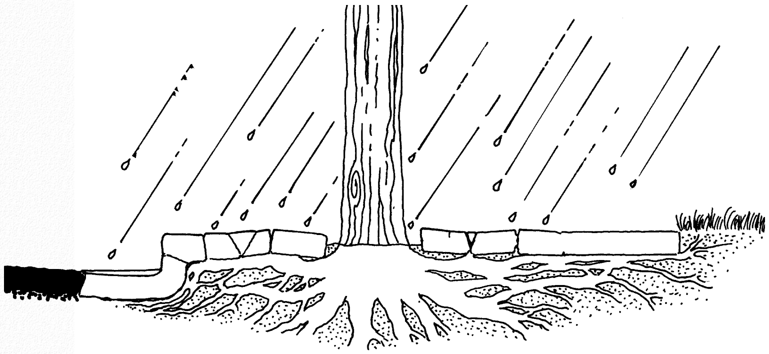

Figure 4-41. *When trees do not get enough water they tend to spread their roots out, which can break up the surface of the sidewalk.*

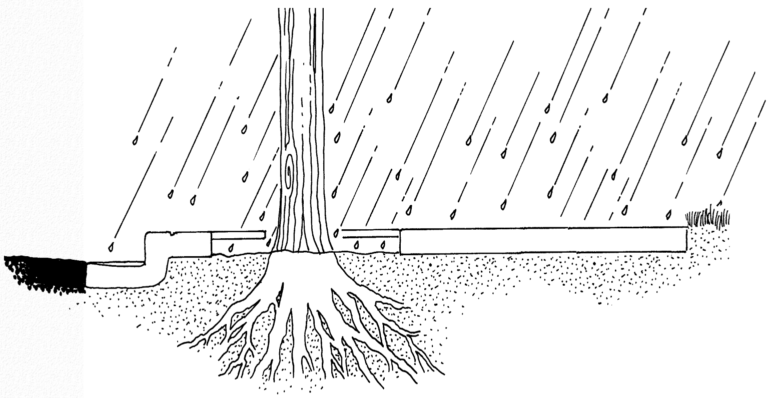

Figure 4-42. *Trees planted with grates are less likely to cause sidewalk cracks than trees planted without grates because the grate allows a sufficient amount of water to reach the tree roots. When trees do not get enough water, they tend to spread their roots out which can break up the surface of the sidewalk.*

The following recommendations should be considered when installing new sidewalk trees or addressing problems with existing sidewalk trees:

SOLUTION 1 – Plant trees whose roots tend to grow down rather than out or use root control systems to guide the direction of root growth;

SOLUTION 2 – Use tree gratings or planting strips to allow enough water to reach the tree roots;

SOLUTION 3 – Avoid planting trees near intersections because they may decrease visibility between pedestrians and drivers;

SOLUTION 4 – Trim tree branches regularly to less than 2.03 m (80 in); or

SOLUTION 5 – Place trees far enough apart for roots and trunk to grow and provide open space for food, air, and water.

Figure 4-43. Well lit sidewalks improve accessibility at night for all pedestrians.

4.5 Well-lit sidewalks

Because many people have low vision, and because everyone's vision is diminished after dark, increasing the lighting in a sidewalk corridor can significantly improve pedestrian access. The transition between poorly-lit and well-lit areas requires people to adjust their vision to the change in light. This is particularly difficult for people with vision impairments. Improving street lighting makes locations appear friendlier and will encourage people to use the area at night. An increase in the number of people using a particular area reinforces general safety by eliminating opportunities for crimes to occur.

Street lighting is designed to serve a variety of purposes. Some designers use lamp styles to provide a sense of neighborhood continuity or preserve the atmosphere of a historic district. Others use lights to improve visibility for motorists and discourage crime. Lights along public rights-of-way that are directed toward the road provide little benefit to pedestrians. Some lights only increase the overall light level and do not improve the quality of the pedestrian environment.

Lighting should be evenly distributed to avoid alternating bright and shadowed areas. The best type of lighting for pedestrians focuses on the sidewalk and shines down rather than out. The benefits of lighting can be amplified by reflective material such as yellow paint or reflective markings on the sidewalk that help pedestrians anticipate and avoid obstacles such as curbs.

4.6 Grade-separated crossings

Grade-separated crossings are facilities that allow pedestrians and motor vehicles to cross at different levels. They can significantly reduce pedestrian-vehicle conflicts and potential collisions by allowing pedestrians to avoid crossing the motorist's path of travel. Appropriately located and designed grade-separated crossings can reduce vehicle delay, increase highway capacity, and eliminate the likelihood of collisions with vehicles.

Figure 4-44. *Providing sidewalks on bridges maintains the continuity of the pedestrian network.*

The Florida Pedestrian Planning and Design Guidelines indicate that grade-separated midblock crossings can also reduce pedestrian travel time and help to maintain the continuity of a neighborhood by providing a connection over major arterials or freeways (University of North Carolina, 1996). However, depending on their design, grade-separated crossings often have significant drawbacks. Some grade-separated crossings are very steep and are difficult for people with mobility impairments to negotiate. They are often not considered pedestrian friendly because users are frequently forced to travel out of their way to use the structures.

The effectiveness of a grade-separated crossing depends on whether or not pedestrians perceive that it is easier to use than a street crossing (ibid.). Grade-separated crossings are also extremely costly to construct, can encourage crime, vandalism, and often are not well utilized. Grade-separated crossings should be designed to minimize the change in the pedestrians' path to allow the most direct route of travel.

Examples of grade-separated crossings include:

- **Overpasses** — bridges, elevated walkways, and skywalks/skyways; and
- **Underpasses** — pedestrian tunnels and below-grade pedestrian networks.

Underpasses can be more expensive to install than other pedestrian facilities because a tunnel must be dug and utility lines may have to be relocated. However, underpass approaches can generally be designed with less severe grades than overpass approaches making them preferable for pedestrians. If the needs of pedestrians are a high priority, the grade-separated crossing will be designed so that the vehicular traffic negotiates the change in level while the pedestrian path of travel remains nearly level.

Grade-separated crossings are most efficient in areas where pedestrian attractions, such as shopping centers, large schools, recreational facilities, parking garages, and other activity centers, are separated from parking garages or transit stops by high volume and/or high speed arterial streets. The following steps should be taken to increase pedestrian safety and access at grade-separated crossings:

- Provide good sight distances in underpasses, preferably with the open ends of the tunnel in view at all times. This increases the user's sense of security and prevents the user from feeling like other people are lurking in the tunnel;
- Provide good lighting and ventilation in tunnels;
- Include an accessible turning space [at least 1.525 m x 1.525 m (60 in x 60 in)] at the top and bottom of the ramps to the grade-separated crossing;
- Make pathways wide enough to permit two-way pedestrian traffic;
- Install barriers or landscaping to prevent pedestrians from making at-grade and at-risk crossings;
- Provide handrails on overpasses; and
- Minimize grades, cross slopes, and additional travel distances.

Minimizing the slope of a grade-separated crossing is often difficult, particularly for overpasses, because a significant rise [generally between 4.27 m and 5.49 m (14 ft and 18 ft)] must be accommodated. Grade-separated crossings should be designed with level landings 1.525 m x 1.525 m (60 in x 60 in) at every 9.30 m (30 ft) rise and a maximum grade of 8.33 percent. Grade-separated crossings that are not accessible by people with disabilities should not be constructed, since all facilities built after January 26, 1992, are required to be accessible to people with disabilities (U.S. Department of Justice, 1991a). Many manual wheelchair users, ambulatory pedestrians with walkers and other aids, and people with low stamina will not find ramped over passes usable because of the extreme ramp lengths. A 5.49 m (18 ft) rise require 64.88 m (216 ft) of ramp run and 8 landings at each approach [each landing being 1.525 m (60 in)]. In addition, existing structures should be prioritized for access improvements. The installation of elevators could provide access for people with mobility impairments and improve use-rates for all pedestrians. Elevators are only effective, however, if they are properly maintained.

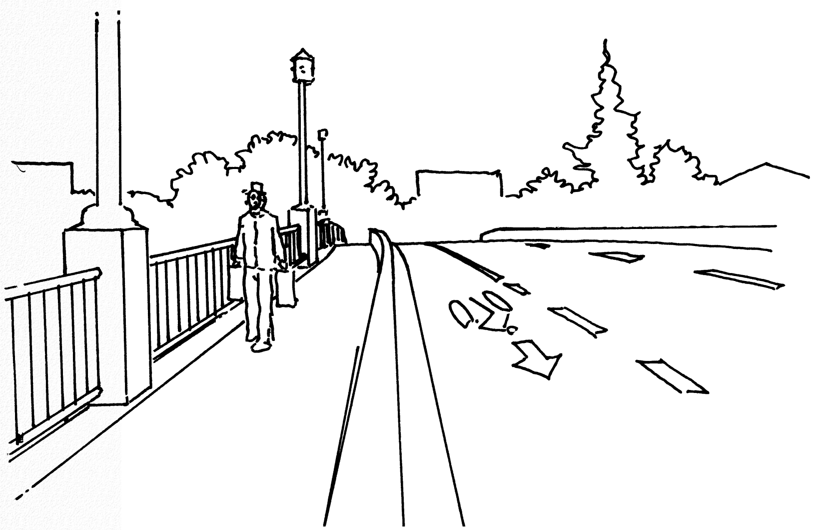

Figure 4-45.
This bridge provides a comfortable pedestrian environment because there is a clear separation between the sidewalk corridor and the street and the sidewalk corridor is wide enough to allow users to travel side-by-side.

4.7 Sidewalks in confined spaces

Sidewalks along bridges and in tunnels are more difficult to design than sidewalks along streets because overall space is at a premium, and the edges of the sidewalk are limited by the roadway and a wall or drop-off. For this reason, pedestrians often feel less protected from traffic when crossing bridges and tunnels. Whenever possible, pedestrians should not be forced to walk uncomfortably close to a wall or drop-off. In addition, a protective barrier should be provided at a drop-off.

To increase access and improve the pedestrian environment, designers should employ the following techniques for sidewalks in tunnels and on bridges:

- Separate pedestrian and street traffic with a railing or barrier that measures at least 1.065 m (42 in), because of the proximity and difference in speed between the vehicular and pedestrian traffic that is magnified by the more confined space in a tunnel or on a bridge;

- Provide a wide pedestrian zone whenever possible, since pedestrians are unable to move off of the sidewalk onto the adjacent property in order to pass or be passed by other pedestrians; and
- Provide a protective barrier to prevent pedestrians from the drop-off at the side of the bridge.

Bridges require additional drainage consideration because moisture has a tendency to freeze more quickly on bridges. If the bridge is located in a colder climate, cross slopes must be carefully designed to quickly drain water off of the sidewalk surface in order to avoid freezing.