CHAPTER 3: PEDESTRIAN AND BICYCLE CIRCULATION

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Illustration 3-a. Sidewalk and Trail

Well designed and appropriately located sidewalks and trails are an asset to a neighborhood. They can make biking and walking become viable alternatives to motorized transportation for shopping, going to school or work, and for recreation.

Overview

3.0 OVERVIEW

Non-vehicular circulation refers to facilities such as sidewalks, trails, and bike lanes provided for non-motorized circulation and access. These facilities serve as critical links in the transportation network of a neighborhood by providing residents access within the neighborhood as well as non-vehicular connectivity to adjacent neighborhoods, commercial districts, schools, businesses, offices, and recreational areas. Connections between neighborhoods are critically important. Developments should not be self-contained islands, but should mesh with adjacent communities, linking streets, sidewalks, parks, and trails in ways that allow people to move freely.

Sidewalks and trails enrich a community's quality of life on many levels. They provide accessibility to people with disabilities, enabling them to better participate in the community; they invite strolling and shopping for all residents, and provide for recreational opportunities, promoting healthier living; and they provide an alternative to the use of motorized modes of transportation.

The location and design of sidewalks, trails, and bikeways requires careful consideration to maximize their usefulness to the community. All potential users, including people with disabilities, should be included in design considerations. It is often useful to include local residents or other community members in the design process to help maximize the usefulness of new proposed pedestrian facilities. This can be accomplished through one or more public meetings. Pedestrian facilities should be safe, attractive, convenient, and easy to use. Facilities that are inadequate or inappropriate to a community's needs discourage use and waste money and resources (Ref. 1).

This chapter provides guidance for the design of sidewalks, trails and bike lanes. Since these facilities provide a fundamental service to the public, they should be designed to meet the needs of the widest possible range of potential users. The overriding goals of the recommended design standards contained here are to provide accessibility and to encourage residents to make walking and biking viable and enjoyable modes of circulation within and among neighborhoods.

Recommended Standards

3.1 SIDEWALKS

Sidewalks are pedestrian facilities, typically parallel to and adjacent to streets, which provide non-vehicular access to homes and neighborhood commercial facilities. They are not intended as bicycle circulation routes, although small children may ride bicycles on sidewalks for safety reasons.

All sidewalks shall be designed to promote accessibility and shall include the following characteristics:

- Wide pathways without obstacles;
- Moderate grades and cross slopes;
- Rest areas outside of the pedestrian zones in high-density areas;
- Firm, stable, and slip-resistant surfaces;
- Buffering from traffic;
- Shade where possible;
- Convenient, safe, and easy street crossings; and
- Adequate lighting to ensure safety.

3.1.1 Location

Since sidewalks provide the “right-of-way” for the public, they primarily exist in a corridor that is located between the edge of a roadway and the residential property line (see figures 2-19 to 2-24), extending along the sides of streets between street corners. Sidewalks may also be located just outside the street right-of-way in an on-lot easement, and in other locations throughout the subdivision as warranted, for pedestrian access and for connections to

Commentary

Sidewalks and other elements of the public right-of-way present unique challenges to accessibility as a result of space limitations, roadway design needs, slope, and terrain. The Architectural and Transportation Barriers Compliance Board (ATBCB) has drafted guidelines for accessibility in the public right-of-way (Ref. 7). This section includes many of the recommendations for sidewalk design identified in Reference 7. However, this section should be reviewed for compliance when a final rulemaking is issued by the ATBCB.

The need for lighted sidewalks and trails should be based on the need for public safety. Excessive lighting and light pollution should be avoided. When necessary, all sidewalk and trail light fixtures shall include appropriate cut-off luminaries.

Illustration 3-b. Typical Sidewalk

Locating the sidewalk just outside the right-of-way in an on-lot easement allows for a narrower right-of-way, and promotes shorter set-back distances between the edge of the roadway and building front. This is sometimes desired to promote community

Commentary

character. Placing the sidewalk in an on-lot easement also allows more unobstructed room within the right-of way for location of utilities.

Illustration 3-c. Sidewalk in an Easement

The 125-foot frontage and 22,000 square foot lot size criteria are based on common practice and the consensus of a consortium of stakeholder group representatives who provided oversight and input to the development of these guidelines. The stakeholder group included representation from state and local regulatory agencies (PennDOT, DEP, DCED, and municipal officials), design professionals (engineers, surveyors, landscape architects, planners), environmental groups, and builder / developers.. Where sidewalks are not provided along road frontages, paths/trails and/or bike lanes should be considered to provide non-vehicular connections to adjacent neighborhoods and other destinations (existing or planned).

The location of sidewalks along one side of the street has been promoted as a way to minimize impervious areas for better stormwater management. However, sidewalks make up only a small percentage of the impervious area within a neighborhood, and neighborhood character and accessibility

Recommended Standards

adjacent communities.

Sidewalks located adjacent to streets shall be provided in all residential neighborhoods having lot sizes less than or equal to 22,000 square feet (1/2 acre).

Sidewalks shall be located on both sides of streets having average lot frontages (width at the front setback line) equal to or less than 100 feet. Where average lot frontages are greater than 100 feet but less than 125 feet, sidewalks shall be located along at least one side of the street.

Sidewalks shall also be provided along both sides of all residential / mixed-use collector roadways. In addition, sidewalks or accessible pathways should be considered along all residential collector roadways to enhance pedestrian connectivity among neighborhoods, commercial centers, and other pedestrian destinations.

As a minimum, sidewalks should be located along one side of all residential access roadways. However, for accessibility, it is recommended that sidewalks be located along both sides of residential access roadways in higher density developments. In addition, sidewalks shall be located along both sides of all residential / mixed-use collectors.

A waiver of the requirement for sidewalks will be considered for small subdivisions

Recommended Standards

(typically less than or equal to 30 lots) where there is no current or planned future connection to external pedestrian destinations, and traffic volumes are low enough that the street itself may serve as an adequate means of pedestrian connectivity between residences within the subdivision.

3.1.2 Buffering

A buffer zone or planting strip having a minimum width of 3 feet shall be included between the back of curb and the near edge of the sidewalk. If trees are to be planted in this buffer, the minimum buffer width shall be 5 feet. In higher density urban settings, the buffer zone may consist of planters and / or pedestrian furniture as illustrated in Figure 3.1. In these cases a minimum buffer width of 5 feet shall be maintained.

Figure 3.1. Sidewalk Buffering
Modified from Source: DCED, PSATS (Ref. 11)

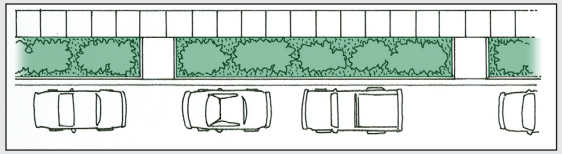
When on-street parking is provided, the parking lane provides an additional buffer between pedestrians and vehicular traffic. In this case an additional pedestrian buffer is not required. Also see section 2.3.9, Street Landscaping.

Commentary

should always be used as the primary justifications for sidewalk location. Additionally, drainage from sidewalks can be directed to a vegetated buffer or swale area between the cartway edge and the sidewalk for stormwater management purposes (see Chapter 4).

Examples of occasions in which a waiver might be appropriate would include isolated subdivisions on single cul-de-sacs or loop streets serving no more than 30 lots, and having no connection to other pedestrian destinations.

Illustration 3-d. Periodic Curb Ramps for Pedestrian Access



Modified from Source: FHWA, 2001; Ref. 3

Where on-street parking is provided, and a planting strip is located adjacent to the curb or swale line, periodic curb ramps should be provided to facilitate

Commentary

pedestrian access onto the sidewalk as shown in Illustration 3-d.

A 4-foot wide sidewalk allows pedestrians to walk side by side and to pass without requiring anyone to step off the sidewalk.

Although 4-foot sidewalks are acceptable, a 5-foot wide sidewalk allows pedestrians to pass more comfortably and provides adequate room for wheel chairs or strollers to pass or be maneuvered side-by-side. It is suggested that 5-foot or wider sidewalks be considered along Residential Access Type B and higher street classifications.

It is also noted that the additional 1 foot of sidewalk width does not add significantly to stormwater impacts since sidewalks typically drain to adjacent grassed areas.

Additional effort is required for mobility on steep grades for pedestrians with disabilities and the elderly. However, sidewalk grades are difficult to control because sidewalks typically follow the path and grade of the street or terrain adjacent to the street. Minimum residential access street grades in mountainous terrain can range up to 12% (or more for short distances).

Rest areas with room for wheelchairs and benches improve the design of a level landing by providing

Recommended Standards

3.1.3 Sidewalk Width

Sidewalks shall be constructed to a minimum width of 4 feet (Ref. 6). However, where pedestrian traffic may be high, such as in high-density developments and along residential mixed-use / collectors, a sidewalk width of 5 feet or greater should be used. Sidewalk width, as defined here, shall be exclusive of any curb width.

Where sidewalks are less than 5 feet in width, passing spaces having a minimum width of 5 feet and length of 5 feet shall be provided at a maximum interval of 100 feet (Ref. 7). This width is needed for wheelchair users to pass one another (see figure 3.2) or to turn around (Ref. 6). Passing space shall also be provided at all sidewalk intersections. In addition, a clear line-of-sight shall be maintained between passing spaces.

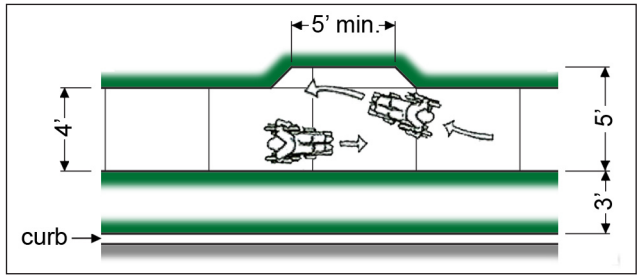


Figure 3.2. Passing Space on Narrow Sidewalks
Modified from Source: FHWA, 2001; Ref. 3

3.1.4 Grade (Longitudinal Slope)

Where the sidewalk is located within or immediately adjacent to the street right-of-way, its grade shall not exceed the grade of the street. Sidewalks in other locations should follow the natural terrain to minimize grading and land disturbance.

When sidewalk grades exceed 5%, landing areas should be provided at 100-foot intervals. The landing area should be at least 5 feet by 5 feet to allow enough space for a wheelchair to stop without blocking the flow of other pedestrians. On sidewalks narrower than 5 feet, extra width should be provided in landing areas as illustrated in Figure 3.2. The slope of landing areas should not exceed 2% in any direction. Rest areas can be located adjacent to landing areas. Refer to section 3.2.1.7 for rest area standards.

Recommended Standards

Where landing areas cannot be provided at a 100-foot spacing, the sidewalk should be widened to a minimum width of 6 feet to permit wheel chairs to travel in a zigzag motion to reduce the grade they must travel (see illustration 3-e).

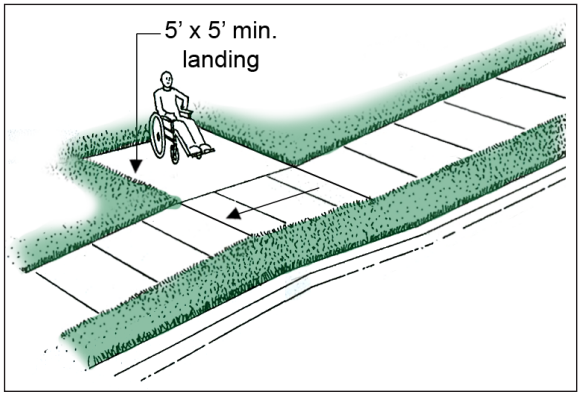


Figure 3.3. Typical Landing Area with Adjacent Rest Area
Modified from Source: FHWA, 2001; Ref. 3

3.1.5 Cross Slope

Sidewalks shall be constructed with a cross slope of 1% to 2% (see figure 3.4), with a construction tolerance of ¼ inch in 10 feet. On sidewalks with longitudinal slopes exceeding 3%, a cross slope of 2% shall be provided to promote sidewalk drainage.

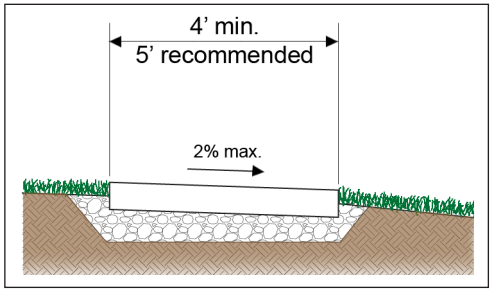
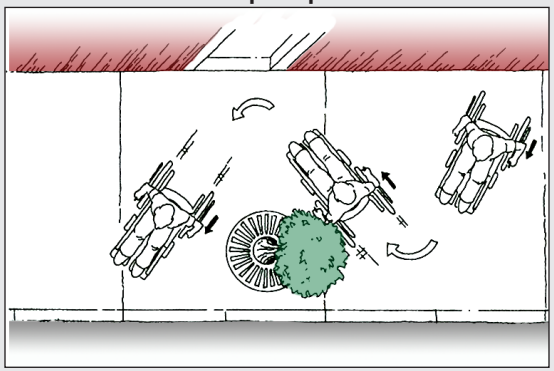


Figure 3.4. Sidewalk Section

Commentary

a resting point that will not impede the flow of other pedestrians (Figure 3.3). Additionally, if sidewalks must be constructed on steep slopes, a wide sidewalk can be used to allow wheelchair users to travel in a zigzag motion to reduce the grade they must travel (see Illustration 3-e).

Illustration 3-e. Wheelchair Path on Steep Slopes.



Modified from Source: FHWA, 2001; Ref. 3

The maximum cross slope of 2% is based on Americans with Disabilities Act requirements (see Ref. 2).

When the ground surface is graded to within 1 inch of the sidewalk surface, grass and other vegetation often become a barrier to cross drainage, and cause the sidewalk to function as a drainage-way as shown in Illustration 3-e. This is counter to the desired effect of having the runoff filter through the grass for stormwater management benefit, and can result in ice build-up in the winter.

One alternative would be to create a drop-off of about 2 inches between the sidewalk surface and the adjacent ground surface. However, this could pose an ankle-twisting hazard to pedestrians walk-

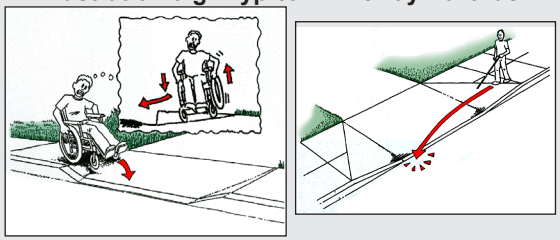
Commentary

ing close to the edge of the sidewalk. This risk is minimized for 5-foot wide and wider sidewalks. Therefore, a positive drop-off should only be used for sidewalks having widths of 5 feet or greater.

Illustration 3-f. Improper Sidewalk Drainage

Driveway ramps provide a means for vehicles to negotiate an elevation change between the street and the driveway. When the ramp for the motorist crosses the pedestrian's path of travel, significant cross slopes and changes in cross slope are created within the pedestrian area of sidewalks which can be hazardous to pedestrians with and without disabilities (see Illustration 3-e).

Illustration 3-g. Typical Driveway Hazards



a. Severe grade change

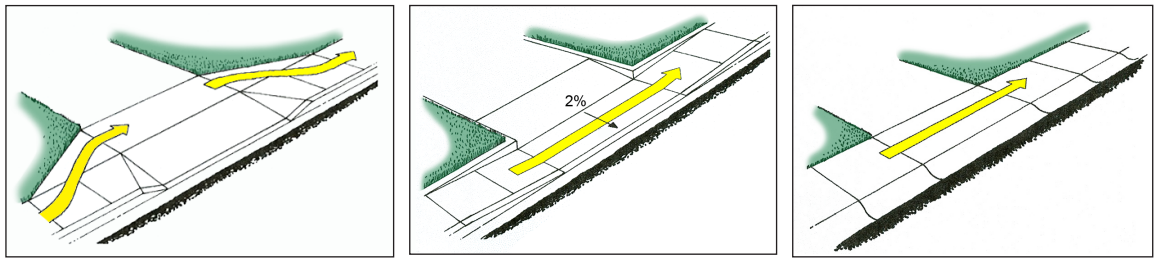
b. Hazard to visually impaired due to uneven walkway

Modified from Source: FHWA, 2001; Ref. 3

Recommended Standards

3.1.6 Driveway Crossings

Driveway crossings shall be designed such that the drivers and pedestrians can use them efficiently and safely. Sidewalk slopes in the vicinity of driveways shall not cause unsafe conditions for pedestrians, and shall meet requirements of the Americans with Disabilities Act. Sidewalk grade shall in no case exceed 8.33% (12 horizontal to 1 vertical). Sidewalk cross slopes shall not exceed 2%. Several acceptable designs are illustrated in Figure 3.5.



a. Jog Level Path

b. Ramp Sidewalk Down to Driveway

c. Rolled Curbs

Figure 3.5. Acceptable Driveway Crossing Designs Where Sidewalk Surface is Not Uneven

Modified from Source: FHWA, 2001; Ref. 3

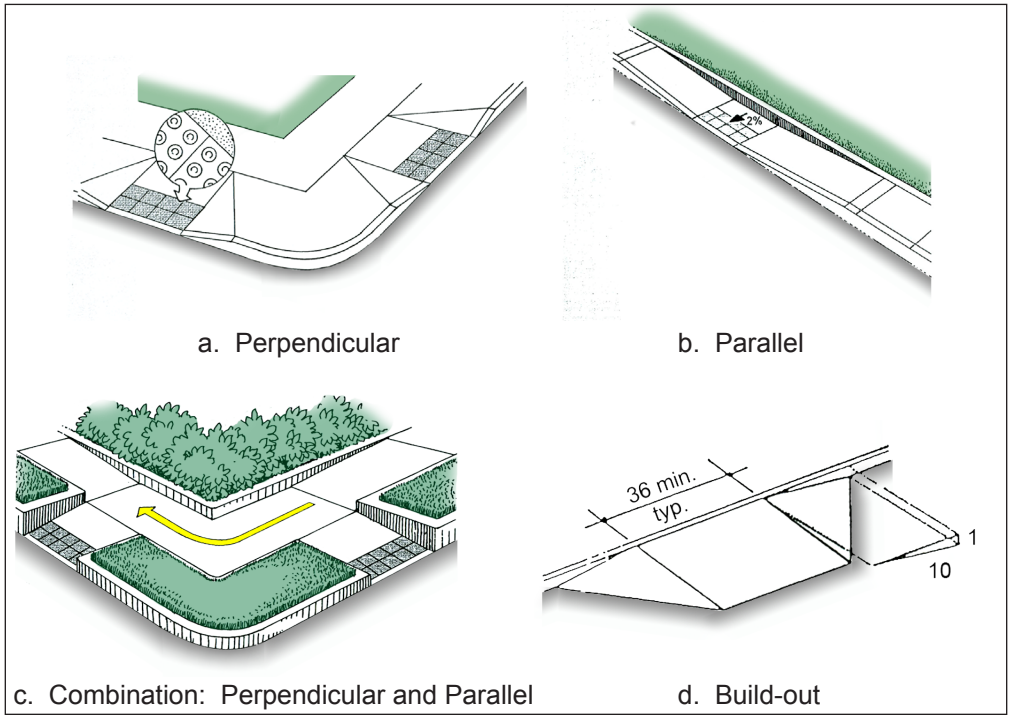
Recommended Standards

3.1.7 Curb Ramps

Curb ramps designed in accordance with the most recent revisions to the Americans with Dissabilities Act (ADA) guidelines shall be provided at all locations where sidewalk cross roadways (See Reference 2).

To help visually impaired people negotiate the change between curb and street when a ramp is present, surface material changes are required on the ramps. See 3.1.7.4 for details about “detectable warnings”.

3.1.7.1 Curb Ramp Location and Configuration: Curb ramps can be perpendicular to the curb, parallel to the curb, a combination of parallel and perpendicular, or built-up beyond the curb line. Figure 3.6 illustrates typical curb configurations.



a. Perpendicular b. Parallel

c. Combination: Perpendicular and Parallel d. Build-out

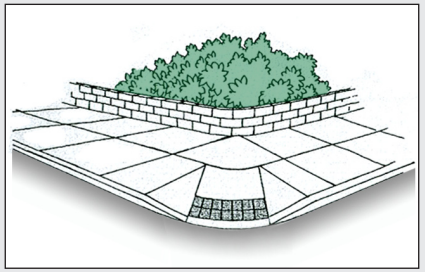
Figure 3.6. Curb Ramp Configurations
Modified from Source: FHWA, 2001; Ref. 3

Commentary

Curb ramps are critical to providing access between the sidewalk and the street for people who use wheelchairs, and would otherwise be excluded from the sidewalk due to the barrier created by the curb. However they can create major legibility barriers for people with vision impairments who rely on the curb to identify the transition point between the sidewalk and the street. Reference 3 provides a comprehensive coverage of the location and design of curb ramps.

Detailed information on each ramp configuration type identified in Figure 3.6 is provided in Reference 3.

Illustration 3-h. Unsafe Radial Curb Ramp



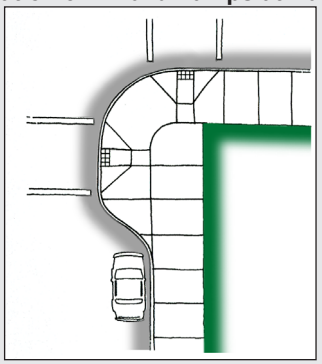
Modified from Source: FHWA, 2001; Ref. 3

The use of radial curb ramps may seem practical; however, they are not safe. Radial curb ramps direct pedestrians into the middle of the intersection, thus making it more difficult to safely negotiate to the other side, especially for visually impaired persons.

Where sidewalks are narrow or space is limited, bulb-outs can be used to extend the area for curb ramps as shown in Illustration 3-g.

Commentary

Illustration 3-i. Curb Ramps at Bulb-out



Modified from Source: FHWA, 2001; Ref. 3

These ramp grades are as reported under the Americans with Disabilities Act as specified in Reference 2.

Recommended Standards

3.1.7.2 Curb Ramp Design Grades: Curb ramps shall be constructed with a ramp grade less than or equal to 8.33% (12 horizontal to 1 vertical). Side flairs shall not exceed a slope of 10% (10 horizontal to 1 vertical) as long as there is a 4-foot clear distance parallel to the axis of the curb ramp at the top of the ramp. Otherwise, the maximum side flair slope shall be 8.33% (12 horizontal to 1 vertical). In addition, the cross slope on a ramp shall not exceed 2%. These design grades are illustrated in Figure 3.7.

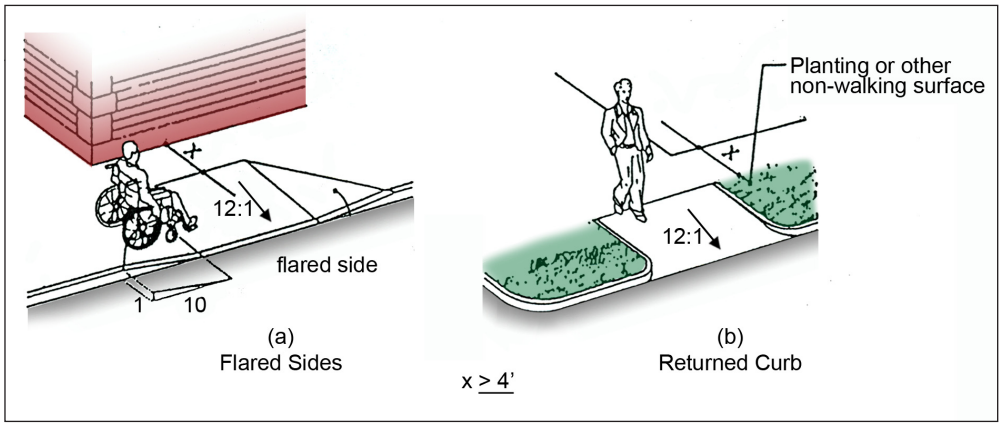


Figure 3.7. Curb ramp grades

Modified from Source: FHWA, 2001; Ref. 3

3.1.7.3 Recommended Curb Ramp Design Principles: The following design principles shall be applied to the design of curb ramps (adapted from Reference 3):

Recommended Standards	Commentary
• Provide a level maneuvering area or landing at the top of the ramp.	Landings are critical to allowing wheelchair users space to maneuver on or off of the ramp. In addition, pedestrians who are continuing along the sidewalk will not have to negotiate a surface with a changing grade or cross slope.
• Design ramp grades that are perpendicular to the curb.	Ramps to assist mobility are unstable if one side is lower than the other or if the full base of support (all four wheels on a wheelchair) are not in contact with the surface. This commonly occurs when the bottom of the curb ramp is not perpendicular to the curb.
• Place the curb ramp within the marked crosswalk area.	Pedestrians outside of the marked crosswalk are less likely to be seen by drivers because they are not in an expected location.
• Design the ramp so that it doesn't require turning or maneuvering on the ramp surface.	Maneuvering on a steep grade can be very hazardous for people with mobility impairments.
• Provide a curb ramp grade that can be easily distinguished from surrounding terrain; otherwise, use detectable warnings.	Gradual slopes make it difficult for people with vision impairments to detect the presence of a curb ramp.
• Design the ramp with a grade of approximately 7% + 1% (do not exceed 8.33% [12 horizontal to 1 vertical]).	Shallow grades are difficult for people with vision impairments to detect, but steep grades are difficult for those using assistive devices for mobility.
• Design the ramp and gutter-line with a cross slope equal to + 2%.	Ramps should have a minimum cross slope so users do not have to negotiate a steep grade and cross slope simultaneously.
• Provide adequate drainage to prevent the accumulation of water or debris on or at the bottom of the ramp.	Water, ice, or debris accumulation will decrease the slip resistance of the curb ramp surface.
• Transitions from ramps to gutter and streets shall be flush. Avoid lips and other sudden level changes adjacent to ramps.	Maneuvering over any vertical rise can cause wheelchair users to propel forward when wheels hit this barrier.
• Align the curb ramp with the crosswalk so there is a straight path of travel from the top of	Where curb ramps are aligned with the cross-walk,

Commentary

people using wheelchairs can build up momentum in the crosswalk in order to get up the curb ramp grade. This alignment is also useful for people with vision impairments.

Clearly defined edges assist users with vision impairments to identify the presence of the ramp.

Without a detectable warning, people with vision impairments may not be able to identify the boundary between the sidewalk and the street. Additional information on the design of detectable warnings can be found in Reference 4.

Asphalt and concrete are the most common surfaces for sidewalks. However, some sidewalks are designed using decorative materials such as brick or cobblestones. Although these surfaces may improve the aesthetic quality of the sidewalk, they may also create significant vibration for wheelchair users. These surfaces tend to buckle with freeze thaw cycles and can create a tripping hazard.

Recent research shows promise for a new sidewalk material made of recycled rubber from shredded vehicle tires. The material, which is hard and firm, appears to be more resilient than concrete and friendly to street trees and their roots. The freeze-thaw cycles of winter do not affect the material's performance. (Ref. 12)

Recommended Standards

the ramp to the center of the roadway to the curb ramp on the other side.

- Provide clearly defined and easily identified edges or transitions on both sides of the ramp to contrast with the sidewalk.

3.1.7.4 Detectable Warnings: Detectable warnings are textured surface features built in or applied to walking surfaces or other elements to warn visually impaired people of hazards on a circulation path. Detectable warnings should be placed at the boundary between the bottom of the curb ramp and the street, and shall be constructed as specified in the most current edition of Reference 4.

3.1.8 Surface Materials

Sidewalk surfaces shall be firm, stable, and slip resistant when dry. Acceptable surface materials include concrete, unit pavers, asphalt, stone, and brick. Materials, and material placement shall not result in any significant variation in surface elevation.

3.1.9 Sidewalk Details

Typical concrete and asphalt sidewalk details are illustrated in Figures 3.8 and 3.9, respectively.

Recommended Standards

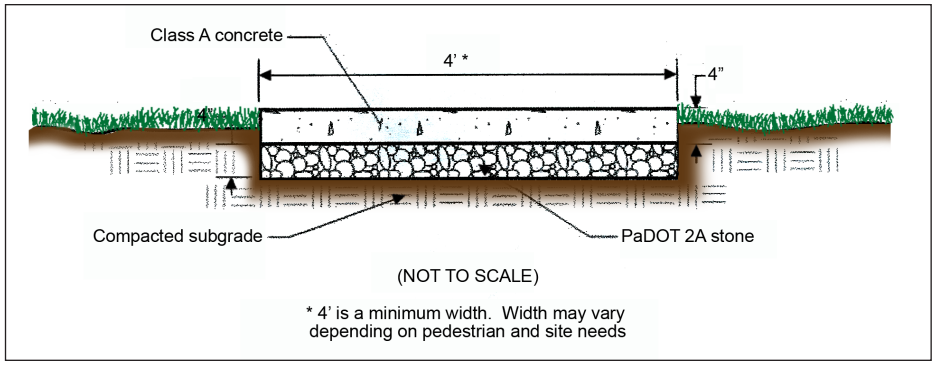


Figure 3.8. Concrete Sidewalk Detail

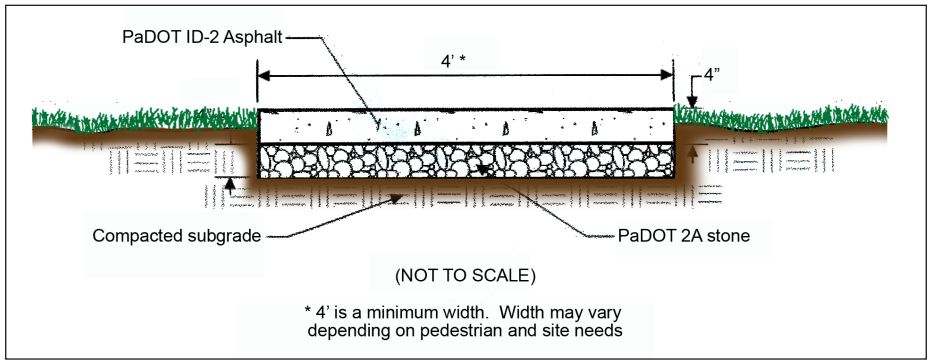


Figure 3.9. Asphalt Sidewalk Detail

3.2 TRAILS

Trails are joint pedestrian and bicycle circulation facilities that are typically physically separated from motor vehicular traffic by open space, a physical barrier, or both. In addition to serving as circulation facilities, trails often serve as recreational facilities supporting multiple exercise opportunities such as walking, bicycling, and skating. All shared-use trails and paths shall be designed to promote accessibility.

Trails are sub-classified by function into types: core circulation trails and minimum disturbance trails.

Commentary

Trails attract a variety of user groups who often have conflicting needs. The most significant conflict is the difference in travel speed between those walking, and bicyclists and in-line skaters. Conflicts are especially significant for people who cannot react quickly to hazards, such as those with mobility impairments. Designers and planners should be aware of potential conflicts between user groups and employ innovative solutions whenever possible. For example, provide appropriate pavement

Commentary

markings and signage, and ensure sufficient separation for users traveling at different speeds.

From a planning perspective, communities should consider development of an interconnected network of trails and pathways that would provide access among neighborhoods, commercial and business centers, and through maintained open space. (See Site Design Considerations, Ch. 1.)

Illustration 3-j. Overlook Summerset at Frick Park

Source: LaQuatra Bonci Associates, Michael Haritan (Ref.10)

The 5-foot buffer width specified is an absolute minimum separation; a greater width should be used whenever possible. Planting, existing or new, should also be used where possible to enhance the buffering effect. On curved streets site distance restrictions may limit the height of any buffer plant materials.

Buffering higher speed trail users from casual users

Recommended Standards

3.2.1 Core Circulation Trails

Core circulation trails are paved multi-purpose facilities whose primary function is to provide pedestrian interconnectivity between neighborhoods and other destinations. They are used primarily for walking and biking. These trails have the heaviest use. These trails could also be used for emergency access (see section 3.3.3).

3.2.1.1 Location

Core circulation trails should be located to provide pedestrian circulation through and between neighborhoods, and to other recreational and commercial destinations. Core circulation trails can also be used as a substitution for sidewalks to provide circulation routes parallel to residential collector streets.

Core circulation trails shall be located within public rights-of-way or easements to which access is not restricted.

Any trail identified on the official map of the municipality that crosses over or adjacent to the land included within the development proposal shall be designed and installed as a part of the infrastructure improvement for the development. The municipal approving authority may waive this requirement at their discretion.

3.2.1.2 Buffering

By definition, core circulation trails located adjacent to streets are to be buffered from motor vehicle traffic. This can be done through the use of vegetated buffers (see Figure 3.10) or physical barriers. A minimum buffer width of 5 feet shall be maintained between the street back of curb or edge of shoulder, and the near edge of the trail.

Recommended Standards

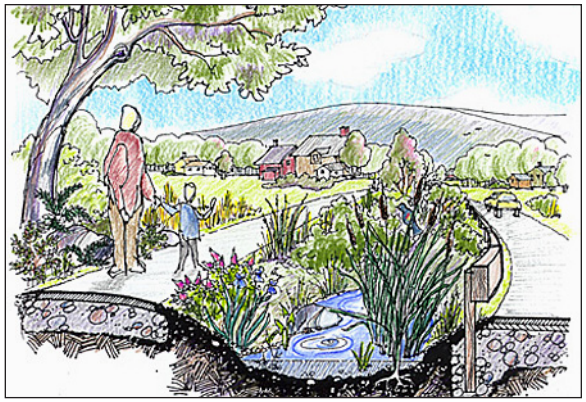


Figure 3.10. Trail Buffering
Source: LandStudies, Inc.

Circulation trails shall also be designed to safely accommodate both higher-speed and casual trail users. In areas where conflicts are anticipated, casual trail users shall be buffered from the higher-speed users. In both cases, adequate signage should be used to promote the desired separation.

3.2.1.3 Surface Materials

Core circulation trails shall have surfaces that are firm, stable, and slip resistant when dry. Acceptable surface materials include asphalt, concrete, crusher run stone, soil stabilizing agents mixed with native soils or other natural materials and aggregates. Material and material placement shall result in a smooth surface without significant variation in surface elevation.

Paved surfaces (asphalt or concrete) shall be used in areas that are subject to flooding or drainage problems, have steep terrain, or where bicyclists or in-line skaters will make up a significant percentage of users.

3.2.1.4 Width

The recommended minimum paved or stabilized width of a core circulation trail shall be 8 feet. In high-use urban areas widths of 12 foot to 14 foot are recommended. Core circulation trails shall also include a 2-foot graded shoulder on both sides of the stabilized path. (See details in Figures 3.16 and 3.17).

Commentary

can be accomplished through the use of different trail materials, trail separation, and clear signage. Illustration 3-k provide an example of user buffering.

Illustration 3-k. Trail User Separation

Surface material and condition significantly affect which user groups will be capable of negotiating the terrain. Core circulation trails that have been built using crushed aggregate generally are unusable by in-line skaters and slow the speed of bicyclists (which may be desirable in some instances).

Trail width is dependent on type and frequency of anticipated use. If limited use is anticipated, the width of core circulation trails may be reduced to 6 feet, however if it is to be a shared use trail, 10 feet might be a more appropriate width.

Commentary

Recommended Standards

Where buffering is used to separate casual trail users from higher-speed users, a minimum trail width of 5 feet shall be used on each side of the buffer. In high use urban areas, a 6- to 7-foot width is recommended.

3.2.1.5 Grade

Core circulation trails shall be designed to follow the natural terrain to the extent practical. Where possible, grades should be maintained at or below 5%. Steeper sections may be used to minimize the extent of site disturbance and grading. When designing steep segments of core circulation trails, the following segment length restrictions shall be followed:

These recommended grades and segment lengths are similar to those provided in Reference 5.

Less than 8% grades	No restriction on segment length
8% < grade < 10%	Max segment length = 300 ft.
10% < grade < 12.5%	Max segment length = 100 ft.
Greater than 12.5% grade	Max segment length = 50 ft.

3.2.1.6 Horizontal and Vertical Alignment

Bicyclists can maintain speeds in excess of 30 mph. Therefore, when bicyclists are anticipated to make up a significant percentage of users, more stringent vertical and horizontal geometric design standards must be met to ensure the safety of bicyclists and other trail users.

When bicyclists are anticipated to be significant users of the core circulation trail, curves for horizontal and vertical alignment shall be designed in accordance with the standards in the most current version of Reference 5.

3.2.1.7 Rest Areas

Periodic rest areas are beneficial for all core circulation trail users, and particularly for people with mobility impairments. Rest areas are especially crucial when grades exceed 8%. A typical rest area is shown in Illustration 3-g.

Rest areas along core circulation trails should be designed with the following characteristics:

- Maximum 5% grade parallel to path / trail.
- Maximum 2% cross slope on paved surfaces.
- Maximum 5% cross slope on unpaved surfaces.
- Width equal to or greater than trail segment leading to rest area.
- Minimum length of 5 feet if no amenities provided. Length must provide room for any amenities (benches, etc) plus 5 feet for wheel chair space.
- Change in grade from path / trail to rest area less than + 2%.

Recommended Standards

3.2.1.8 Cross slope and Drainage

Maximum cross slope for paved surfaces	2%
Maximum cross slope for unpaved surfaces	5%

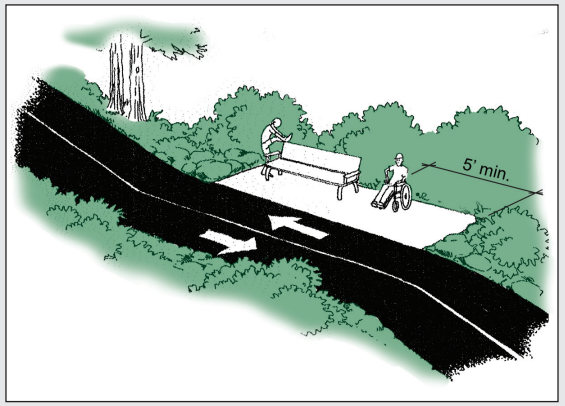
Standards from Reference 5.

To provide for drainage on trails with minimal cross slopes, the land surface on at least one side of the trail should be graded to be lower than the trail surface. When there is a natural surface cross slope from one side of the trail to the other, the pitch of the trail should be in the direction of the land cross slope so that sheet drainage from uphill can continue unobstructed downhill across the trail.

Side swales shall be used adjacent to trails when it is necessary to intercept uphill runoff before it crosses the trail. Excess runoff and runoff velocity can cause damage to trail surface materials, may be a nuisance or hazard to trail users (particularly resulting from snow melt and re-freeze in colder climates), or may result in the deposition of silt and debris from above onto the trail.

Commentary

Illustration 3-l. Typical Rest Area with 5' Minimum Landing for Wheelchair



Modified from Source: FHWA, 2001; Ref. 3

Severe cross slopes can make it difficult for wheelchair users and other pedestrians to maintain balance. The impact of cross slopes are compounded when combined with steep grades.

Typical examples of trail cross slope and drainage are illustrated below:

Illustration 3-m. Slight Trail Cross slope

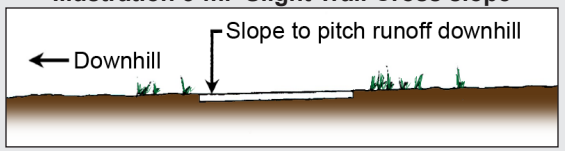
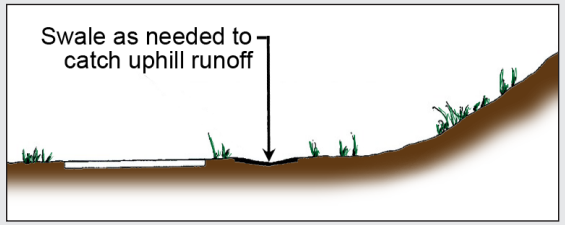


Illustration 3-n. Interception Swale Adjacent to Trail



Commentary

Illustration 3-o. Stop Sign Where Trail Intersects Street

Recommended Standards

3.2.1.9 Intersections

To avoid conflicts at intersections, the following guidelines should be followed (all from Reference 8):

- Design intersection geometry as close to a "T" or "+" as possible;
- Use 8-foot corner radii;

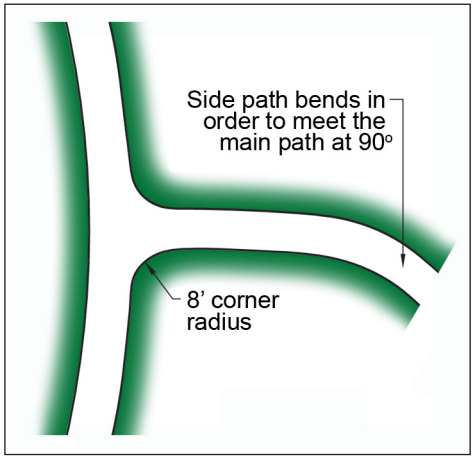


Figure 3.11. "T" Intersection

- To avoid cross traffic conflicts on high use trails, off-set 4-way intersections and create two "T" intersections;

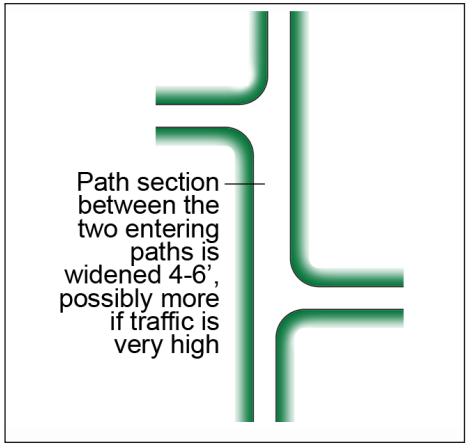


Figure 3.12 Off-Set Intersections

- Provide adequate directional and traffic control signage;
- Avoid confusing and complex intersections;

Recommended Standards

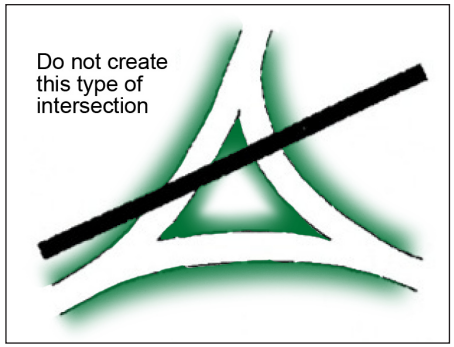


Figure 3.13. No Confusing Intersections

- For user safety and comfort, adequate sight lines should be provided;

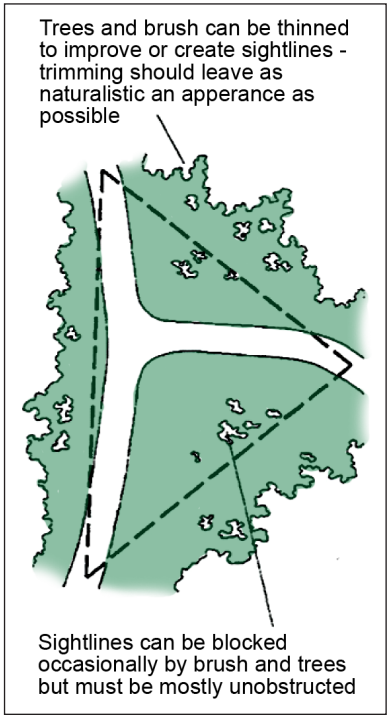


Figure 3.14. Typical Sight Lines

Commentary

Commentary

Illustration 3-p. Picture of Flooding Signage

Illustration 3-q. Picture of Mileage Signage

Recommended Standards

3.2.1.10 Signs

All trails shall include adequate regulatory and informational signs.

All regulatory signs shall conform to the proposed standards for bicycle signs in the *Manual on Uniform Traffic Control Devices* (Ref. 9), and shall be placed as illustrated in Figure 3.15.

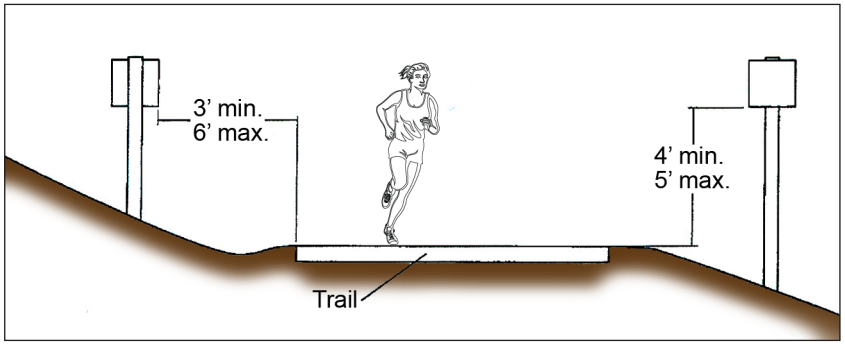


Figure 3.15. Trail Sign Location
Modified from Source: the Manual on Uniform Traffic Control Devices, Ref. 11

Typical regulatory signs include:

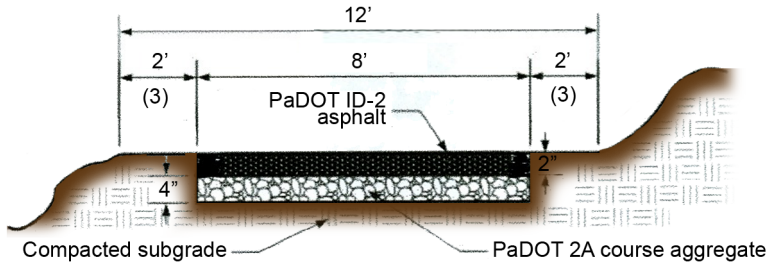
- Stop, yield, and stop ahead warnings;
- Unexpected or hazardous conditions warnings;
- Turn and curve warnings;
- Intersection signs; and
- Purpose and restricted usage signs.

Informational signs may be placed at trailheads and other appropriate locations along trails. Typical informational signs would include trail head identification, mileage indicators, signs identifying features of special interest along the trail, etc.

3.2.1.11 Trail Details

Typical core circulation trail details are illustrated in Figures 3.16 and 3.17.

Recommended Standards



(NOT TO SCALE)

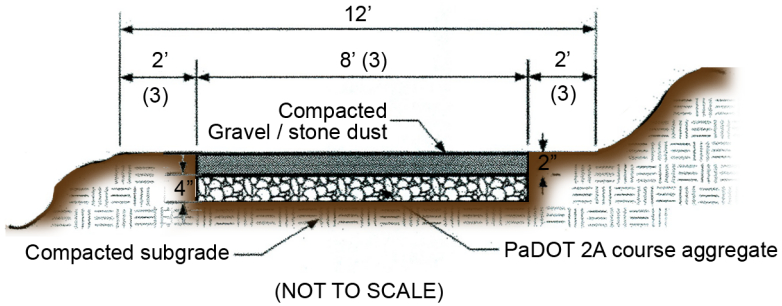
NOTES:

(1) Standard width 8’. If heavy usage is anticipated then greater width may be required. For limited use trails, narrow width may be acceptable

(2) Suitable for bike and pedestrian use

(3) Provide 2’ graded shoulder

Figure 3.16 Core Circulation Trail Section, Asphalt Surface



(NOT TO SCALE)

NOTES:

(1) Suitable for equestrian use; all-terrain (mountain) bicycle use and hiking.

(2) Susceptible to wash-out on slopes greater than 5%

(3) Stabilized surface width to be based on anticipated usage

Figure 3.17 Core Circulation Trail Section, Crusher Run Gravel Surface

3.2.2 Minimum Disturbance Trails

Minimum disturbance trails are intended to provide recreational opportunities and access to

Commentary

Commentary

Illustration 3-r. Soft Trail Surface

Recommended Standards

unique site features while producing a minimal impact on the landscape. Typically, examples include nature trails, recreational trails, and trails to specific points of interest (historic, scenic, etc.). Figure 3.18 illustrates a typical example.

Figure 3.18. Scenic Overlook on Tudek Park Trail

3.2.2.1 Location

Minimum disturbance trails shall be located in public rights-of-way or in unrestricted easements within the development. The minimum easement width should be 10 feet. All residents shall have equal right to gain access to these trails.

3.2.2.2 Surface Materials

The trail surface material shall provide a stable surface for its intended use, keeping in mind the desire to minimize the amount of land disturbance. Typical trail surfaces materials would include grass, stabilized grass, compacted gravel, wood chips, etc. Adequate drainage should be provided under the selected surface to minimize rutting and other damage during wet periods.

Recommended Standards

3.2.2.3 Design Standards

Specific design standards for width, grade, cross slope, horizontal alignment, etc., will depend on the specific purpose of the trail and the desire for minimum land disturbance. Sections of a trail may be stepped or terraced to accommodate natural terrain. Trail design must consider anticipated trail use and wear. The design shall include adequate temporary and permanent erosion and sedimentation control, and drainage measures.

3.2.2.4 Intersections and Signage

Intersection and signage shall be as identified in sections 3.2.1.9 and 3.2.1.10.

3.2.2.5 Rest Areas

Rest areas should be provided at regular intervals along minimum disturbance trails. In particular, opportunities for rest should be provided where terrain is moderate to steep.

Commentary

Minimum impact trails are typically designed to provide access to open space and greenways within a municipality. It can be anticipated that they will be used for walking, jogging, mountain biking, and x-country skiing.

Minimum disturbance trails should be designed to follow natural terrain and fit with the existing landscape. Reference 8 provides excellent guidance on the design of minimum disturbance trails. It is not intended that all minimum disturbance trails be handicapped accessible.

Illustration 3-s. Minimum Disturbance Trail

Rest areas should include some form of seating and trash receptacles. Rustic benches and container enclosures made of wood should be considered.

Most bicycle travel in Pennsylvania now occurs on streets and highways without striped bike lanes. In many instances streets are safe and efficient for bicycle travel that do not have signing and striping. However, delineation of bicycle lanes along roadways provides for more predictable movements

Commentary

by both bicyclists and motorists, enhancing bicycle safety within the corridor. Due to their low traffic volume, striped bike lanes will typically not be necessary along residential access streets.

Width standards were compiled from Reference 5.

Bike lane configurations shown in Figure 3.19 would be typical of residential collectors.

Bike lane configurations shown in Figure 3.20 are typical of residential mixed-use collectors.

Recommended Standards

3.3 BIKE LANES

Delineated bike lanes should be considered along residential collector and residential / mixed use collector roadways where significant bicycle demand is anticipated, and where delineation of bicycle lanes will enhance the safety of bicyclists.

Bike lanes shall be one-way facilities; two-way bike lanes along the same side of the roadway are not permitted unless they are designed as shared-use paths / trails.

3.3.1 Width

Typical bike lane widths and configurations are illustrated in Figures 3.19 and 3.20.

Figure 3.19 illustrates bike lanes along streets where parking is prohibited. As indicated, if no curb exists, the minimum bike lane width shall be 4 feet. If the roadway is curbed, the minimum bike lane width shall be 5 feet to accommodate drainage along the gutter line.

Figure 3.20 illustrates bike lanes along streets where parking is permitted. As indicated, the minimum width bike lane shall be 5 feet for cases in which a parking lane exists.

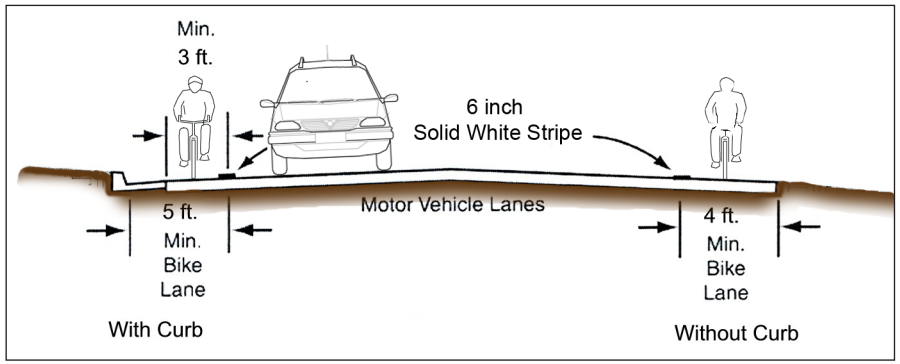


Figure 3.19. Bicycle Lanes Along Streets Where Parking is Not Permitted
Modified from Source: Task Force on Geometric Design, Ref

Recommended Standards

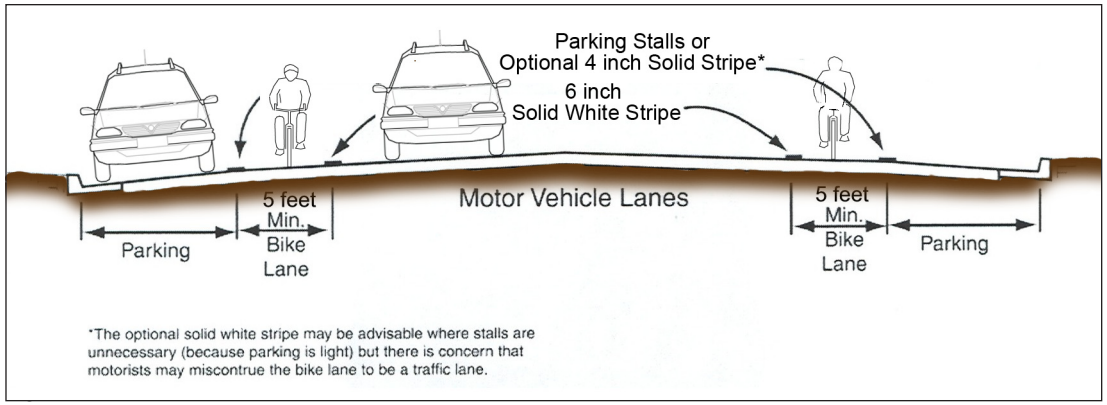


Figure 3.20. Bicycle Lanes Along Streets With Parking Lanes
Modified from Source: Task Force on Geometric Design, Ref. 5

3.3.2 Pavement Markings

Bike lanes require standard markings as illustrated in Figure 3.21.

Commentary

Commentary

Recommended Standards

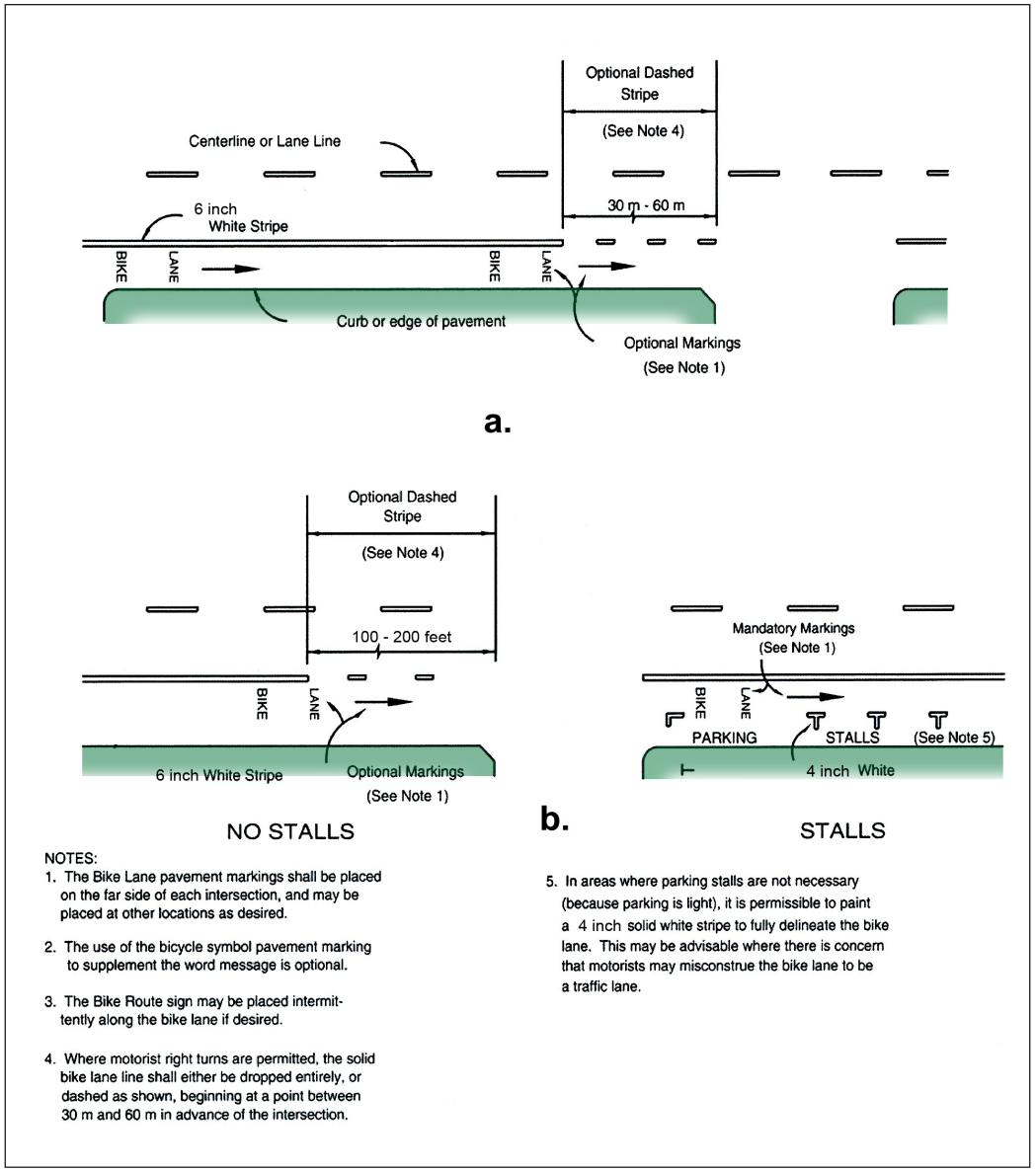


Figure 3.21. Bicycle Lane Pavement Markings; a. Residential Collectors (no parking) b. Residential / Mixed Use Collectors (Parking Permitted)

Modified from Source: Task Force on Geometric Design, Ref. 5

Recommended Standards

3.3.3 Emergency Access Walkways/Trails

a. Walkways that accommodate fire vehicles may be permitted in extreme or unusual cases and are subject to approval.

b. Newly constructed overhead obstructions at a roadway or fire walkway must have a minimum of fifteen (15)-feet clearance in order for a fire vehicle to pass safely underneath.

c. Fire walkways must be a minimum of twelve (12)-feet wide and designed to withstand the weight of a fire vehicle (twenty [20] tons minimum).

d. Fire walkways shall be linked to the roadways by means of a curb cut and ramp to the elevation of any fire walk or drive. Grades on fire walkways or fire lanes shall not exceed 10%.

e. Provisions shall be made to ensure access to the fire walkways. No parking shall be permitted within fifteen (15) feet of access to fire walkways. A chain shall be placed across the entrance to the fire land or walkway, of one-fourth (1/4)-inch noncase hardened steel. The location of the chain shall be approved by the Fire Marshal.

Commentary

References

References

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