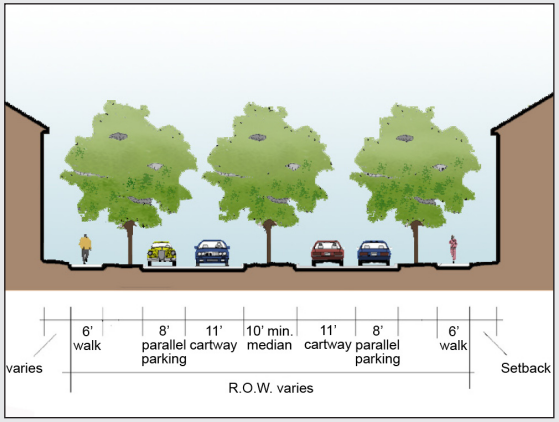
CHAPTER 2:
STREET STANDARDS



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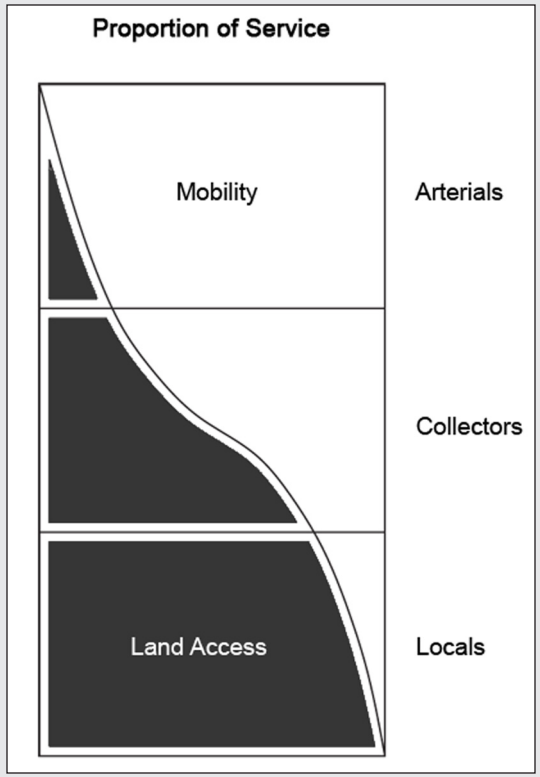


Source: AASHTO (Ref. 1)

Land access refers to entering and exiting individual properties. While this diagram refers to the importance of vehicular access over vehicular mobility, in a local street setting, individual properties are also accessed by those on foot; therefore, the pedestrian mode of access is also of importance when designing local streets.

Recommended Standards

2.0 OVERVIEW

Federal and state transportation agencies categorize streets by function into three classes: locals, collectors, and arterials. As illustrated in Illustration 2-a, this classification scheme is characterized by a continuum in function between land access and mobility. Most, if not all, subdivision streets in Pennsylvania can be classified as local or lower-end collector streets. As such, these streets are a subset of the traditional Department of Transportation classification system.

This chapter provides standards for residential streets. In the context of this document, residential street classification and standards encompass both pure residential land uses, and a mix of residential and community-serving commercial land uses. Safe residential streets are attained by specifying street geometries that discourage excessive speeds, emphasize access, and minimize conflicts between pedestrian and vehicular movements.

The recommended standards presented in this chapter assist with meeting the goal of providing safe residential streets. Recognizing the many sub-classifications possible for residential streets, the American Association of State Highway and Transportation Officials (AASHTO) recommends (as a first step in the design process) that each street be defined in terms of its specific function within the community (Ref. 1, Page 13). Section 2.2 of this chapter presents a street classification system which meets the functional requirements of municipal streets in Pennsylvania. Section 2.3 provides general street and parking design guidance, and sections 2.4 through 2.9 provide specific geometric and other design standards for each class of residential street. Section 2.10 and the Appendix contain a series of typical construction details for street design and construction.

The overriding goal of this chapter is to provide standards that not only meet the need for safe and efficient movement of vehicles and pedestrians, but also minimize environmental impacts, and construction and maintenance costs.

Recommended Standards

Commentary

2.1 PURPOSE AND STRATEGY

2.1.1 Purpose

The primary purpose of residential and mixed-use streets is to provide local access to individual properties. These streets may also function as collectors to distribute traffic having an origin or destination at a residential or community-commercial / business property to a higher-level collector or arterial. Residential streets shall promote:

a. safe and efficient movement of vehicular, pedestrian and bicycle traffic;

b. cost efficiency that takes into consideration land use, construction, and future maintenance; and

c. environmental stewardship and sustainability by minimizing adverse impacts on the natural environment.

Residential streets are commonly used for purposes other than efficient traffic movement. The design of residential and mixed-use streets must consider and balance community needs, including lot access, visual aesthetics, parking, drainage, utility access, pedestrian and bicycle circulation, emergency access, and maintenance. Above all, since these are streets where epople live, creating a safe environment for pedestrians, as well as vehicle circulation, is critical.

2.1.2 Strategy

The design and planning of residential and mixed-use streets shall:

a. use the functional classification system presented in Section 2.2;

b. follow the natural contours of the land and preserve natural features whenever practical;

c. minimize traffic speed and volume, noise, congestion, and hazards to pedestrians;

d. minimize the amount of paved area; and

e. provide an affordable and maintainable street system that serves the residents in the community.

Pursuing strategy “b” may mean departing from strict compliance with the street grade standards in sections 2.4.7, 2.5.8, 2.6.7, and 2.7.1. The intent of any such variance will be to minimize site impacts and preserve natural site features while maintaining a safe street.

Strategy “d” will minimize stormwater run-off impacts and reduce construction and maintenance costs.

The intent of strategy “e” is to promote appropriate street widths (travel-way and parking lane) to meet, but not exceed, community needs.

2.2 FUNCTIONAL CLASSIFICATION SYSTEM

Residential streets provide a variety of functions within residential neighborhoods. Each street within a residential neighborhood shall be designed to reflect the overall purpose it is intended to serve. Proposed or existing streets shall be classified according to their function. The function of the street shall provide the basis for residential street design.

The following classification systems shall be used to identify street function.

The residential street classifications include:

Different types of residential streets have different characteristics with regard to density of residences and land use. Consequently, a single design for a typical residential street is not practical. A functional classification system differentiates between the various types of residential streets in order to provide a design that best meets the needs of the community.

Commentary

The American Association of State Transportation Officials (AASTO) presents street classification as a hierarchy of movements beginning with the "main movement" defined by the highest volume streets. The functional classification system presented here is presented from a residential access perspective, moving from the lowest classification of street which provides individual lot access, to higher classifications with greater emphasis on mobility and efficiency of traffic movement.

The traffic volume limits used throughout this document are based on a measure of average daily traffic (ADT). Average Daily Traffic (ADT) is defined by AASHTO (Ref. 1) as the total volume of traffic on a street during a given time period (in whole numbers of days), greater than one day and less than one year, divided by the number of days in the time period. ADT is a count of all traffic on a street (in both directions) for the given time period. This unit of measure is consistent with the Institute of Transportation Engineers trip generation rates. Trip generation is measured as the total number of trip ends (origin or destination) measured at a particular driveway. For residential street design purposes, ADT is assumed to be based on trip generation rates (trip ends per day or trips per day [TPD]) as defined in the most current version of *The Trip Generation Handbook*, Institute of Transportation Engineers (Ref. 10).

Residential Access Streets normally serve only those residences located on that street or within the immediate neighborhood. Traffic volumes are low; therefore, a street can be designed that is not excessive and that meets the needs of the community within a reasonable footprint. Typical residential access streets are illustrated below:

Recommended Standards

- Residential access streets
- Residential Collectors
- Residential mixed-use collectors
- Special use streets (alleys, divided streets, and stub streets)

Non-residential street classifications include:

- Commercial / industrial access streets
- Municipal Collectors
- Municipal Arterials

The recommended standards provided in this chapter are provided for residential street classifications.

Streets classifications are based on average daily traffic (ADT) volume. Estimated ADT is to be based on trip generation rates in trips per day (TPD) as defined in Section 2.3.13. A trip distribution analysis will be required to determine each streets usage within a residential development to assure that appropriate design standards are met.

2.2.1 Residential Access Streets

Residential access streets provide direct access to individual residential properties abutting that street. They carry traffic that has its destination or origin on that street or from within the local neighborhood.

Recommended Standards

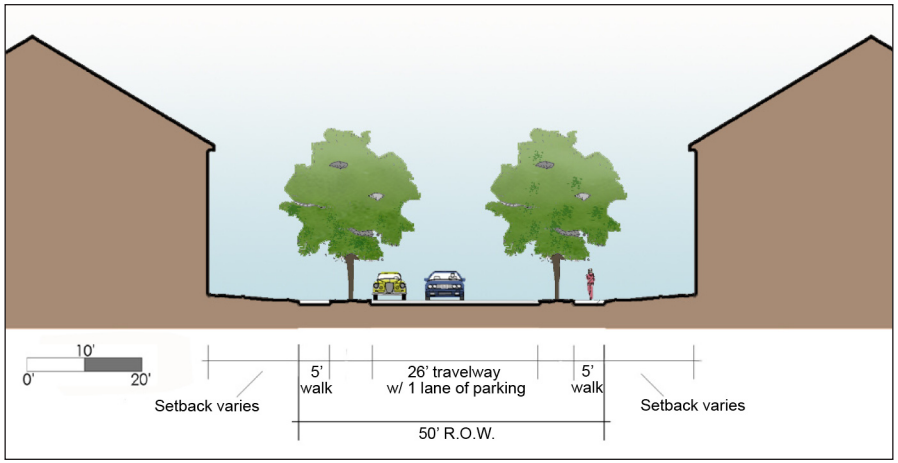


Figure 2.1. Residential Access
Modified from Source: The Hamer Center for Community Design Assistance (Ref. 2)

Residential access streets play a significant role in defining the character of neighborhoods. Residences along these streets also serve as the origin and destination for non-motorized circulation (walking or cycling). These streets should therefore be designed to be pedestrian- and bicycle-friendly (Figure 2.1).

Residential access streets offer levels of service commensurate with low design speeds and short vehicular trip routes. Through traffic is discouraged on these streets. Reflecting neighborhood character and creating a pedestrian-friendly environment is of higher importance than vehicular mobility.

2.2.1.1 Traffic Volume -- Residential Access Street

Limiting traffic volumes for each residential access street class are tabulated in Table 2-1. Traffic volumes shall be computed using trip generation rates provided in Table 2-8.

Table 2-1. Residential Access Street Limiting Traffic Volumes

Street Class	Limiting Traffic Volume (ADT)
RA-A	
Single Access	300
Multiple Access	800
RA-B	1600

Commentary

Illustration 2-b.

Eagle View Subdivision, Chester County
Source: The Hamer Center for Community Design Assistance (Ref. 2)

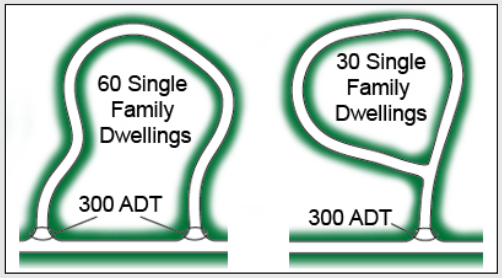
Greyhampton Subdivision, Centre County

The traffic volume limits for residential access streets are based on the standards in Residential Streets (Ref. 5). This document was developed through a partnership among the National Association of Home Builders, the American Society of Civil Engineers, the Institute of Transportation Engineers, and the Urban Land Institute. These standards are not based on specific research; rather, they represent a consensus that reflects the experience and judgment of these organizations.

Commentary

Illustration 2-c compares a residential street with two access points with a loop street. The loop street only has one point of connection with a higher-order street. The number of single-family dwellings indicated is based on a trip generation rate of 10 trips per day, as tabulated in Table 2-8.

Illustration 2-c. Street Access Points



Modified from Source: Bucks County Planning Commission (Ref. 4)

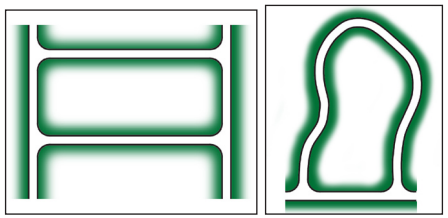
The limiting traffic volume for single access streets is based on Appendix D of the International Fire Code (Reference 19).

Limiting traffic volumes for single-access streets are based on a desire to minimize the risk of any one residence being cut-off from emergency services in the event the street is blocked, while at the same time recognizing these street types as valuable and viable development and planning options. The traffic limit for self-looping streets is 50% greater than that for cul-de-sacs because the residents in the loop can exit the loop in either direction.

Residential collectors may take a number of forms. Illustration 2-d shows a residential collector connecting development, and Illustration 2-e shows a residential collector in a more interconnected grid pattern.

Recommended Standards

Streets connected at both ends are “through streets” (Figure 2.2).

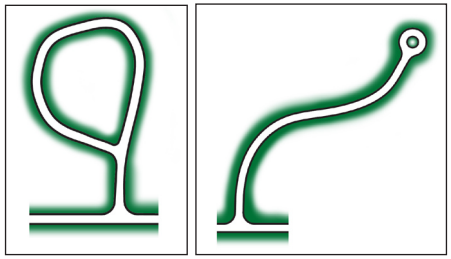


Straight Loop

Figure 2.2. Through Streets

Modified from Source: Bucks County Planning Commission (Ref. 4)

Single access streets (self-looping streets and cul-de-sacs) are a sub-classification of residential access streets that have only one access point. Self-looping streets and cul-de-sacs are limited to an average daily traffic volume (ADT) of 300 trips per day. See Figure 2.3.



Self-Looping Cul-de-sac

Figure 2.3. Single Access Streets

Modified from Source: Bucks County Planning Commission (Ref. 4)

Design standards for residential access streets are provided in Section 2.4.

2.2.2 Residential Collectors

Residential collectors provide mobility out of residential neighborhoods and serve to link residential access streets and / or entrances to multi-family residential complexes. Their primary function is to collect and distribute residential traffic to collectors and other higher-level streets. They may include some limited individual lot and driveway access although such access, is discouraged.

Recommended Standards

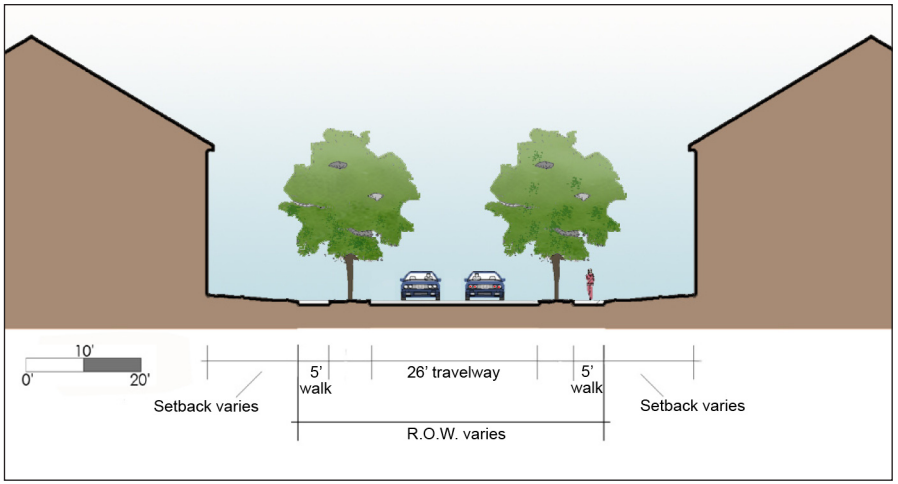


Figure 2.4. Residential Collector
Modified from Source: The Hamer Center for Community Design Assistance (Ref. 2)

Neighborhood character shall be of equal importance to vehicular mobility in the design of residential collectors. Within these corridors bicycle and pedestrian movements are secondary to vehicular movements. However, it is recommended that bicycle and pedestrian facilities be included within these corridors, and that appropriate separation and buffering be provided to avoid conflicts. See chapter 3 for more details.

Commentary

Illustration 2-d. Collector Connects Developments

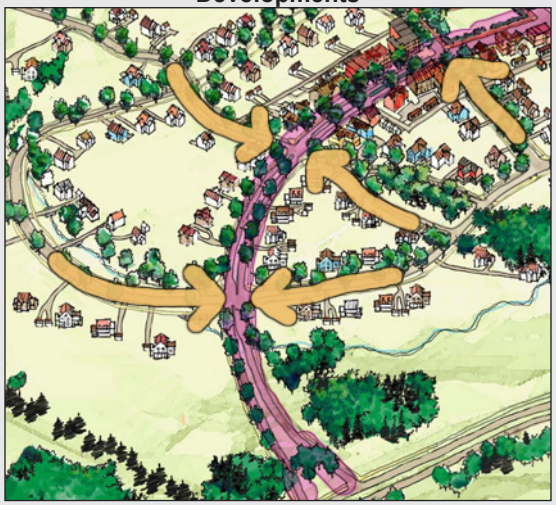
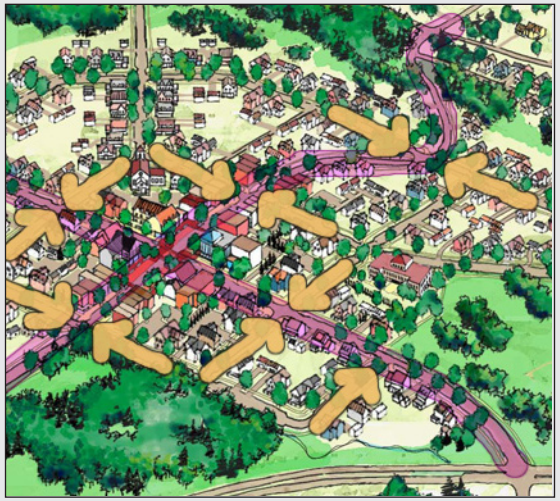


Illustration 2-e. Collector in Grid Setting



In many cases, streets functioning as collectors in developments built before the adoption of this standard were designed with continuous lot frontage and on-street parking. For this reason, lot frontage

Commentary

and parking are not restricted when defining streets existing at the time of the adoption of this standard.

Parking is restricted on residential collectors to promote mobility and minimize pedestrian conflicts. This requirement may be waived along portions of the corridor to meet special needs such as community facilities, ballfields, etc. Other than these exceptions, parking along these streets should be discouraged.

The authors are unaware of any other street classification scheme that includes a purely residential collector. Collectors are typically considered to carry traffic from multiple sources with no upper limit on traffic loading. As defined here, a residential collector is intended to be part of a residential neighborhood. The upper limit provided is based on the need to limit the size of streets within strictly residential neighborhoods for health and safety reasons. Higher traffic loads should be limited to Municipal collectors or higher-level streets.

The maximum Average Daily Trips (ADT) of 3,000 vehicle trips is established to minimize conflicts due to the number of turning movements onto and off residential collector streets.

Residential mixed-use collectors can take on distinctly different characteristics depending on the neighborhood type and development style.

Recommended Standards

2.2.2.1 Traffic Volume - Residential Collectors

Residential collectors shall be limited to an average daily traffic volume (ADT) of 3,000. If the anticipated traffic volume exceeds this value, the street shall be classified as a street of higher order and PennDOT standards shall be used.

Design standards for residential collectors are provided in section 2.5.

2.2.3 Residential Mixed-Use Collectors

Residential mixed-use collectors provide access to a mix of residential and neighborhood commercial uses. They also serve as residential collectors, and connectors between residential neighborhoods and higher-order streets. In the design of residential mixed-use collectors, reflecting neighborhood character is of equal importance to mobility.

Recommended Standards

Figure 2.5. Two Sided Parking
Modified from Source: The Hamer Center for Community Design Assistance (Ref. 2)

Residential dwellings along mixed-use collectors typically include quad houses, townhouses, or multi-family units that are accessed through off-street parking lots, alleys, or shared entry-ways. Access to driveways of individual dwelling units should be discouraged on mixed-use collectors.

On-street parking may be used for access to neighborhood commercial properties, and to accommodate spill-over parking for residential properties.

Mixed-use collectors may also serve as origin and destination nodes for pedestrians and cyclists. Pedestrian and bicycle access needs shall be accommodated along these street corridors.

2.2.3.1 Traffic Volume -- Residential Mixed-Use Collector

Residential mixed-use collectors are limited to an average traffic volume of 2,000 ADT. If the anticipated traffic volume exceeds this value, the street shall be classified as a street of higher-order, and the design shall be based on PennDOT standards.

Design standards for this street classification are provided in section 2.6.

2.2.4 Special Use Streets

Special use streets include alleys and divided streets and stub streets.

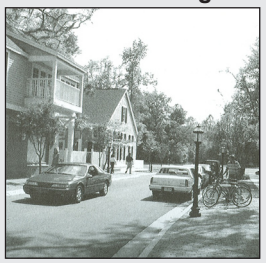
2.2.4.1 Alley: Alleys provide rear-lot access to abutting properties. To discourage through traffic and parking, they are intentionally narrow. They can provide the primary vehicular access to a property or serve as secondary access. Where appropriate, ancillary units such as garage

Commentary

Illustration 2-f.

First floor retail with offices and/or residences above.

Illustration 2-g.



Mixture of different housing types.
Source: The Hamer Center for Community Design Assistance (Ref. 2)

Uses along residential / mixed-use collectors serve as origins and destinations not only for vehicles, but also for pedestrians and bicycles. The maximum average daily traffic volume of 2,000 vehicle trips recognizes the collector characteristics of these streets, and also the need to minimize conflicts among pedestrians, bicycles, and vehicles.

As a primary vehicular access, alleys enable properties to have an unencumbered public front facing

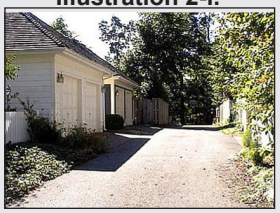
Commentary

the street by eliminating the need for driveways. Alleys were used frequently in older villages in Pennsylvania, as shown here at the left below.

Illustration 2-h.

Alley in a historic village (Boalsburg, PA) Source: The Hamer Center for Community Design Assistance (Ref. 2)

Illustration 2-i.



Alley in newer development (Kentlands, MD) Source: The Hamer Center for Community Design Assistance (Ref. 2)

The use of alleys can create an ordered, pedestrian-scaled front to a property by permitting service and maintenance functions in less visible locations. Modern use of alleys is illustrated above, right.

Divided streets are used to create community character and provide esthetic value. They can also be used to split traffic around and preserve existing significant natural features.

Illustration 2-j.

Typical Parkway

Illustration 2-k.

Typical Boulevard

Source: The Hamer Center for Community Design Assistance (Ref. 2)

Recommended Standards

convertions and in-law units face directly onto an alley.

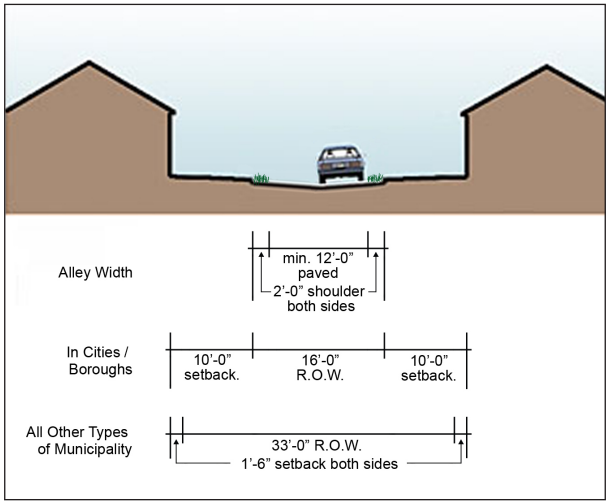


Figure 2.6. Alley Widths
Modified from Source: The Hamer Center for Community Design Assistance (Ref. 2)

2.2.4.2 Divided Streets: Divided streets are residential collectors or residential mixed-use collectors with a planted or natural median that separates opposing traffic lanes.

There is no limiting traffic volume for divided streets. However, if the average traffic volume exceeds 3,000 ADT, the street horizontal and vertical geometry shall be designed based on PennDOT standards for collector streets.

Recommended Standards

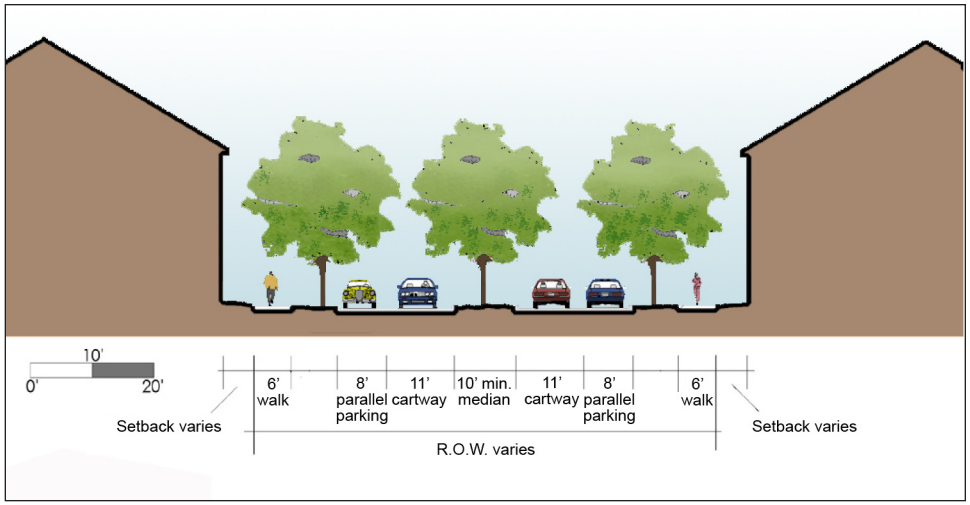


Figure 2.7. Boulevard with Parking
Source: The Hamer Center for Community Design Assistance (Ref. 2)

a. *Parkway* – A divided street with no parking, often uncurbed, with limited or no direct lot access. Parkways are typically more rural in nature, and median width may vary along its length to accommodate natural features.

b. *Boulevard* - A divided street, often curbed, where parking is permitted along its length at designated locations, or secondary access streets that run parallel to boulevard cartway. Some direct lot access is permitted. Boulevards are typically more urban in nature.

2.2.4.3 Stub Streets: A stub street is a portion of a street constructed as a part of a development or development phase that is to be extended when the adjacent property is developed. Stub streets are permitted in the following cases:

a. *Residential access, collector, and residential mixed-use collector streets* may be constructed as stub streets within subsections of a phased development for which the proposed street extension has been approved as part of the development masterplan.

b. *Residential collector and mixed-use collector streets* may also be constructed as stub streets to adjoining properties not included in the development plan if the future extension of the street is anticipated or planned.

Commentary

The creation of stub streets provides an opportunity for interconnection of neighborhoods which has many advantages. It provides more direct routes between local destinations and eliminates the need to funnel traffic of local origin and destination onto higher-volume streets; encourages pedestrian and bicycle travel to local destinations; and provides efficiency in school bus routing, transit services, emergency access, and municipal services of all kinds. In addition, interconnectivity of neighborhoods encourages development of community commercial uses within neighborhoods and promotes

Commentary

more of a community or small-town atmosphere.

Many municipalities own and maintain non-residential streets. Non-residential street definitions are provided here for the sake of clarity. However, design standards for these street types are not provided in this document.

These streets typically serve the lots in industrial or business parks.

Existing streets should be classified based on function and traffic volume. Existing streets do not need to meet design standards for the particular classification of streets outlined here.

Traffic patterns are used to control traffic movement and speed. Slow and yield-flow patterns are used along residential access streets to minimize traffic speed and pedestrian-vehicle conflicts.

Recommended Standards

2.2.5 Non-Residential Streets

Streets that do not provide access to residential or community-serving commercial properties.

2.2.5.1 Commercial / Industrial Access Streets: Commercial / industrial access streets provide direct access to commercial / industrial properties abutting that street. They carry traffic that is commercial in nature, and has its destination or origin on that street or from within the local industrial / commercial area.

2.2.5.2 Municipal Collector: Municipal collector streets function primarily to provide mobility between communities and business centers; they link important traffic generators within the municipality. They also provide land access for strip business and commercial centers and provide direct links to higher-order, state-owned streets.

Municipal collector streets should be designed in accordance with standards for PennDOT collector and arterial streets.

2.2.6 Existing Streets

Each existing street abutting or affecting the design of a subdivision or land development shall be classified according to its function, design, and use by the municipality at the request of the applicant, or during plan review. The classification of existing streets shall take into account the hierarchy outlined in this section, and may also include higher orders as determined by the municipality.

2.3 GENERAL DESIGN STANDARDS

2.3.1 Traffic Patterns

The street standards presented here are shown in the traffic flow patterns illustrated in Figure 2.8, and described below:

Recommended Standards

Free-flow: Free-flow traffic requires a unique lane for traffic moving in each direction. Free-flow streets shall have a marked center line.

Slow-flow: Slow-flow traffic occurs when parked vehicles and / or constricted lane widths restrict the passing space available to vehicles moving in opposite directions. Slow-flow streets shall not have a marked centerline except in the vicinity of intersections.

Yield-flow: Yield-flow occurs when two-way traffic is impossible when parked vehicles are present. Yield-flow streets should not have a marked centerline except in the vicinity of intersections.

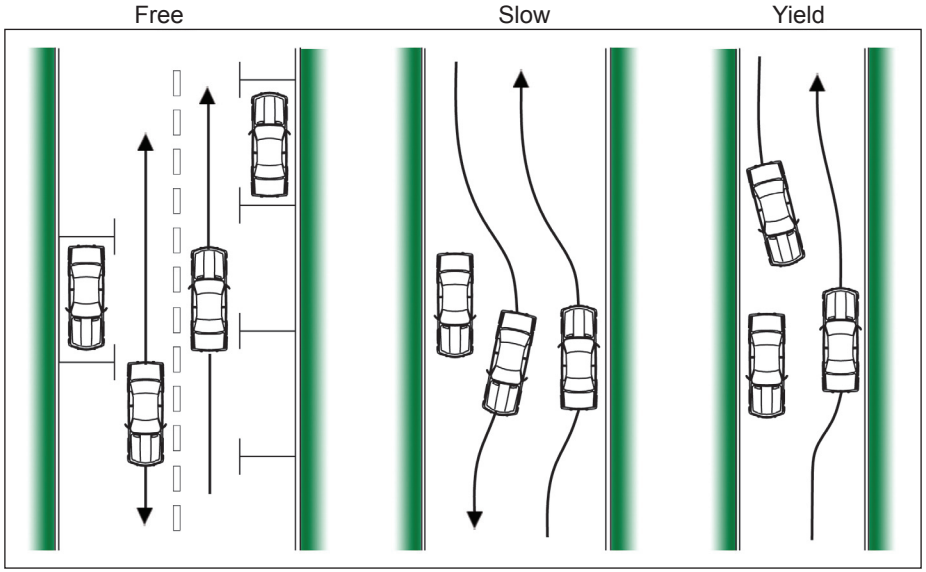


Figure 2.8. Types of Traffic Flow.
Modified from Source: National Association of Homebuilders et al., *Residential Streets* (Ref. 5)

2.3.2 On-Street Parking

Angled or parallel on-street parking may be used to meet all or a part of the parking requirement defined in chapter 4. On-street parking can serve to slow the adjacent travelway-lane traffic as well as to provide a buffer between street traffic and pedestrians.

Angled on-street parking shall be designed in accordance with the dimensions in Table 2-2.

Commentary

In a free-flow traffic pattern, each lane is only used to facilitate traffic movement.

In a slow-flow pattern, lanes are wide enough to accommodate two-way traffic but are narrow enough that if there is a parked car along the side of the street, some drivers will choose to stop and yield the right-of-way to the oncoming driver.

In a yield-flow pattern, some motorists must stop and yield the right-of-way to oncoming vehicles. For decades prior to the 1960s, yield flow was the widely accepted norm for local streets. Yield operation continues to be explicitly endorsed in the AASHTO Greenbook (Ref. 1), which acknowledges the condition of "one unobstructed moving lane where opposing conflicting traffic will yield and pause on the parking lane until there is sufficient width to pass." However, yield traffic patterns raise safety concerns (pedestrian and vehicular), and may delay emergency responses. Special consideration should be given to adequate site distance. For these reasons, yield traffic flow patterns should only be considered for low-volume Residential Access Streets as specified in Section 2.4.2.

In high-density residential and mixed-use residential areas, on-street parking can be used to create an effective barrier between streets and sidewalks. Also, in many instances on-street parking creates less impervious area than off-street parking which must include additional travel and access isles.

Commentary

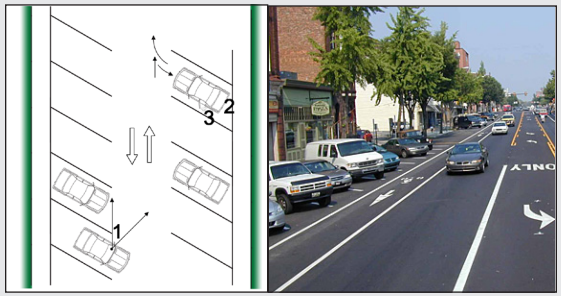
Although angled on-street parking is permitted, it's use is only recommended where traffic volume and speed are sufficiently low to not pose significant risk of an accident when vehicles back into the travel lane.

Many communities are requiring back-in only angled parking to enhance safety. All parking requires a backing movement, either as the vehicle is parked or when the vehicle leaves the space. Backing into a defined, empty parking space is safer than edging out into a travel lane where the view is obstructed by adjacent parked vehicles. Doing the backing movement as the vehicle pulls in, rather than as it pulls out has several advantages: 1) when exiting, the driver can more easily see the traffic flow without pulling into the travel lane, 2) loading/ unloading at the rear (trunk) happens at the safety of the sidewalk, rather than out in the travel lane, and 3) the open door directs people (children) easily to the sidewalk, rather than the need to step back near or in the travel lane to close the door and then walk to the sidewalk. See Illustration 2-1.a, below.

Angled on-street parking dimensions are based on the values reported in angled off-street parking with additional parking space width and length for pedestrian safety.

Illustration 2-l. Back-in Only Angled Parking

a. **b.**



High Street, Pottstown, PA Source: Tom Hylton

Recommended Standards

Table 2-2. On-Street Angled Parking Dimensions

Stall Angle (degrees)	**S*** Stall Width (ft)	**C*** Stall Length (ft)	**D*** Stall Depth (ft)	**O*** Front Over-hang (ft)	**A*** Minimum Lane Width (ft)
45	10	14.1	20	2.1	12 / 14**

* See Figure 2-9 for definition.

** 12-foot width applies to two-way traffic; 14-foot width applies to one-way traffic (Boulevard, for example).

Modified from Source: Stover, V.G., and F.J. Koepke (Ref. 6, 1988 Edition)

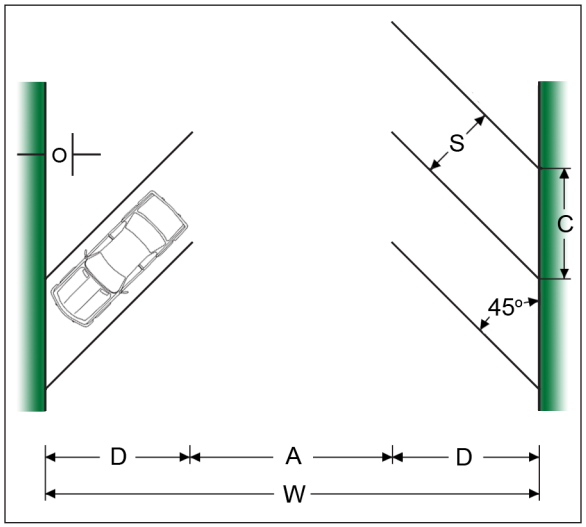


Figure 2.9. Parking Adjacent to Street

Where curb overhang is allowed, the stall depth (D) may be reduced by the front overhang (O). If a sidewalk exists at the curb, the combined width of the curb and sidewalk shall be sufficient to permit a 3-foot unobscured walkway width (i.e., the minimum width of sidewalk plus curb shall be 3 feet plus the dimension "O").

Parallel on-street parking spaces shall be 23 feet long. The parking lane width shall be as specified in Tables 2-9, 2-10, 2-14, and 2-16.

Recommended Standards

2.3.3 Intersections

Design standards for the intersection of residential streets follow:

2.3.3.1 Intersection Horizontal Alignment: Streets should intersect each other at 90-degree angles. Where this is not possible, a 50-foot section of the lower-order street (or street with lower traffic volume) should be angled to meet the higher volume street at a 90-degree angle (Figure 2.6).

Commentary

The length of on-street parking is based on the length necessary to parallel-park a standard or mid-sized automobile. Many communities are adding painted-striping to guide drivers into a specific spot along the parking lane. The stripes between the spaces help to decrease the time needed to pull into and out of a parallel space because maneuvering room has been set aside.

Illustration 2-m. Striped Spaces for Parallel Parking

College Ave., State College, PA

Intersections are points of conflict and potential hazard. The readily obvious assignment of right-of-way that is inherent to three-way intersections, together with substantially fewer conflict points, makes the three-way intersection much safer than a four-way intersection.

Right-angle intersections are the most comfortable for drivers, and provide the most direct view of approaching traffic.

If local site conditions require an acute-angled intersection, and preclude bending the angled street, the municipal authority can consider waiving this requirement. Suggested maximum intersection angles are provided in Table 2-2. Note that adequate sight distance must be provided for all

Commentary

intersections.

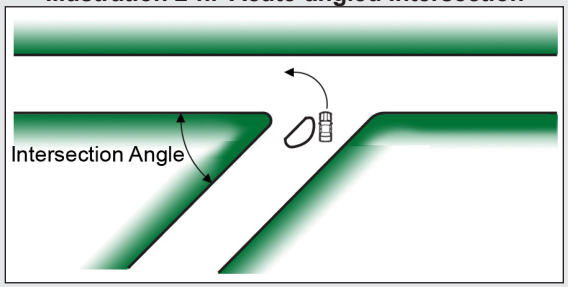
Table 2-3. Intersection Alignment Angle

Intersection Type	Minimum Intersection Angle *
Arterial - Residential Collector Collector - Collector Collector - Residential Access	≥ 80 0 ≥ 70 0 ≥ 70 0

* See Figure 2.10 for angle alignment
Source: Stover, V.G., and F.J. Koepke (Ref. 6)

Another method of compensating for a badly angled intersection is to install an island that separates traffic and channels the left-turn traffic (see Illustration 2-k). These islands must be designed to accommodate the occasional truck or large emergency vehicle. Appropriate radii must be provided. In cases where appropriate radii cannot be met, the islands should be designed to be mountable.

Illustration 2-n. Acute-angled Intersection



Modified from Source: National Association of Homebuilders et al., *Residential Streets* (Ref. 5)

Intersections should be spaced far enough apart to not interfere with each other and restrict egress capacity. Reference 6 (chapter 6) provides a detailed analysis of the factors affecting intersection and access drive spacing. Since the spacing required to minimize egress conflicts is dependent

Recommended Standards

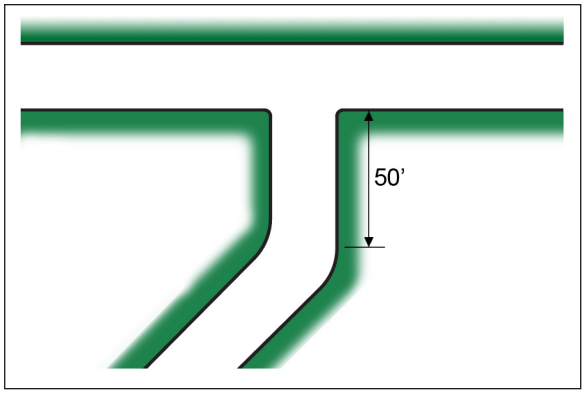


Figure 2.10. Realignment of an Angled Street
Modified from Source: National Association of Homebuilders et al., *Residential Streets* (Ref. 5)

2.3.3.2 Intersection Spacing: The spacing of streets or other driveway access locations along a particular street shall be as indicated in Table 2-5. Residential driveways as defined in section 2.3.4.1 are exempt from this standard except for corner lots on or adjacent to a residential collector or residential/mixed use collector street. These residential driveways must meet the intersection spacing standards in Table 2-5.

Recommended Standards

Table 2-4. Intersection Spacing

Through-Street Classification	Intersection Spacing "S" (Edge of pavement or curb corner to corner spacing; see Figure 2-5)
Residential Access	125 feet
Residential Collector	175 feet
Residential/Mixed-Use Collector	250 feet
Higher-Order Non-Residential Street	> 325 feet *

* To be determined by municipality or PennDOT based on traffic characteristics of the higher-order street. PennDOT standards for signalized intersections require a 500-foot separation between adjacent intersections.

Modified from Source: Stover, V.G., and F.J. Koepke (Ref. 6)

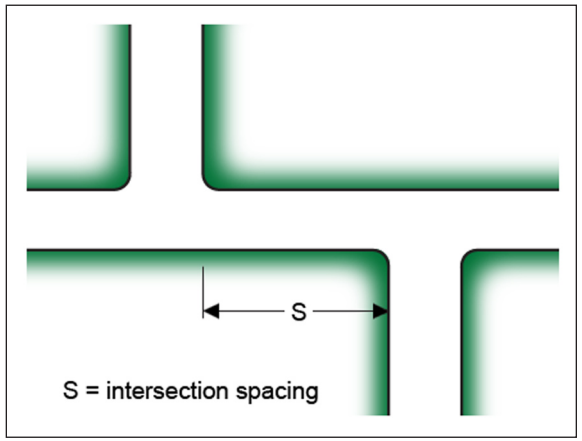


Figure 2.11. Intersection Spacing

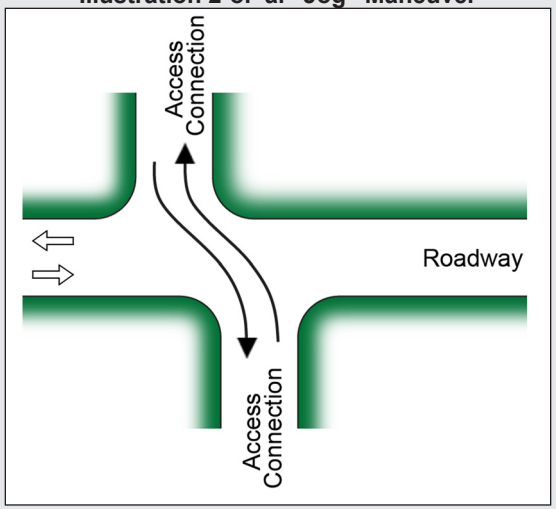
Modified from Source: National Association of Homebuilders et al., *Residential Streets* (Ref. 5)

Commentary

on traffic volumes, trip directions, and turning movements, it is difficult to develop recommended standards for intersection spacing. The intersection spacing guidelines identified in Table 2-3 are based on considerations presented in Reference 6 and simplified recommendations suggested in Reference 5. These recommendations are also intended to minimize traffic conflicts resulting from "jogging" or "corner-cutting". Drivers make a "jog" movement when intersections on opposite sides of the street are too closely spaced (Figure 2-o a).

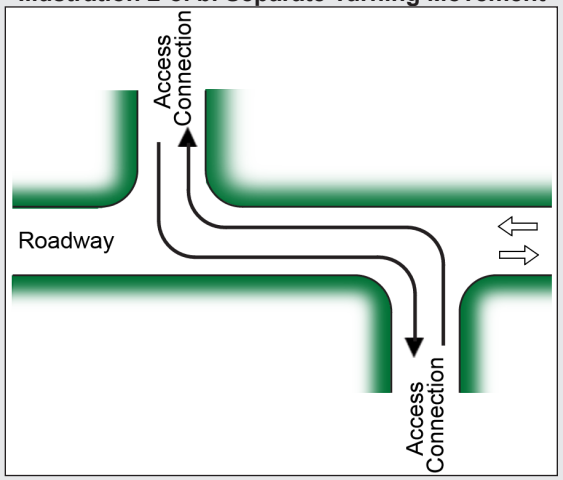
Table 2-4 specifies intersection spacing "S", where "S" is the edge of pavement or curb-line corner to corner distance between intersecting streets as illustrated in Figure 2-11. These standards apply to cross intersections as well as off-set intersections.

Illustration 2-o. a. "Jog" Maneuver



Commentary

Illustration 2-o. b. Separate Turning Movement



Modified from Source: National Association of Homebuilders, et al., *Residential Streets* (Ref. 5)

Intersection spacing requirements are dependent on traffic volumes, trip directions, and frequency of turning movements. It is recommended that intersections be aligned wherever possible.

Curb/edge-of-pavement radii is the radius of the circle joining the intersecting street edges. As this radius increases, the paving cost and pedestrian crossing distances for the intersection increase, dangerous incomplete stops become more frequent, and drivers make turns at higher speeds. However, if this radius is inadequate, traffic conflicts can arise, and vehicles might drive over curbs or rut shoulders and the adjacent landscape (Ref. 5).

The curb radii in Table 2-5 were determined through a detailed analysis of vehicle-turning movements. This analysis was based on the following assumptions and conditions:

- A single-unit truck (SU), as defined in Reference 1, was used at all intersections to define curb radii. Typical trash collection

Recommended Standards

2.3.3.3 Intersection Curb/ Edge Pavement Radii: Minimum required intersection curb/edge-of-pavement corner radii are given in Table 2-5.

Table 2-5. Minimum Required Curb/ Edge Pavement Radii -- Without Bulbouts

Intersection Type	Connecting Street Paved Widths	Minimum Curb Radii (ft)
Residential Access to Residential Access		
Curbed (see note 1)	18/20-ft connecting to 18/20-ft	20
	18/20 ft connecting to 26/28 ft	15
	26/28 ft connecting to 26/28 ft	15
Uncurbed	18/20 ft connecting to 18/20 ft	40
	18/20 ft connecting to 18/20 ft with intersection curbing (see note 2)	20

Recommended Standards

Residential Access to Residential Collector Curbed Uncurbed	18/20 ft (RA) connecting to 26 ft (RC) 26/28 ft (RA) connecting to 26 ft (RC) 18/20 ft (RA) connecting to 24 ft (RC) 18/20 ft (RA) connecting to 24 ft (RC) with intersection curbing (see note 2)	25 20 40 25
Residential Collector to Residential Collector Curbed (see note 3) Uncurbed	26 ft connecting to 26 ft 24 ft connecting to 24 ft 24 ft connecting to 24 ft with intersection curbing (see note 2)	20 40 25
Residential Access to Residential Mixed-Use Collector (Curbed)	18/20 ft (RA) connecting to 38 ft (RMC) 26/28 ft (RA) connecting to 38 ft (RMC) 18/20 ft (RA) connecting to 22/30 ft (RMC) 26/28 ft (RA) connecting to 22/30 ft (RMC)	15 10 25 15
Residential Collector to Residential Mixed-Use Collector -- Curbed	26 ft (RC) connecting to 38 ft (RMC) 26 ft (RC) connecting to 22/30ft (RMC) (see note 4)	20 40
Residential Mixed-Use Collector to Residential Mixed-Use Collector -- Curbed (see note 5)	38 ft (RMC) connecting to 38 ft (RMC) 38 ft (RMC) connecting to 30 ft (RMC) 22/30 (RMC) connecting to 22/30 ft (RMC)	10 20 20

Notes:

1. To permit access to the full pavement width by the WB-50 design vehicle, parking shall be restricted within 50 feet of the intersection measured along the curb-line.
2. The use of curbing at the intersection of uncurbed streets is intended to keep the wheel path of turning vehicles on the pavement surface. Figure 2-12 illustrates intersection curb placement along otherwise uncurbed streets.
3. Requires design vehicle to occupy approximately 10% of opposing lane. This can be avoided by using a 25-foot curb radius.
4. The curb radius may be reduced to 25 feet if it is acceptable to allow the SU design vehicle to occupy up to 50% of the opposing lane of traffic to make the turning

Commentary

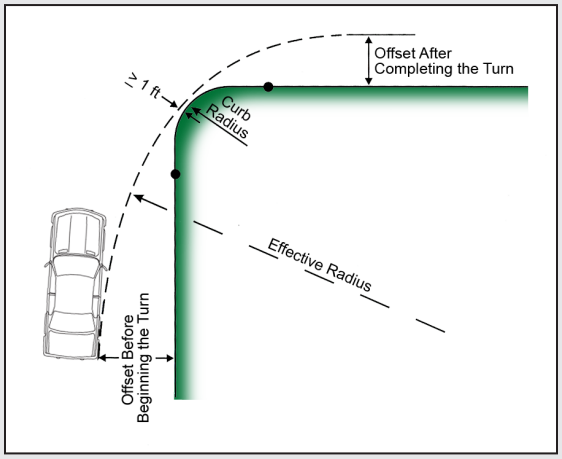
vehicles, service vehicles, emergency service vehicles, and school busses (conventional and large) have turning radii similar to, but slightly shorter than, the SU design vehicle. It was assumed that the SU vehicle could use both lanes of a residential access roadway to negotiate turns, but on other street types it would be restricted to the lane defining its directional movement.

- The SU design vehicle coupled with its stated turning path lane restrictions defined the limiting turning radius at all intersections. An Intermediate Semitrailer (WB-50), as defined in Reference 1, was used to further define curb radii at all intersections where commercial deliveries would need access. It was assumed that the WB-50 design vehicle would use the full width of the street on both legs of the intersection to negotiate a turn. Some communities restrict delivery times to early morning, when traffic is lighter, to reduce the possibilities of traffic conflicts with the WB-50 vehicles.

When street widths accommodate on-street parking, the beginning and end of the turn is off-set from the curb by a distance equal to the parking lane width (see Illustration 2-p), making the available effective turning radius much larger than the curb radius.

Commentary

Illustration 2-p. Effective Turning Radius at Residential Intersections



Modified from Source: Stover, V.G., and F.J. Koepke (Ref. 6)

Bulb-outs may be used in conjunction with on-street parking to provide a shorter crossing distance for pedestrians, and produce a "choker" that helps reduce vehicle speed (see section 2.3.8.1). When used in residential areas (see Illustration 2-n), they may also reduce impervious area.

Illustration 2-q. Illustration of Bulb-out

Source: Stover, V.G., and F.J. Koepke (Ref. 6)

Recommended Standards

movement. If vehicles similar in size to the SU design vehicle will use the intersection infrequently, it may be desirable to reduce the curb radii to reduce impervious area and pedestrian crossing distance at the intersection. It is noted that the pedestrian crossing distance would be reduced by 24 feet if the corner radii are reduced from 40- to 25 feet (Ref. 21).

5. To permit access to the full pavement width by the WB-50 design vehicle, parking shall be restricted within 40 feet of the intersection as measured along the curb-line.

The minimum intersection curb / edge-of-pavement radii identified in Table 2-5 are based on the street widths indicated. If wider streets are specified, smaller intersection curb / edge-of-pavement radii may be appropriate. Any reduction in the specified radii must be supported by documentation specifying an appropriate design vehicle and demonstrating that the vehicles corresponding turning movements can be adequately accommodated by the proposed curb / edge-of-pavement radii.

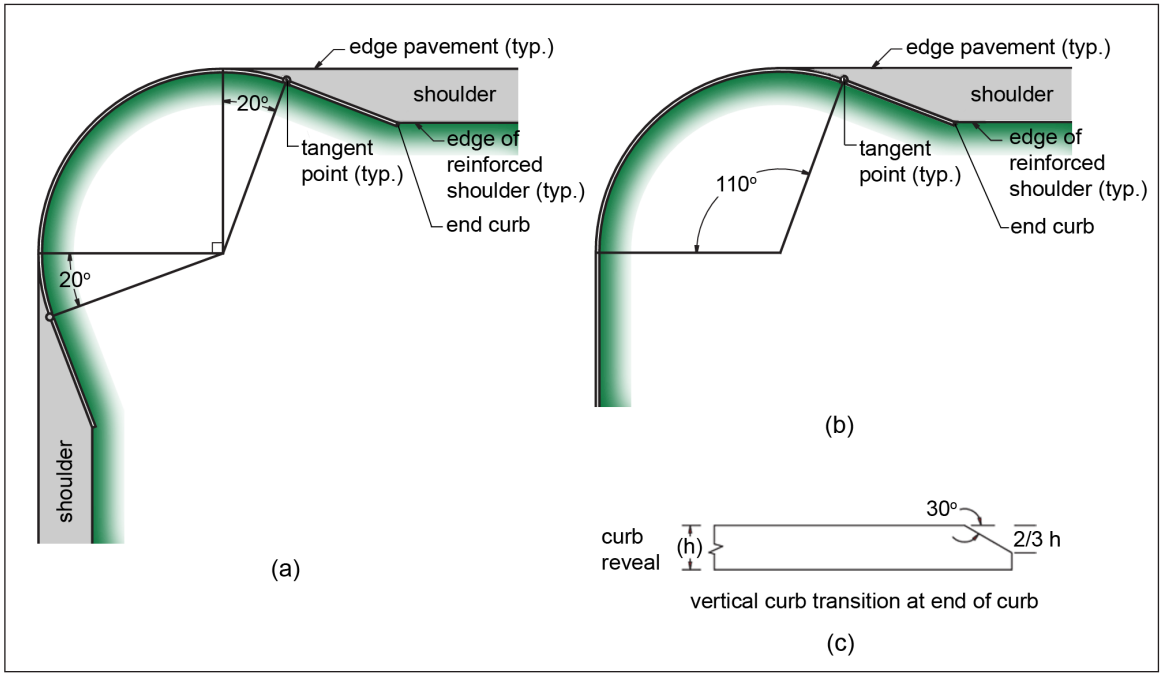


Figure 2.12. Intersection Curb Transition

(a) Uncurbed street to uncurbed street, (b) curbed street to uncurbed street, (c) End curb transition
Modified from Source: Stover, V.G., and F.J. Koepke (Ref. 6)

Recommended Standards

When a municipal street intersects State right-of-way, PennDOT standards for curb and edge of pavement radii apply.

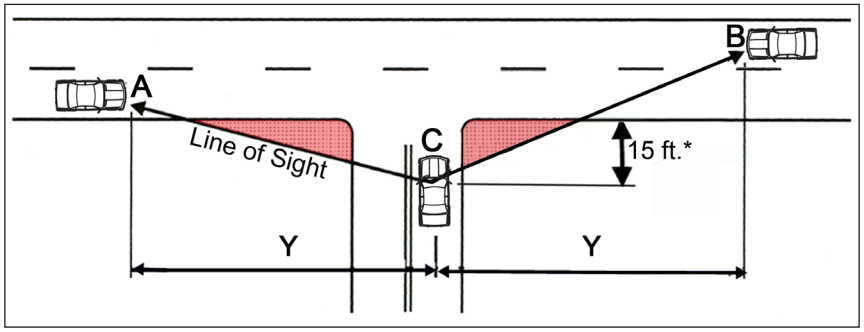
When a curbed street intersects with an uncurbed street, provide a curb transition as illustrated in Figure 2.12.

When bulb-outs (Section 2.3.8.1) are used at intersections, the resulting effective street width at the bulb-out shall be used to determine an appropriate curb radii. If bulb-outs are designed to be mountable, the full street width may be used.

When a municipal street intersects a State right-of-way, PennDOT standards for curb / edge-of-pavement radii shall apply.

2.3.3.4 Intersection Sight Distance: Whenever a proposed street intersects an existing or proposed street of higher-order or traffic volume, the street of lower-order or traffic volume shall be made a stop street. The street of lower order or traffic volume shall also be designed to provide a minimum clear line-of-sight as defined in Figure 2.13 and Table 2-6.

The clear sight triangle is defined by a line of sight from the position of the eye of the driver (3.5 feet above the street surface) in the stopped vehicle, to the position of an oncoming vehicle in either lane approaching the intersection. The elevation of the sight-line at the approaching vehicle is taken as 3.5 feet above the street surface to represent the approach vehicle driver's eye. The base of the triangle is defined as the corner sight distance ("Y" in Figure 2.13). Points A and B of the clear sight triangle are located along the centerline of the approaching travel lanes. Point C is located at the center of the stopped vehicle's lane and 15 feet behind the intersecting street edge-of- pavement.



* a 10-foot off-set distance may be used when residential access streets intersect other residential access streets.

Figure 2.13. Minimum Intersection Sight Distance

Modified from Source: Stover, V.G., and F.J. Koepke (Ref. 6)

Commentary

Key areas along an intersection approach and across the corners of the intersection should be clear of obstructions that might block a driver's view of oncoming traffic. These areas are known as clear sight triangles.

The elevation of the sight-line at the approaching vehicles is taken as 3.5 feet to ensure the entering driver's ability to judge the rate of closure of, and gap size between, approaching vehicles.

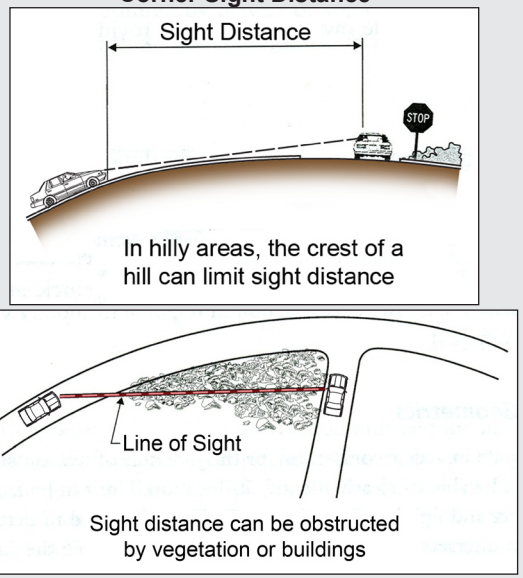
The corner sight distance is dependent on the approaching traffic speed, reaction time and decision time of the entering driver, street grades, and other factors. The minimum intersection sight distances in Table 2-6 and Figure 2.13 are based on PennDOT standards at the time of this writing (Chapter 2, Reference 18).

The reduced site triangle off-set of 10 feet for residential access streets intersecting other residential access streets reflects the reduced risk of an incident at these intersections, and permits reduced yard setbacks.

The intersection line-of-sight could be obstructed by vertical alignment, or horizontal obstructions in the site triangle, or a combination of both. This is illustrated in Illustration 2-r.

Commentary

Illustration 2-r. Obstructions to Corner Sight Distance

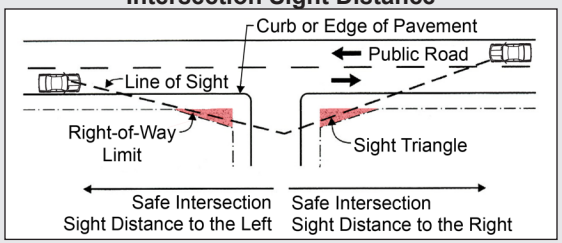


Modified from Source: Stover, V.G., and F.J. Koepke (Ref. 6)

The standards for clear site distance used here are based on data presented in References 1 and 6. These standards were derived from field observations of driver gap-acceptance behavior (Ref. 9).

Methods of ensuring maintenance of the line-of-sight sight triangles are illustrated in Illustration 2-s.

Illustration 2-s. Methods of Preserving Intersection Sight Distance



a. Sight triangle incorporated as right-of-way

Recommended Standards

Table 2-6. Minimum Intersection Sight Distance (passenger cars)

Design Speed (mph)	Sight Distance (Y) (ft.)
20	225
25	280
30	335
35	390
40	445
45	500
50	555
55	610

The site distance values in Table 2-6 apply to a vehicle starting from a stop on a street grade not exceeding 3%, and entering or crossing a two-lane, two-way street. If the rear tires of the stopped vehicle are resting on a grade steeper than 3%, the sight distances in Table 2-6 should be increased by 10%. If the through street contains a median or includes more than one through lane in either direction, an adjustment should be made to the sight distance as follows:

$$Y = 1.47\ V\ (7.5 + 0.5\ X\ AL)$$

Where:

Y = site distance (ft)
V = through street design speed (mph)
AL = number of additional travel lanes (count lanes in both directions)

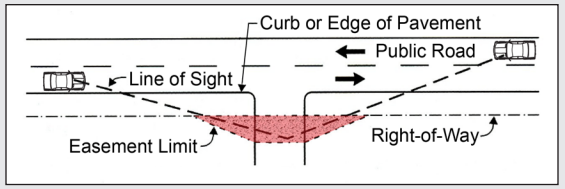
Note: Any median width should be converted to equivalent lanes by dividing the median width by 12 feet.

Embankments, buildings, fences, landscaping, crops, parking, tree overhangs, signs, etc., shall be designed so that they do not interfere with the sight distance anywhere within the sight triangle from an elevation of 2 feet above the ground to 8 feet above the ground.

Areas within the clear sight triangle shall be dedicated as additional right-of-way or shall be maintained in a sight easement.

Recommended Standards

Commentary



b. Sight triangle protected by acquisition of use (easement)
Modified from Source: Stover, V.G., and F.J. Koepke (Ref. 6)

2.3.3.5 Intersection Approach Grade for Stop Streets: Intersection approaches, where vehicles stop while waiting to proceed, shall be designed with an approach pavement grade less than + 3%. The limiting approach grades can be increased to 5% if it can be shown that ice and snow conditions will not create a significant problem.

On residential access streets, the approach grade shall be maintained for a minimum distance of 25 feet from the intersection along the minor street from the edge of cartway on the through street. For all other street classifications, a minimum distance of 50 feet shall be maintained.

The limiting street grades (less than 3%) are based on minimizing hazards from snow and ice, and allowing for unimpeded vehicle acceleration from a stop. In areas where snow and ice are not of particular concern, street grades could be increased to 5% (Ref. 1 and 5) as long as an appropriate adjustment is made to the stopping sight distance in section 2.3.3.4.

The length of the minimum approach grade is reduced to 25 feet for residential access streets to minimize site grading impacts. This is justified by the low design speed of these streets.

2.3.3.6 Turn Bays and Deceleration lanes: Turn bays and deceleration lanes shall be constructed when warranted by a traffic impact study (see section 2.3.14). When warranted, turn bay and deceleration lane geometry shall be designed in accordance with PennDOT standards (Ref. 18).

Turn bays and deceleration lanes provide for safety and efficiency on streets. Limited traffic volumes on residential access streets typically don't warrant these features. However, these features should be provided whenever they are warranted based on a traffic impact study.

2.3.4 Driveways

a. *General:* Driveways shall be located, designed, constructed and maintained in such a manner as not to interfere or be inconsistent with the design, maintenance, and drainage of the street.

b. *Approach:* All driveway entrances shall be designed to maintain proper drainage from the street. Where the street is curbed, driveway approaches shall be installed to maintain continuation of flow along the gutter-line. Alternatively, a gutter-line may be formed in the pavement across the driveway entrance to ensure proper drainage.

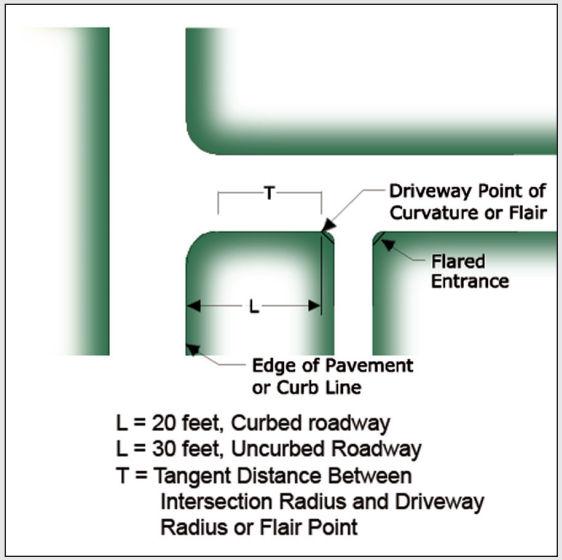
In this context, proper drainage means that drainage from and along the street within the right-of-way is maintained. Where the street is curbed, an adequate flow-line must be maintained along the gutter so runoff is not directed into the driveway entrance. This can be accomplished by ensuring that the driveway elevation rises at least to the curb height along the entrance profile prior to dropping to the desired grade. Where the street is not curbed, entrance grading shall direct runoff to a street swale

Commentary

and away from the driveway entrance.

The minimum distance from intersection standards are as specified in PA Code Title 67, Chapter 441.8. To minimize vehicle conflicts, a larger separation distance should be used when possible. This requirement may be waived only if the intersecting street radius extends along the property frontage to the extent that compliance is physically impossible. See Illustration 2-t for a graphic description of specified distances.

Illustration 2-t. Driveway Off-set from Intersection



Comparable to a PennDOT minimum use driveway (PA CODE Title 67, Chapter 441.8). Illustration 2-u shows a typical shared driveway.

Recommended Standards

c *Minimum distance from Intersections:* The distance from the edge of pavement of the intersecting street to the point of curvature of the driveway edge of pavement or curb radius shall be a minimum of 20 feet on curbed streets and 30 feet on uncurbed streets. For flared driveways, measurement shall be to the beginning of the flair. In no case shall the tangent distance between the intersection radius and driveway radius or flair point be less than 10 feet.

d. *Corner lots:* When bounded by streets of two different street classifications, driveways for corner lots shall gain access from the street of lower classification. However, access shall be permitted from the street of higher classification in the following cases:

1. if no other reasonable access is available; and
2. when grading limitations or other restrictions dictate that access be from the higher-order street.

e. *Property line clearance:* Except for joint-use driveways, no portion of any access shall be located outside the property frontage boundary line.

f. *Sidewalk Crossing:* If a sidewalk is present, the sidewalk pavement material shall be continued across the driveway width. See Figure 2.14.

Figure 2.14. Concrete Sidewalk Continues Across Driveway

2.3.4.1 Driveways to Single-family Dwellings, Duplex Houses, or Apartments with Five Units or Fewer:

a. *Joint driveways:* Joint or common driveways serving no more than three (3) single-family dwellings are permitted and shall be designed in accordance with the standards

Recommended Standards

of this section.

b. *Curb Cut:* The minimum curb cut or driveway width at the cartway edge shall be 10 ft. The maximum curb cut or driveway width at the cartway edge shall be 20 ft.

c. *Curb return entrance:* A curb return entrance is illustrated in Figure 2.15. When curb return entrances are used, the curb shall have a minimum 3-foot radius. However, any driveway entering into a PennDOT right-of-way shall be designed in accordance with PA Code Title 67, Chapter 441.

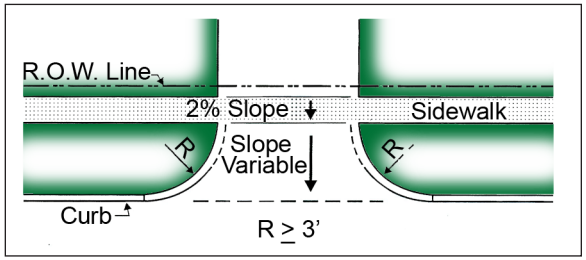


Figure 2.15. Typical Curb Return Entrance
Note: for driveways entering into PennDOT ROW, design shall be in accordance with standards in PA Code Title 67, Chapter 441.
Modified from Source: AASHTO (Ref. 1)

d. Flared entrances: When flared driveway entrances are used, a minimum 2-foot flair shall be provided. A typical flared entrance is illustrated in Figure 2.16.

Commentary

Illustration 2-u. Shared Driveway

Modified from Source: National Association of Homebuilders, et al. *Residential Streets* (Ref. 5)

The driveway return radius standard is from Reference 1, p. 402. A 5-foot radius is common practice.

The 2-foot flare width provides an effective driveway width similar to that of a 3-foot curb radius.

Commentary

An entrance radius slightly larger than the curb return entrance radius is specified for non-curbed driveway entrances to minimize shoulder run-off.

Excessive changes in driveway grade at the entrance or along the profile will cause the front or rear bumper to drag on the surfaces of the street or driveway. The 8% change in grade at driveway entrances is based on PennDOT standards in Reference 18.

When the change in grade at a point along the driveway is less than 10%, field rounding will provide an adequate transition. However, when the change in grade equals or exceeds 10%, a vertical curve should be provided.

The standards here have been adapted from chapter 7 of Reference 6 and modified to reflect

Recommended Standards

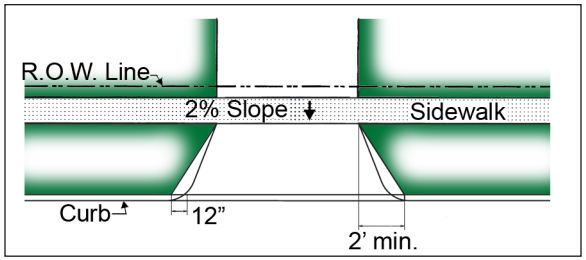


Figure 2.16. Typical Flared Driveway Entrance
Modified from Source: AASHTO (Ref. 1)

e. Non-curbed entrance: Non-curbed driveway entrances shall have a minimum edge-of-pavement radius of 5 feet as illustrated in Figure 2.17.

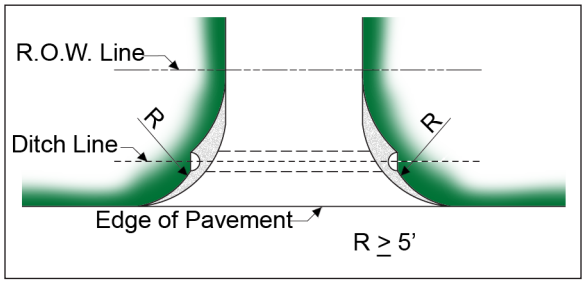


Figure 2.17. Typical Non-curbed Driveway Entrance
Modified from Source: AASHTO (Ref. 1)

f. Driveway Profile: Driveway profiles shall provide efficient access to the abutting residential street, allow for low-speed 90-degree turns into the driveway, and provide safe access to the residential garage or parking area. The following standards shall apply:

1. The algebraic change in grade between the street cross slope and the driveway approach apron shall be less than or equal to 8%.

2. When the algebraic change in grade at any point along the driveway exceeds 10%, a vertical curve having a length specified in Table 2-7 shall be used.

Recommended Standards

Table 2-7. Length of Vertical Curves for Extreme Changes in Driveway Grade

Algebraic Change in Grade (%)	Length of Vertical Curve	
	Sag	Crest
10	25	10
15	35	20
20	45	30
25	55	40

3. Driveway grades shall not exceed 10% for the first 18 feet from the street edge of pavement. In addition, the driveway grade shall not exceed 10% in any area used for designated parking along the driveway, or within 20 feet of garage entrances.

4. Driveways serving residential dwellings should they generally be less than 15%, but in no case should exceed 20%.

2.3.4.2 Entrance Drives for Multi-family Developments and Off-street Parking Lots:

1. Except as outlined in section 2.3.4, all driveway entrances onto public rights-of-way shall be designed in accordance with PennDOT entrance standards as defined in PA Code, Title 67, Chapter 441.

2. With the exception of driveways outlined in section 2.3.4.1, all private driveways and streets shall be designed in accordance with the standards for public streets in Sections 2.5 through 2.8.

2.3.5 Easements

To economize on the loss of site area, easements may be used in lieu of rights-of-way for utilities, sidewalks, snow storage, sight triangles, slope maintenance areas, etc., whenever possible. Streets, curbs, street gutters, and cross drainage pipes and culverts must be placed in the street right-of-way.

Commentary

PennDOT standards (Reference 18).

An 18-foot area at the driveway entrance provides vehicles with a transition and landing area at the entrance from which to safely enter the street. On steep driveways, this area also provides a safe parking area when inclement weather prevents the vehicle from driving the remaining length of the driveway.

Easements grant rights of passage through and/or use of privately owned property. Easements provide the same access to utilities as rights-of-way (Ref. 13, p. 62). The use of easements may allow the placement of utility lines along the shortest path, thereby decreasing both the overall length of the line and the associated costs.

Legal rights to easement land areas are typically assigned to the municipality, utility company, and/or home owners. Easement areas across lots are maintained by the owners, saving the municipality upkeep funds. (Adopted from Reference 14, p. 25.)

Commentary

Rights-of-way used for utilities, sidewalks, snow storage, sight triangles, slope maintenance areas, or other design elements shall be subject to review to ensure that the minimum required right-of-way width does not unfairly contribute to an increase in housing cost through an associated reduction in density. (Adapted from Reference 14, p. 25)

A center-crowned street cross-section facilitates pavement drainage at the street edge. Pavement cross-slopes between 2% and 6% are recommended in Reference 1. A 3% cross slope is recommended for residential streets. Cross slopes less than 2% will not provide adequate pavement cross drainage. Steeper cross slopes produce enhanced pavement drainage and narrower gutter flow widths (less spread) for the same gutter flow rate. Cross slopes greater than 4% may result in some driver discomfort.

Cross slopes greater than 4% are sometimes used on multi-lane streets to provide adequate pavement cross drainage. For multi-lane streets, PennDOT cross-slope standards based on pavement drainage requirements should be followed.

Traffic-calming measures are mainly used to address speeding and to reduce the volume of cut-through traffic on neighborhood streets. These issues can create an atmosphere in which non-motorists are intimidated, or even endangered, by motorized traffic. By addressing high speeds and cut-through volumes, traffic calming can increase both the real and perceived safety of pedestrians

Recommended Standards

2.3.6 Rights-of-way

Rights-of-way shall be set aside to provide adequate space for the construction and maintenance of streets, shoulders, curbs, street gutters, and cross drainage pipes and culverts. They may also accommodate sidewalks, snow storage, sight triangles, slope maintenance areas, and utilities such as water, sewer, storm drainage, electrical service, cable TV, and gas lines where appropriate.

2.3.7 Travelway Cross Section

With the exception of alleys and divided streets, residential streets shall be constructed with a center-crowned street cross-section as illustrated in Figure 2.18. Cross slopes between 2% and 4% are appropriate for residential streets.

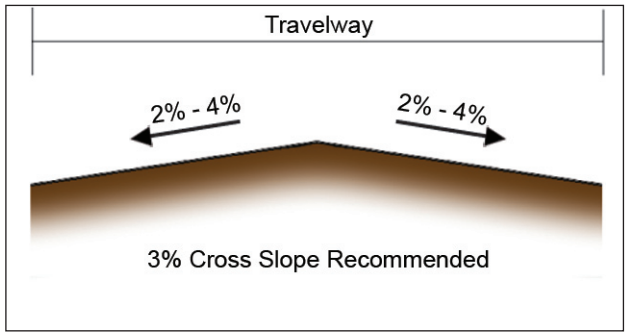


Figure 2.18. Crowned Pavement Section

For streets having more than one travel lane in each direction, PennDOT standards for street cross slope should be followed.

2.3.8 Traffic Calming

Traffic calming measures are techniques designed to slow traffic and reduce cut-through traffic volumes in residential neighborhoods. The minimum road width standards contained in this chapter were established to enhance traffic calming. The measures included in the following sub-sections may be used to further enhance traffic calming.

Traffic calming measures shall be designed in accordance with the standards in Reference 12, *Pennsylvania's Traffic Calming Handbook.*

Recommended Standards

2.3.8.1 Intersection -- Bulb-Outs

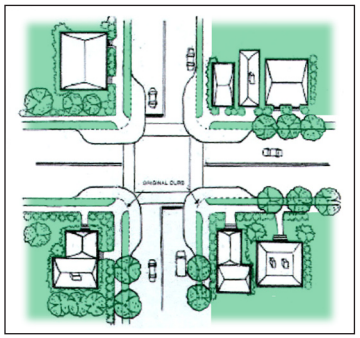


Figure 2.19.
Intersection Bulb-Outs
Source: PennDOT (Ref. 12)

Bulb-outs are curb extensions used to narrow the paved street width, typically at places where pedestrians cross. They usually extend the width of a parking lane, about 6- to 8-feet from the conventional curb line. They are appropriate for use on all residential street classifications. Typical reasons for their use include:

- Reduce pedestrian crossing distance
- Improve the line-of-sight for pedestrians
- Make pedestrians more visible to oncoming traffic
- Slow traffic by funneling it through a narrower street opening
- Slow vehicles making a right turn by reducing the effective curb radius

Bulb-out design should consider the following elements:

- Adequate drainage must be provided. Ponding may occur along the curb-line or on the sidewalk if adequate provision is not made for drainage.
- Consideration should be given to the need for snow and ice removal.
- Vertical curbs are recommended to create a positive barrier. However mountable curbs can be used if necessary to accommodate turning trucks and busses.
- Mid-block bulb-outs should be combined with crosswalks whenever possible.

For additional guidance and for future updates, see Reference 12, ch. 5, pp. 24-25.

Commentary

and bicyclists, and improve the quality of life within neighborhoods (Ref. 12).

Several traffic-calming measures are included as a part of other standards. For example, narrow street widths are promoted as a part of the street standards for each street classification, and bulb-outs are included as an option under intersection cartway radius definitions in section 2.3.3.

Bulb-outs are perhaps the most common traffic-calming technique. They greatly reduce the time needed for pedestrians to cross an intersection and help to clearly define the parking lane. Bulb-out configurations also improve pedestrian visibility at intersections. Bulb-outs have been observed to reduce travel speeds by up to 5 mph (Ref. 12). However, when the bulb-out width is less than the width of the parking lane, little reduction in travel speed is realized.

Illustration 2 - v. Bulb-Out

Bulb-outs are typically used at intersections. However, they can be used at mid-block locations where there is significant pedestrian activity (near schools, for example), where a block is long and a mid-block crossing is desired, or to address speeding. Bulb-outs are also sometimes referred to as curb extensions, knockdowns or chokers.

Commentary

Raised intersections have been observed to have only a minor affect on vehicle speed (Ref. 12). The effectiveness of raised intersections can be enhanced through the use of textured surface materials.

Illustration 2 - w. Raised Intersection

Source: Pedestrian and Bicycle Information Center (Ref. 26)

Recommended Standards

2.3.8.2 Intersection -- Raised

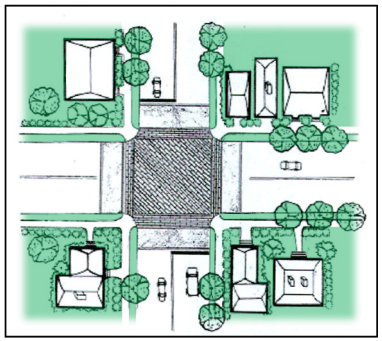


Figure 2.20.
Raised intersection
Source: PennDOT (Ref. 12)

Raised intersections comprise the entire intersection, including the associated crosswalks. The intersections are raised 3-inches to 6-inches above street level. Raised intersections function to lower travel speeds and decrease conflicts between vehicles and pedestrians by better demarcating crossing areas and elevating pedestrians above the street level. They are most appropriately used where there is high pedestrian activity in residential / mixed-use areas.

Design considerations include:

- The ramp grade of 4% to 8% should be maintained on the approach to the raised intersection.
- Use of tactile measures to warn visually impaired people of the location of the cross walk and raised intersection.
- Use of appropriate drainage elements.
- All ADA requirements must be met.
- Consideration must be given to snow and ice removal.

For additional guidance and for future updates, see Reference 12, ch. 5, pp. 48-49.

Recommended Standards

2.3.8.3 Intersection -- Traffic Circle

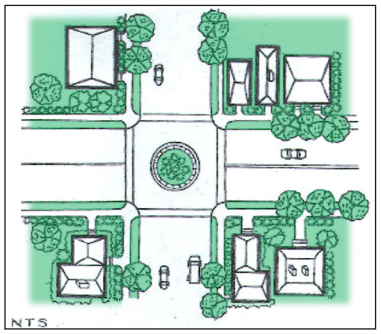


Figure 2.21. Traffic Circles
Source: PennDOT (Ref. 12)

Traffic circles are raised islands located in the center of an unsignalized intersection. All traffic must negotiate the circle and circulate in a counterclockwise direction. Their primary function is to improve the efficiency and safety of stop-sign controlled (2-way or 4-way) intersections.

Traffic circles can be used on any street where traffic volumes are less than 3,500 trips per day, but should not be used where there may be a significant pedestrian crossing volume or high left-turn movements.

Other design considerations include:

- Turning analysis should be completed to ensure that the design vehicle can negotiate the circle.
- Careful consideration needs to be given to intersection paving and drainage. can be used if necessary to accommodate turning trucks and busses.
- For safety, street lighting should be considered in the vicinity of traffic circles.
- Provisions should be made for snow and ice removal.

For additional guidance, including recommended geometric standards, and for future updates, see Reference 12, ch. 5, pp. 34-36.

Commentary

The curve of a traffic circle forces the driver to slow down and pay attention to other vehicles. Traffic circles have been observed to reduce accidents at intersections and reduce the speed of vehicles traveling along an uncontrolled street at two-way stop intersections. Traffic circles are most effective at reducing speeds when several are used in a series. On average, speeds are reduced by 4 to 6 mph in the vicinity of circles.

Illustration 2 - x. Traffic Circle

Source: Pedestrian and Bicycle Information Center, Ref. 26.

However, traffic circles may make it difficult for emergency vehicles, busses, and trucks to turn left. In addition, emergency vehicles experience delays (5 to 8 seconds per circle) when traveling straight through traffic circles (Ref. 12); therefore, they should not be used along emergency response routes.

Commentary

Diagonal diverters may be expected to reduce traffic volumes by 20 to 70% (most reductions around 35%) (Ref. 12). Unless the neighborhood is confined to a limited area, installing a single diverter may merely shift through traffic to other local streets. Diagonal diverters generally need to be installed in a group or cluster to effectively route traffic to collector and arterial roadways.

Illustration 2 - y. Diagonal Diverter

Chicanes work by deflecting the vehicle path and thereby shortening the driver's sight distance. Chicanes have been observed to reduce travel speeds inside the chicanes by 5 to 13 mph, and in the vicinity of the chicanes by 1 to 6 mph (Ref. 12).

Recommended Standards

2.3.8.4 Intersection - Diagonal Diverter

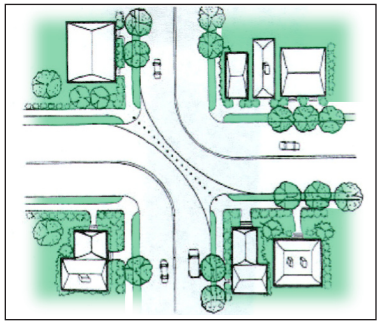


Figure 2.22.
Diagonal Diverter
Source: PennDOT (Ref. 12)

A diagonal diverter is a physical barrier placed diagonally across a four-way intersection. Their purpose is to eliminate through traffic. They are most appropriately used on residential access or residential / mixed-use streets to control traffic flow through a neighborhood. A variety of diverter designs are possible.

Design considerations should include:

- The diverter radius should be appropriate for the street design speed or a reduction in speed should be posted.
- The design and location of diverters shall be coordinated with emergency response agencies.
- Include curb cuts and breaks in diverters to accommodate pedestrian and bicycle movements.
- Diverters should be clearly visible at all times. Use painted curbs, delineation, street lights, and advance warning directional arrow signs.

For additional guidance, including recommended geometric standards, and for future updates, see Reference 12: Ch. 5, p. 48-49

2.3.8.5 Chicanes

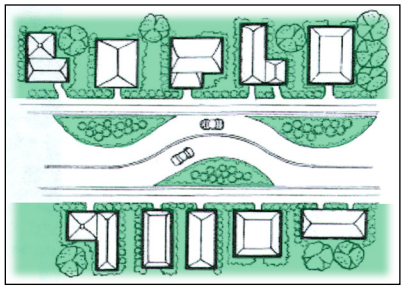


Figure 2.23. Chicanes
Source: PennDOT (Ref. 12)

Chicanes are a series of three curb extensions staggered on alternating sides of the street at mid-block locations. The primary function of chicanes is to slow vehicles by making motorists weave through the extensions.

Chicanes are appropriate for use on two-lane, two-way streets as well as one-lane, one-way streets. Chicanes can be used on any street classification with traffic volumes less than 3,500 vehicles per day. However, they are not recommended in areas where they may interfere with driveway access, or where traffic volumes are low or unbalanced (movements predominantly in one direction). For these reasons, their use is not recommended on residential access streets.

Recommended Standards

For additional guidance and for future updates, see Reference 12, ch. 5, pp. 26- 27.

2.3.8.6 Raised Median Islands

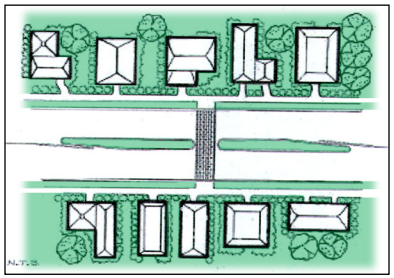


Figure 2.24.
Raised Median Islands
Source: PennDOT (Ref. 12)

Median islands are narrow islands between travel lanes that can be designed to accommodate pedestrians through breaks in the curbing and landscaping. They can be used at intersections or mid-block. The primary function of raised median islands is to reduce the crossing distance for pedestrians by allowing them to cross half the street at a time. Although the travel lanes do not change width, the median island creates the perception that the width is narrower.

Design considerations include:

- Driveway and intersection location must be considered when determining median island location and length.
- Width: 6- to 8 feet to comfortably accommodate pedestrians.

Commentary

Illustration 2 - z. Chicanes

Source: Pedestrian and Bicycle Information Center, Ref. 26.

Chicanes have been observed to lose their effectiveness when motorists have the opportunity to cross the center-line and maintain nearly a straight line of travel (Ref. 12). This may happen on low-volume roadways or when traffic movements are primarily one-directional.

Raised median islands can also be used to visually enhance the street if landscaped appropriately. They are also effective in preventing passing movements, and can be used in combination with chicanes to keep vehicles from crossing the middle line.

Commentary

Illustration 2 - aa. Raised Median Island

Raised median islands have also been found to result in a small reduction in travel speed (2 to 3 mph) if they create a local reduction in travel-way width (Ref. 12).

Each speed table / hump design has unique speed-reducing characteristics based on profile, height, length, and spacing. Reference 12 provides detailed information on the effectiveness of each design.

Illustration 2 - bb. Speed Table/Hump

Source: Pedestrian and Bicycle Information Center, Ref. 26.

Recommended Standards

- Length: 12- to 20 feet minimum needed to result in some reduction in travel speed.
- Provisions should be made for snow and ice removal.

For additional guidance and for future updates, see Reference 12: Ch. 5, p. 30, 32.

2.3.8.7 Speed Table / Hump

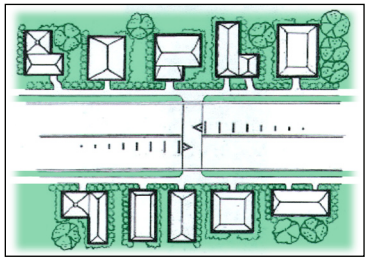


Figure 2.25.
Speed Table / Hump
Source: PennDOT (Ref. 12)

A speed table/ hump is a raised surface on the roadway that is typically 3- to 4-inches in height, and 12- to 20-feet in length. They are primarily used at mid-block locations for speed reduction. The use of speed humps should be limited to application on residential access streets.

A variety of speed hump designs have been developed (Watts, Seminole County, Gwinnett County, etc.) and tested. Specific design details and application recommendations for each are outlined in Reference 12. Speed humps have been found to be a very effective means of vehicle speed reduction.

Design considerations include:

- Hump height, length, and profile
- Spacing/ location along the street
- Drainage
- Appropriate signage and pavement markings
- Should not be installed on curves
- Cannot be used on streets without curbs unless restrictive signing or fencing is used adjacent to the hump

Recommended Standards

- Should not be used on emergency response routes
- Consideration should be given to snow and ice removal

For additional guidance and for future updates, see Reference 12: Ch. 5, p. 38- 45.

2.3.8.8 Raised Crosswalk

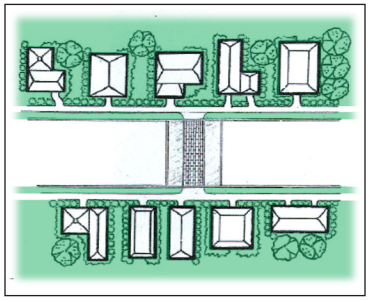


Figure 2.26.
Raised Crosswalk
Source: PennDOT (Ref. 12)

Raised crosswalks are similar to speed tables/ humps, though these are marked and elevated for pedestrian crossing purposes. Raised crosswalks serve as an extension of the sidewalk at mid-block locations or intersections. Their purpose is to reduce vehicle speeds and improve the visibility of pedestrians by clearly defining crossing locations. They are most appropriately used in areas of significant pedestrian crossing activity along residential access and residential / mixed-use streets. Their use is not recommended along residential collector roadways or primary emergency response routes.

Design considerations include:

- Use of tactile measures to warn visually impaired people of the location of the cross walk
- Appropriate placement of signage to alert drivers of crosswalk
- The ramp grade of 4% to 8% should be maintained on the approach to the raised crosswalk
- Appropriate drainage elements must be considered in the design
- All ADA requirements must be met
- Consideration must be given to snow and ice removal

For additional guidance, including recommended geometric standards, and for future updates, see Reference 12, ch. 5, pp. 46-47.

2.3.9 Street Landscaping

Street trees are usually planted within a buffer area between the street edge and the sidewalk (see chapter 3, Section 3.1.2, “Buffering”). Street landscaping shall be designed to fit the scale and character of the development. The following standards shall be applied

Commentary

Speed table / humps should be distinguished from speed bumps, which may be encountered in parking lots. Speed bumps are 3 to 6 inches high and 1 to 3 feet in length. Speed bumps result in significant vertical displacement at low speeds, but are not appropriate as traffic-calming measures on through streets.

Due to their width, markings or material change, and their elevation change, raised crosswalks provide both a visual and physical device for slowing traffic. Raised crosswalks have been observed to reduce speeds an average of 6 mph (Ref. 12). The effectiveness of raised crosswalks can be enhanced through the use of textured surface materials.

Illustration 2 - cc. Raised Crosswalk

In addition to efficient circulation for vehicles and pedestrians, residential streets should also

Commentary

create positive aesthetic qualities for residents and visitors. Street trees grow to become one of the larger elements of the street environment, yet they are instrumental in creating a comfortable, human-scaled space (see Illustration 2-dd). Along with helping to naturalize a street, street trees also minimize air pollution and create shade, which reduces summer temperatures in that area (Ref. 2).

Illustration 2-dd. Tree Canopy

Tree canopy assists in creating a pleasant pedestrian space along the street
Source: The Hamer Center for Community Design Assistance (Ref. 2)

Much of the character of older neighborhoods is derived from the mature street trees that form a canopy over the entire street (Ref. 5).

When plant materials for a streetscape are selected, the image and scale of the neighborhood, location of utilities, traffic control devices, street-lighting hardware, traffic clearances, as well as intersection clear sight triangles should be considered (Ref. 5).

The choice of tree species should take into consideration their mature height and spread, the root system's potential for damaging sidewalks and street pavements, maintenance requirements, and

Recommended Standards

(Ref. 22).

a. Plant trees on both sides of the street with spacing as follows:
   1. Under 30-foot spread at maturity: 15-35 feet on center
   2. 31 to 50-foot spread at maturity: 25-55 feet on center
   3. Over 50-foot spread at maturity: 40-80 feet on center

b. Plant trees on only one side of the street as an option when the street is adjacent to a significant feature that precludes planting on both sides of the street, such as:
   1. Preserved hedgerows or woods
   2 Open space or conservation areas
   3. Common green or central open space

c. When a less formal arrangement is desired, or where more screened views or more filtered views are deemed appropriate, groupings of smaller trees may be used to replace the trees specified in a above.

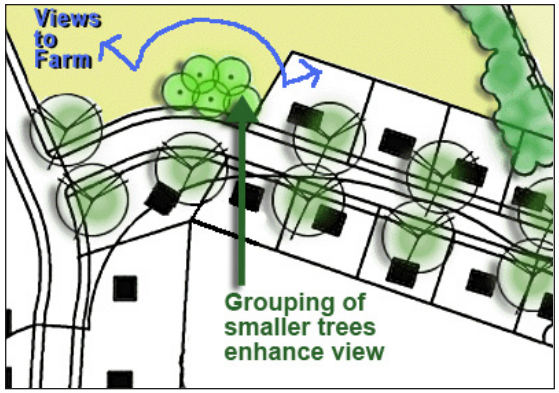


Figure 2.27. Smaller Street Trees Alternative
Less-formal street tree layout is appropriate due to adjacent farm views
Modified from Source: Judith Larkin (Ref. 22)

d. When possible, retain existing trees located within the proposed right-of-way. These will be counted toward fulfillment of the street tree requirements specified above.

e. Street trees should be planted at least 3 feet behind the back-of-curb. If the street is not

Recommended Standards

curbed, street trees shall not be planted within the clear zone.

2.3.10 Street Lighting

Residential street lighting shall be required only where there is concern for public safety. When installed, street lighting shall meet the standards of this section. Standards for the lighting for non-vehicular pedestrian and bicycle paths and walkways shall be as specified in chapter 3.

Pole Height: All pole-mounted luminaires used to illuminate residential streets within the municipality shall have a pole height such that the maximum elevation of the bottom of the luminaire does not exceed 25 feet above the street surface. Municipal streetlights mounted on signal poles, existing utility poles, or where utility easements will conflict with the streetlights mounted according to the requirements of this section shall be exempted from the height requirements as set forth under this section.

Shielding: All municipal streets shall be shielded in accordance with the following standard:

Initial luminaire output < 2,000 lumens No shielding required

Initial luminaire output > 2,000 lumens Fully shielded

A fully shielded luminaire is one in which all light emitted by the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any pan of the luminaire, is projected below the horizontal as determined by photometric test or certified by the manufacturer. Any structural part of the light fixture providing this shielding must be permanently attached.

Commentary

adaptability to the specific street environment (Ref. 5).

Shrubs selected for right-of-way planting should be low growing or, in the case of large shrubs, tolerant of under-trimming. Low shrubs and ground covers with vigorous root systems can be effective for erosion control on slopes within the right-of-way (Ref. 5).

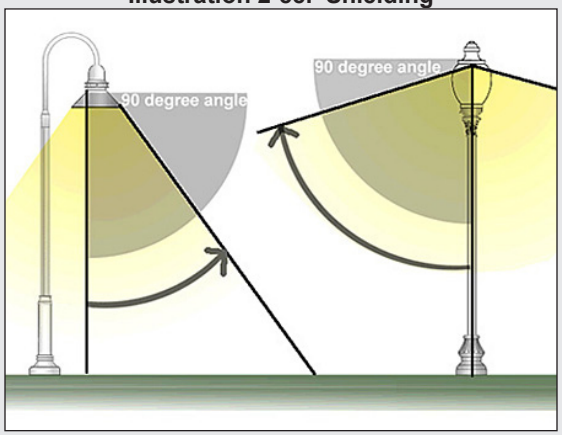
Before planting trees or shrubs near streetlights, check their photosensitivity. Continuous exposure to streetlights can cause abnormal growth in certain trees and shrubs. In northern states where salt is used on the streets for snow and ice removal, salt-tolerant species should be selected (Ref. 5).

Residential street lighting, where used, does not serve the same purpose as highway lighting. Vehicles traveling at slow speeds can easily traverse residential streets at night without external lighting. For pedestrian safety, street lights should be considered at intersections and other locations where there is risk of pedestrian / bicycle and vehicle conflicts (see chapter 3).

Shielding is required to avoid unnecessary light pollution of the night sky. Light rays that are not directed toward the ground serve no purpose, are a waste of energy, can produce glare, and will reduce the view of stars in the night sky. Most lighting manufacturers have several fixtures that comply with these requirements, often called “Dark Sky lights.”

Commentary

Illustration 2-ee. Shielding



Shielding can occur invisibly inside the fixture, as on the right, or be a visible part of the light fixture, as shown on the left.

Source: Clearwater Conservancy (Ref. 23)

Recommended Standards

2.3.11 Signage and Signalization

The developer shall provide all necessary street signs and traffic signalization as may be required by local, State, or Federal regulations. In addition, the following standards shall apply:

1. The design and placement of traffic control and other street signs placed within public right-of-way shall follow the requirements specified in the most current edition of the *Manual of Uniform Traffic Control Devices for Streets and Highways* (Ref. 11).

2. On non-public streets, all traffic control signs must be designed in accordance with the most recent version of Reference 11. Non-traffic control signs on non-public streets do not have to meet these standards.

3. At least one street-name sign pole shall be placed at each intersection identifying all crossing street names. Signs shall be placed so they do not obstruct sight distances, and shall be under light standards if present. The design of street-name signs shall be consistent, of a style appropriate to the community, of a uniform size and color, and erected in accordance with any local standards.

4. At signalized intersections, street signs shall be located on the overhead arm supporting the traffic signal, or otherwise suitably suspended over the intersection. Street

Recommended Standards

clearance shall be a minimum of 15 feet from the bottom of any sign or supporting equipment and the top of the paved surface.

2.3.12 Streets and Special Hazard or Environmental Conservation Areas

Streets shall be laid out to avoid hazardous and special environmental conservation areas such as areas of unstable soils, steep slopes, large ravines, floodplains, stormwater critical drainage-ways, riparian areas, and other environmentally sensitive areas. Where it is necessary to cross these areas, crossings should be perpendicular or near perpendicular to the feature.

2.3.13 Trip Generation Rates

Trip generation rates shall be based on the most recent data published by the Institute of Traffic Engineers (ITE) for the proposed use or housing type. Table 2-8 presents trip generation rates from Reference 10. More current data from ITE, or data from local or regional traffic studies prepared in accordance with ITE standards, may be used in place of the data in Table 2-7.

Table 2-8. Trip Generation Rates for Residential Housing Units

Housing type	Average weekday vehicle trips per day (TPD)
Single-family detached	10 *
Residential condominium / townhouse	5.9
Apartment (average) Low rise (3 stories or fewer) High rise (more than 3 stories)	 6.6 4.2
Mobile home	5.0
Retirement senior living (avg) Senior housing – detached Senior housing – attached Assisted living Senior continuous-care village	 3.7 3.5 2.7 2.8
Planned unit development	7.4

Note: Land use definitions and trip generation rates from Ref. 10. Reported values may be superseeded by rates reported in the latest update to Ref. 10.
*9.6 reported in Reference 10.
Source: Institute of Transportation Engineers (Ref. 10).

Commentary

Unstable soils are soils with high shrink-swell or slip potential. Stormwater critical drainage-ways are swales or other discharge channels that serve an important natural stormwater control function. Examples include floodplains (storage potential) and wide karstic drainage-ways (natural infiltration potential).

The Institue of Traffic Engineers defines vehicle trips per day as the average number of vehicle trip ends per day per independent variable (dwelling units, employees, etc.) counted at the site's driveway (Reference 10). For example, leaving a dwelling unit and returning counts as two trip ends or two trips per day.

Commentary

Trip Generation Studies are required to estimate traffic loads iin order to define street class and the design standards appropriate for each street.

Using the values from Table 2-8, 800 trips per day is equivalent to 80 single family homes, or 135 townhouses.

Street width is dependent on the vehicle width, traffic volume, parking requirements, and traffic pattern.

The design vehicle assumed for residential access streets is a single unit truck (SU) as defined by the American Assoc. of State Highway and Transportation Officials (Ref. 1). As defined, a

Recommended Standards

2.3.14 Traffic Studies

A Trip Generation Study shall be performed for all proposed residential developments. This study shall document the anticipated traffic distribution and loads within the development based on the trip generation rates provided in Table 2-8. The anticipated traffic load must support the design street classification used for all streets.

A Traffic Impact Study shall be performed for all developments generating total traffic volumes greater than 800 trips per day as determined by using the trip generation rates specified in Table 2-8. The traffic impact study shall include an analysis of the need, if any, for signals, turn lanes, additional travel lanes, and other street improvements for internal and adjacent streets.

Traffic impact studies are to be prepared in accordance with the local municipal ordinance on traffic impact studies. If no such ordinance has been adopted (by either the municipality or the county), then the traffic study shall be prepared in accordance with PennDOT requirements.

2.4 DESIGN STANDARDS FOR RESIDENTIAL ACCESS STREETS (RA)

Residential access streets (RA) are classified as Type A (RA-A), and Type B (RA-B). Design standards for each class follow.

2.4.1 Design Speed

Type A	20 mph
Type B	25 mph

2.4.2 Street Width

Tables 2-9 through 2-12 provide design matrices for use in establishing street width. Also see Appendices A and B.

Recommended Standards

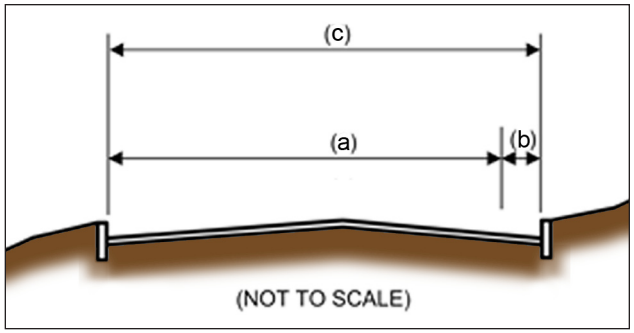


Figure 2.28. Cross-Section Profile -- Curbed Residential Access Street

Table 2-9. Residential Access Type A -- Curbed

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Street Width (curb to curb)
Yield **	One Side or Alternating Sides	10	8	18
Slow	Alternating Sides	18	8	26
Free	No Parking	18	n/a	18
Free	One Side	18	8	26

* All travelway widths are for two-way streets; for one-way use ½ of travelway width except for "yield" traffic pattern.

** Use only when ADT less than or equal to 300.

Table 2-10. Residential Access Type B -- Curbed

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Street Width (curb to curb)
Slow	Alternating Sides	20	8	28
Free	No Parking	20	n/a	20
Free	One Side	20	8	28
Free	Two Sides	20	8 each side	36

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

Commentary

single-unit truck has a width, wheelbase, and turning radius larger than standard service vehicles (including trash trucks), conventional and large school buses, and conventional single-unit fire and rescue vehicles.

With the exception of the yield pattern, 9-foot wide travel lanes are provided. References 1, 2, 4, 5, and 6 all recommend 9 feet as a minimum lane width for low-volume residential access streets. By design, these lane widths make driving at high speeds uncomfortable enough to ensure non-vehicular safety. A 10-foot lane width is provided for the yield pattern to allow clearance between parked cars and the travel lane.

It is further noted that although a 7-foot minimum parking lane is suggested in several references (1, 2, 4, 5, and 6), an 8-foot parking lane is recommended due to the more narrow lane width.

It is noted that Appendix D of the International Fire Code (Ref. 19) specifies a minimum street width of 26 feet when there is a fire hydrant along the access route or street. This allows a pumper truck to be stopped at the hydrant and permit other emergency vehicles to pass by as they proceed to the site of the fire. The same accessibility can be provided by designing a pull-off for the tanker truck adjacent to the fire hydrant. This pull-off should have a minimum length of 24 feet.

A travel lane width of 10 feet is used in all cases for type B residential access streets. This lane width allows for slightly greater ease of vehicle movement.

Commentary

Where parking is permitted on the shoulder, it is recommended that the outer six (6) feet of the 8-foot wide shoulder be stabilized grass. Grass shoulders will help to retard surface runoff and, to some degree, enhance infiltration. Maximizing grassed shoulder width will also create a narrower perceived street width, promoting slower vehicular travel speeds. However, wider gravel widths may be appropriate on higher volume curved streets to accommodate rear wheel-turning movements characteristic of larger trucks on curved streets.

Traffic volumes and speeds on residential access streets permit shared use of the cart-way by bicycles and motorized vehicles. The omission of separate travel lanes for bicycles minimizes the street pavement width, thereby reducing construction and maintenance costs, as well as minimizing stormwater impacts.

Recommended Standards

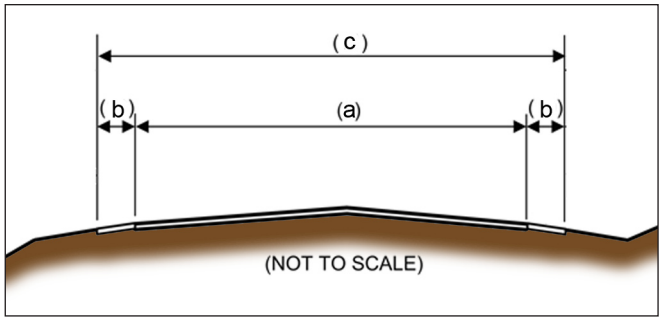


Figure 2.29. Cross-Section Profile -- Residential Access Street with Reinforced Shoulder

The first 2-feet of a "reinforced shoulder" shall be gravel in accordance with PennDOT standards for gravel shoulders. The remaining width of reinforced shoulder may be either a continuation of a gravel shoulder, stabilized grass, or a combination of both. Stabilized grass shoulders shall be constructed using a soil stabilizing geo-fabric or grid under a grass surface which will support occasional parking.

Table 2-11. Residential Access Type A -- Reinforced Shoulder

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Shoulder Width (each side) (ft.)	(c) Street Width (shoulder to shoulder)
Free	No Parking	18	2 each	22
Free	One Side	18	2 on one side, 8 on parking side	28
Free	No Parking	18	8 each	34

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

Table 2-12. Residential Access Type B -- Reinforced Shoulder

Traffic Pattern	Parking Type	(a) Travelway width* (ft.)	(b) Shoulder width (each side) (ft.)	(c) Street width (shoulder to shoulder)
Free	No Parking	20	2 each	24
Free	One Side	20	2 on one side, 8 on parking side	30
Free	Two Sides	20	8 each side	36

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

Recommended Standards

2.4.3 Bicycle Access

On residential access streets bicycles shall share the street with other vehicles. No additional street width shall be provided for bicycles (see more in chapter 3).

2.4.4 Pedestrian Access

To promote a pedestrian-friendly neighborhood character, it is recommended that sidewalks and / or pedestrian trails be provided in all residential developments. As a general guideline, sidewalks should be provided along residential type A and B streets for medium- to high-density developments. More details about sidewalks are provided in chapter 3.

2.4.5 On-street Parking

The amount of on-street parking provided shall not exceed the requirements of section 4.1 in chapter 4 by more than 10%. If parking is to be provided along only a portion of the street, the street width should be reduced in areas where parking will not be provided. Bulb-outs and other appropriate transition elements should be used to accommodate changes in street width (see 2.3.8 for more about bulb-outs).

Individual parking spaces along residential access streets shall not be delineated by pavement markings. However, adequate signage shall be provided to clearly designate on-street parking areas. This is particularly important where parking is limited to one side only, or where parking alternates from one side to the other.

2.4.6 Right-of-way Width

Rights-of-way shall be set aside to provide adequate space for the construction and maintenance of streets, shoulders, curbs, street gutters, and cross-drainage pipes and culverts. They may also accommodate sidewalks, snow storage, sight triangles, slope maintenance areas, and utilities such as water, sewer, storm drainage, electrical service, cable TV, and gas lines where appropriate.

The minimum right-of-way width for residential access streets shall be 50 feet.

2.4.7 Street Slope

a. *Longitudinal Slope:* 12% maximum
0.5% minimum

Steeper slopes may be permitted for short distances upon approval by the municipal

Commentary

The requirement for sidewalks here is to separate pedestrian and vehicular and bicycle traffic in moderate- to high-density subdivisions. However, pedestrian and bicycle trails should be considered for all residential developments.

These slopes are based on recommendations from the American Assoc. of State Highway and Transportation Officials (Ref. 1), the Hamer Center

Commentary

for Community Design (Ref. 2), and the Institute of Transportation Engineers (Ref. 6), and a desire to minimize the disturbance caused by excessive cut and fills.

Residential access streets should be constructed at a line and grade consistent with the surrounding terrain to minimize disturbance. Grades up to 17% are acceptable for short distances in hilly or mountainous terrain as long as icing is not considered to be a significant hazard. A short distance as intended here would generally be less than 200 feet.

Where ADA-accessible sidewalks are required adjacent to the street, maximum street grades may be limited to 5% (see chapter 3).

The recommended minimum horizontal curve radii are as suggested in Reference 5 and are based on friction factors and other data reported in Reference 1. These values were established such that the lateral force exerted in the curve causes the driver to experience a feeling of discomfort when negotiating a curve at the design speed. The recommended minimum radii are twice as large as radii at imminent skidding on a level, dry surface for average tire tread conditions (a safety factor of 2 with respect to radius). When considering the effect of negative cross-slope (super-elevation) caused by the street's cross-slope on vehicles entering curves to the left, the recommended radii result in safety factors against imminent skidding of 1.8 and 1.9 for 3% and 2% cross slopes, respectively.

Recommended Standards

engineer.

b. *Maximum longitudinal slope within 50 feet of intersections: See section 2.3.3.5.*

2.4.8 Horizontal Curvature

Horizontal curvature on residential streets shall be designed without super-elevation to minimize vehicular travel speeds. The minimum street curvature (radius) for residential access streets shall be as follows:

Type A	90 feet
Type B	165 feet

These values are to be measured at the center-line of the street. The minimum tangent length between reverse curves shall be 50 feet.

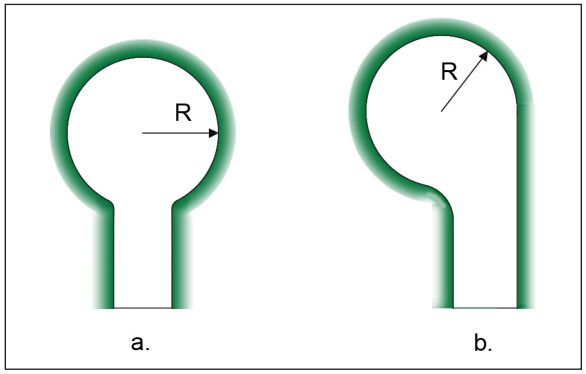
2.4.9 Cul-de-sacs

Cul-de-sacs are single access streets (single means of ingress and egress), and include a turn-around at the end. Cul-de-sac streets shall meet the design standards for a type "A" residential access street (RA-A).

2.4.9.1 Cul-de-sac Turnarounds: Cul-de-sac turnarounds can be a variety of shapes, including circular, "T", and "Y". Figures 2.14 through 2.16 illustrate several configurations.

Recommended Standards

a. ***Circular turnarounds without center islands:*** The minimum allowed paved radius of a circular cul-de-sac without a center island shall be 42 feet. If parking is to be provided around the cul-de-sac, the minimum paved radius allowed shall be 55 feet.



a. centered b. off-center

Figure 2.30. Circular Turnarounds Without Center Islands
Modified from Source: National Association of Homebuilders et al., *Residential Streets* (Ref. 5)

If a fire hydrant is located adjacent to the cul-de-sac bulb, the minimum cul-de-sac radius shall be 48 feet (58 feet if parking is permitted around the cul-de-sac perimeter)

A minimum 28-foot transition radius shall be installed between the cul-de-sac street and the cul-de-sac bulb.

b. ***Circular turnarounds with center islands:*** Minimum radii for circular turnarounds with center islands are the same as for circular turnarounds without center islands (see section 2.4.10.1a above). For centered islands, the minimum allowed travel lane width shall be 24 feet. To minimize pavement within the cul-de-sac, the travel

Commentary

A 42-foot radius turn-around can accommodate a 180-degree continuous turning movement by single-unit vehicles. This movement may require bumper curb overhang. A 45-foot radius turn-around would accommodate a 180-degree continuous turning movement by single-unit vehicles without curb-overhang (computed from clearances and minimum turning radius from Reference 1 and Reference 5).

A 55-foot radius turn-around can accommodate a 180-degree continuous turning movement by single-unit vehicles with sufficient clearance for an 8-foot parking lane around the perimeter of the turn-around (computed from clearances and minimum turning radius' from Reference 1).

Note that a 35-foot radius cul-de-sac meets the minimum requirements in Appendix D of Reference 19 for the case where no fire hydrant is adjacent to the cul-de-sac. However, this does not provide adequate room for continuous turning movements for service vehicles and school busses. Therefore, a 42-foot minimum radius is recommenced. It is also noted that a 40-foot radius cul-de-sac must be maintained to qualify for liquid fuels funds.

The additional radius needed when fire hydrant is adjacent to the cul-de-sac permits emergency vehicles to pass a pumper truck stationed at the hydrant during a fire. Alternatively, a pull-off could be used adjacent to the hydrant for emergency vehicle access (Reference 19).

The minimum 28-foot transition radius is based on the design vehicle turning radius.

To reduce the amount of paving, turnarounds may have center islands. However, adequate turning and maneuvering space must be provided. To expedite turning movements, the street pavement should be wider at the rear of the center island as illustrated in Figure 2.14b. Center islands create

Commentary

an attractive landscape area, and can be used for stormwater management and snow storage (Ref. 5).

Illustration 2- ff Cul-de-sac Center Island

Center island in cul-de-sac serves stormwater management purpose.

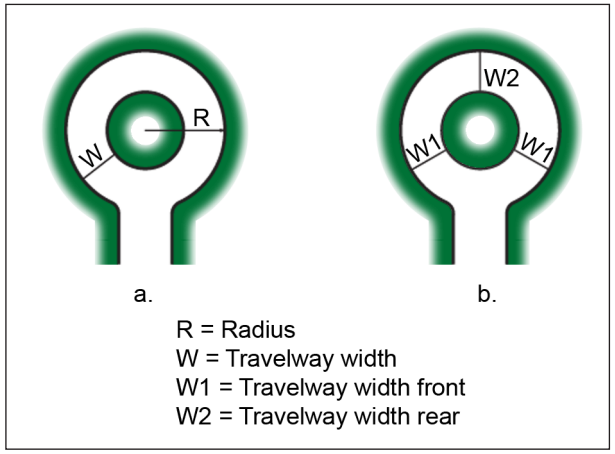
Illustration 2-gg Retangular Center Island

Center island is more rectangular in shape to relate to the adjacent housing (Washington's Landing, Pittsburgh, PA) Source: The Hamer Center for Community Design Assistance (Ref. 2)

Site designers should use the circular cul-de-sac as a basic standard; however, where possible, creative solutions that enhance the character of the community are encouraged, such as the turnaround in Illustration 2-gg where the dead-end street configuration relates to the site design and adjacent

Recommended Standards

lane can be offset as shown in Figure 2.16b with a 20-foot travel lane at the front (W1) and a 24 foot travel lane at the rear (W2). If parking is to be accommodated on the cul-de-sac, an 8-foot parking lane shall be added adjacent to the travel lane.



a. centered b. off-set

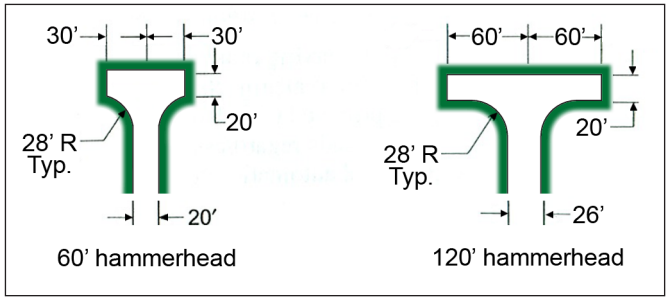
Figure 2.31. Circular Turnarounds with Center Islands
Modified from Source: National Association of Homebuilders et al., *Residential Streets* (Ref. 5)

When a fire hydrant is located adjacent to the cul-de-sac, the minimium cul-de-sac radius shall be increased as specified in Section 2.4.10.1a.

A minimum 28 foot transition radius shall be installed between the cul-de-sac street and the cul-de-sac bulb.

Recommended Standards

c. ***"T" and "Y" type turnarounds:*** The use of "T" or '"Y" turnarounds is allowable on cul-de-sacs serving 10 or fewer homes. The dimensions of a "T" turn-around are illustrated in Figure 2.32. Similarly a "Y" turnaround can be constructed with the same leg dimensions. .



a. No fire hydrant b. Fire hydrant adjacent to turnaround

Figure 2.32. "T" Turnarounds
Modified from Source: National Association of Homebuilders et al., *Residential Streets* (Ref. 5)

d. ***Cul-de-sac Length:*** As a single access street, cul-de-sacs are limited to serving no more than 30 single-family residential units.

2.4.10.2 Cul-de-sac Right-of-way: The minimum acceptable right-of-way for cul-de-sacs shall be 10 feet beyond the edge of pavement.

2.5 DESIGN STANDARDS FOR RESIDENTIAL COLLECTOR STREETS (RC)

2.5.1 Design Speed

A 35 mph design speed shall be used for the design of residential collector streets

2.5.2 Lot Access Restrictions

Commentary

architecture.

The use of "T" (sometimes refered to as hammerhead) or "Y" shaped turnarounds requires that all vehicles make a back-up movement when turning. However, they require less paving, their construction and maintenance costs are lower, and they provide greater flexibility in land planning and the location of homes.

Appendix D of the International Fire Code (Ref. 19) limits cul-de-sac length to 750 feet unless some form of secondary access is provided. As of this writing, this portion of the International Fire code has not been adopted by Pennsylvania and can not be enforced. However, safety of residents and emergency vehicle access should be a consideration when establishing cul-de-sac length.

This is an average value modified from AASHTO recommendations in Reference 1. The design speed is based more on function than terrain.

Commentary

Whenever possible, residential collector streets should have no lots directly fronting onto or gaining access from the collector street. When site or other conditions make this impossible, the amount of residential frontage indicated in Table 2-19 is allowed. This table sets out the percentage of the total length of collector streets along which residential streets may front or gain access.

The street widths are intended to minimize impervious areas while meeting the collector function. They are based on AASHTO guidelines (Ref. 1).

The use of curbing is discouraged along residential collectors to enhance opportunities to use street swales for water quality enhancement. Curbing should be provided where street drainage could cause erosion (typically when street grades exceed 4%, or where cut-slope limitations prohibit the use of street swales). Curbing should also be used to delineate the edge of pavement where appropriate.

Recommended Standards

Lot frontage and vehicular access shall be discouraged along residential collectors. Allowable access frontage is indicated in Table 2-13.

Table 2-13. Allowable Access Frontage on Residential Collector Streets

ADT*	< 1,200	1,200 – 1,599	1,600 – 2,000	> 2,000
Frontage Length**	20%	10%	5%	0%

* ADT: Average Daily Trips
** Listed as a percentage of total collector street length

Only lots having frontages of 100 feet or greater may access on to residential collector streets. Space shall be provided on these lots for turnaround movements so that vehicles will not have to back out of driveways. Lots less than 100 feet in width shall only have vehicular access via a rear alley.

2.5.3 Street Width

Tables 2-14 and 2-15 provide design matrices for use in establishing street width for residential collectors. Also see Appendices A and B.

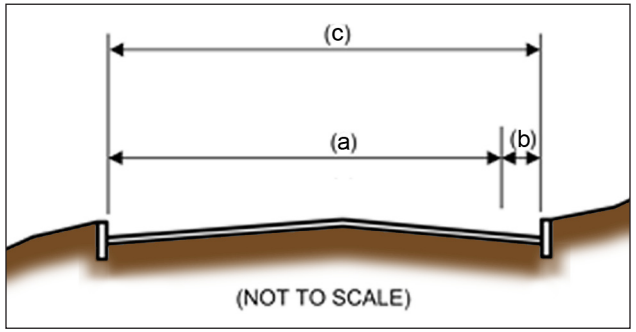


Figure 2.33. Cross-Section Profile -- Curbed Residential Collector Street

Table 2-14 .Residential Collector -- Curbed

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Street Width (curb to curb)
Free	No Parking	24	n/a	26**

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

Recommended Standards

** One additional foot is provided on each side of the striped travelway to provide for a drainage gutter.

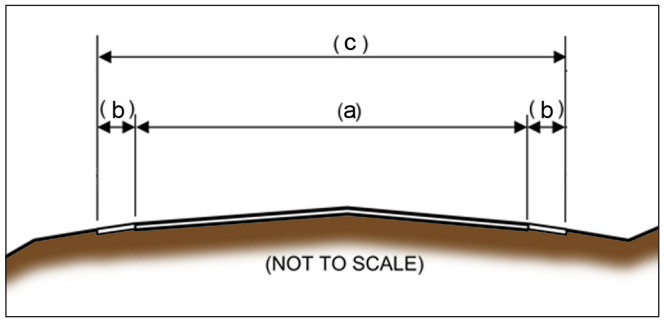


Figure 2.34. Cross-Section Profile -- Residential Collector with Reinforced Shoulder

The first 2-feet of a "reinforced shoulder" shall be gravel in accordance with PennDOT standards for gravel shoulders. The remaining width of reinforced shoulder may be either a continuation of a gravel shoulder, stabilized grass, or a combination of both. Stabilized grass shoulders shall be constructed using a soil stabilizing geo-fabric or grid under a grass surface which will support occasional parking.

Table 2-15 .Residential Collector -- Reinforced Shoulder

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Shoulder width (each side) (ft.)	(c) Street width (shoulder to shoulder)
Free	No Parking	24	6 each	36

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

2.5.4 On-street Parking

Parking is not permitted along residential collectors.

2.5.5 Bicycle Access

Where required, bicycle access shall be provided along residential collector streets either through the addition of a bicycle lane at the edge of the pavement, or by an adjacent bicycle path. Bicycle lanes and paths shall be designed in accordance with the standards in chapter 3.

Commentary

Parking is restricted along residential collectors to minimize impervious area, discourage lot frontages, and enhance traffic flow.

Collector streets can serve as bicycle and pedestrian corridors as well as corridors to move motorized vehicles. Where possible, a bicycle lane should be clearly marked. A waiver of the requirement to accommodate bicycles may be considered if there is no reasonable or safe connection for bicycle access beyond the subdivision.

Commentary

The requirement for sidewalks or pedestrian pathways may be waived if adequate pedestrian accessibility is provided by other means.

A 50-foot right-of-way width is recommended if curbing is used along the entire length of the street. If portions of the street are uncurbed, a 60-foot right-of-way is recommended. Some variability of right-of-way should be permitted to accommodate site-specific conditions, and help maximize the area available for lots.

These standards are based on recommendations in References 1, 5, and 6, and a desire to minimize the disturbance caused by excessive cut and fills.

Residential collector streets should be constructed at a line and grade consistent with the surrounding terrain to minimize disturbance. Grades up to 12% are acceptable for short distances (approximately 200 feet) in hilly or mountainous terrain as long as icing is not considered to be a significant hazard.

Where ADA-accessible sidewalks are required adjacent to the street, maximum street grades may be limited to 5%. (See chapter 3).

Residential streets should be designed without super-elevation because of the frequency of cross-

Recommended Standards

2.5.6 Pedestrian Access

Where required, sidewalks or pedestrian pathways shall be constructed along residential collector streets provided that there is a reasonable and safe destination for pedestrians along or connecting to the walkway. Sidewalks and pedestrian pathways shall be designed in accordance with the standards in chapter 3.

2.5.7 Right-of-way Width

The rights-of-way shall be established to provide adequate space for the construction and maintenance of streets, shoulders, curbs, street gutters, and cross-drainage pipes and culverts. They may also accommodate sidewalks, snow storage, sight triangles, slope maintenance areas, and utilities such as water, sewer, storm drainage, electrical service, cable TV, and gas lines where appropriate.

The right-of-way width for residential collector streets shall be as follows:

- Minimum 50 feet
- Maximum 65 feet

Right-of-way widths shall be established in even 5- foot increments.

2.5.8 Street Slope

a. *Longitudinal Slope:* 10% maximum
0.5% minimum

Steeper slopes may be permitted for short distances upon approval by the municipal engineer.

b. *Maximum longitudinal slope within 50 feet of intersections:* See Section 2.3.3.5

2.5.9 Horizontal Curvature

The minimum allowable street curvature (radius) for residential collector streets is 440 feet.

Recommended Standards

This value is to be measured along the center-line of the street. The minimum tangent length between reverse curves shall be 100 feet.

Commentary

streets, alleys, and driveways. The minimum horizontal curvature radius is based on friction factors reported in Reference 1. These friction factors were established such that the lateral force exerted in the curve causes the driver to experience a feeling of discomfort when negotiating the curve at the design speed. This criterion results in a safety factor of approximately 2 for lateral skidding (safety factor is the ratio of the friction factor for imminent skidding to the friction factor for discomfort).

The recommended minimum street curvature of 440 feet ignores the affective negative superelevation caused by the street cross slope on vehicles entering curves to the left (Reference 1). For these vehicles the factor of safety against imminent skidding is reduced to 1.8 for streets having cross slopes of 3% and 1.9 for streets having cross slopes of 2%. In addition, a greater feeling of discomfort will be experienced. To maintain a safety factor of 2 for all vehicles, a minimum curvature of 490 feet should be maintained.

Note that if street superelevation is being used, minimum horizontal curvatures should be based on standards in the current version of Reference 1 for superelevated streets.

2.6 DESIGN STANDARDS FOR RESIDENTIAL MIXED-USE COLLECTORS (RMC)

2.6.1 Design Speed

A 30 mph design speed shall be used for the design or residential mixed-use collector streets.

This is an average value modified from AASHTO recommendations in Reference 1. The design speed is based more on function than on terrain.

2.6.2 Street Width

Tables 2-16 and 2-17 provide design matrices for use in establishing street width for residential mixed-use collectors. Also see Appendices A and B.

Lane widths are used to permit access by delivery vehicles but maintain a relatively narrow street to discourage high traffic speeds. This width is based on AASHTO guidelines in Reference 1.

Commentary

An 8-foot parking lane is used to provide a measure of comfort in entering and exiting vehicles adjacent to moving traffic. It is anticipated that parking will be provided along residential mixed-use collectors for access to neighborhood commercial facilities.

Curbed streets are recommended where street access to neighborhood commercial properties is desired.

Recommended Standards

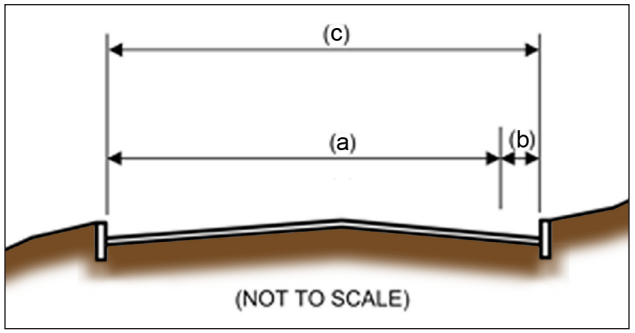


Figure 2.35. Cross-Section Profile -- Curbed Residential Mixed-Use Collector Street

Table 2-16. Residential Mixed-Use Collector -- Curbed

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Street Width (curb to curb)
Free	No parking	22	0	22
Free	One lane	22	8	30
Free	Two lanes	22	8 each side	38

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

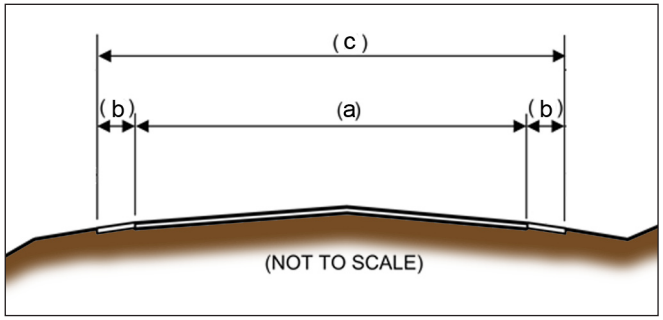


Figure 2.36. Cross-Section Profile -- Residential Mixed-Use Collector with Reinforced Shoulder

The first 2-feet of a "reinforced shoulder" shall be gravel in accordance with PennDOT standards for gravel shoulders. The remaining width of reinforced shoulder may be either a continuation of a gravel shoulder, stabilized grass, or a combination of both. Stabilized grass shoulders shall be constructed using a soil stabilizing geo-fabric or grid under a grass surface which will support occasional parking.

Recommended Standards

Table 2-17. Residential Mixed-Use Collector -- Reinforced Shoulder

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Shoulder width (each side) (ft.)	(c) Street Width (shoulder to shoulder)
Free	No Parking	22	6 each	34

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

2.6.3 On-street Parking

All on-street parking shall be delineated with white striping and shall meet the standards of section 2.3.2.

2.6.4 Bicycle Access

When provided, bicycle access shall be located as follows:

On-street parking: Locate bicycle paths off travel lanes and buffered from vehicular traffic.

No on-street parking: A bicycle lane may be designed as a part of the street.

Bicycle lanes and bicycle paths shall be design in accordance with the standards in chapter 3.

2.6.5 Pedestrian Access

Sidewalks or pedestrian path ways shall be provided along residential mixed-use collectors. Sidewalks and pedestrian path ways shall be designed in accordance with the standards in chapter 3.

2.6.6 Right-of-way Width

The rights-of-way shall be established to provide adequate space for the construction and maintenance of streets, shoulders, curbs, street gutters, and cross drainage pipes and culverts. They may also accommodate sidewalks, snow storage, sight triangles, slope maintenance areas, and utilities such as water, sewer, storm drainage, electrical service, cable TV, and gas lines where appropriate.

Commentary

On-street parking is encouraged for access to neighborhood commercial properties.

Bicycle access to neighborhood commercial and multi-family residential properties is encouraged. To avoid conflicts between bicycles and parked cars, bicycle lanes should not be a part of the street pavement when on-street parking is specified.

Sidewalks or pedestrian pathways shall be provided as necessary to provide pedestrian accessibility to neighborhood commercial and multi-family residential properties. Appropriate buffering should be provided between pedestrians, bicycles, and motorized vehicles within these corridors.

A 50-foot right-of-way width is recommended if curbing is used. Some variability in right-of-way should be permitted to accommodate site-specific conditions, and help maximize the area available for lots.

Commentary

The 8% street grade limitation is intended to provide comfortable street access to neighborhood commercial properties. Residential mixed-use collector streets should be constructed at a line and grade consistent with the surrounding terrain to minimize disturbance. Where ADA-accessible sidewalks are required adjacent to the street, maximum street grades may be limited to 5%.

Residential streets should be designed without superelevation because of the frequency of cross-streets, alleys, and driveways. The minimum horizontal curvature is based on friction factors reported in Reference 1. These friction factors were established such that the lateral force exerted in the curve causes the driver to experience a feeling of discomfort when negotiating the curve at the design speed. This criteria results in a safety factor of approximately 2 for lateral skidding (safety factor is the ratio of the friction factor for imminent skidding to the friction factor for discomfort).

The recommended minimum street curvature of 275-feet ignores the affective negative superelevation caused by the street cross slope on vehicles entering curves to the left. For these vehicles the factor of safety against imminent skidding is reduced to 1.8 for streets having cross slopes of 3% and 1.9 for streets having cross slopes of 2%. In addition, a greater feeling of discomfort will be experienced. To maintain a safety factor of 2 for all vehicles, a minimum curvature of 320 feet should be maintained.

Recommended Standards

The right-of-way width for residential mixed-use collector streets shall be as follows:

- Minimum 50 feet
- Maximum 65 feet

Right-of-way widths shall be established in even, 5-foot increments.

2.6.7 Street Slope

a. *Longitudinal slope:* 8% maximum
0.5% minimum

b. *Maximum longitudinal slope within 50 feet of intersections:* See section 2.3.3.5

2.6.8 Horizontal Curvature: The minimum allowable street curvature (radius) for residential mixed-use collector streets is 275 feet. This value is to be measured along the center-line of the street. The minimum tangent length between reverse curves shall be 100 feet.

Recommended Standards

2.7 DESIGN STANDARDS FOR ALLEYS

When used, alleys shall be designed in a linear or curvilinear grid configuration. Rear lot alleys can be accessed from perpendicular side streets and/or side lot alleys. The spacing between rear lot alley access points shall not exceed 600-feet measured from edge of right-of-way to edge of right-of-way as illustrated in Figure 2.37.

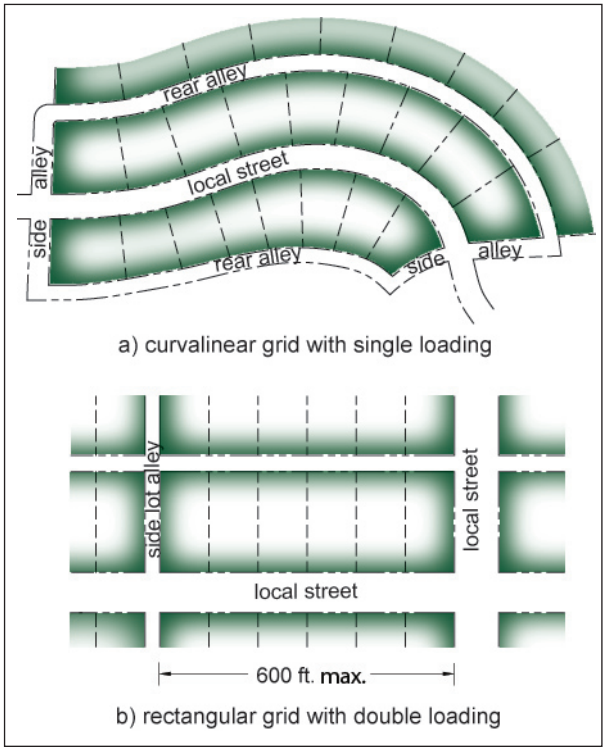


Figure 2.37. Alley Layout

2.7.1 Geometric Standards

Minimum paved cart-way	12 ft.
Curbs	Not permitted
Minimum shoulder width	2 ft. (stabilized grass or gravel)
Minimum right-of-way	16 ft. (20 ft. recommended)
Pavement cross slope	Inverted; 2% min and 6% max (see Figure 2.38)
Longitudinal slope	No limitations; Alley slope should not exceed 25%
Horizontal curvature	No limitations

Commentary

Alleys provide rear lot access. They have historically been used in small-town, grid-type subdivision configurations. However, they are also adaptable to configurations characteristic of rural or suburban cluster developments. Alleys are particularly useful when lot frontages are less than 80 feet.

A 12-foot cart-way provides for one clear travel lane. When vehicles approach each other from opposite directions, both vehicles must yield and pull onto the shoulder to pass. Curbs along alleys would interfere with passing movements and are not permitted. Some communities choose to make alleys one-way to avoid the need for vehicles to pass.

The longitudinal slope of alleys should follow the natural grade.

At the time of this writing, only cities and boroughs

Commentary

can collect liquid fuels taxes for rights-of-way less than 33 feet. To meet this requirement, a 33-foot alley right-of-way may be appropriate in some instances. Figure 2.39 compares a 16-foot alley right-of-way with 10-foot building setback, with a 33-foot alley right-of-way having a 12-foot cart-way and 1.5-foot building set-back. Where feasible, it is recommended that the right-of-way be reduced to a 12-foot cart-way.

Pavement cross-slope is inverted to accommodate alley drainage.

Temporary standing for up to 15 minutes is intended to permit short-term loading and unloading of vehicles. State Code Title 67, Chapter 601.6, prohibits parking in the traffic lane of any street.

An 8-foot spread will result in a very thin layer of

Recommended Standards

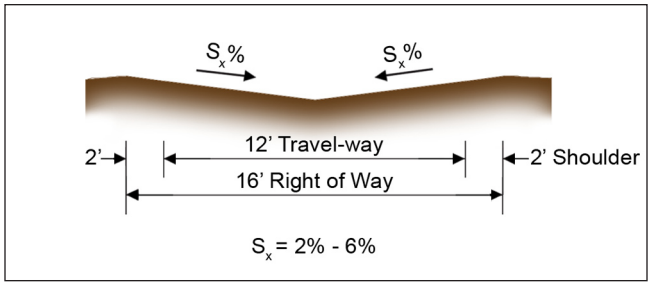


Figure 2.38. Alley Cross Section -- Inverted Crown

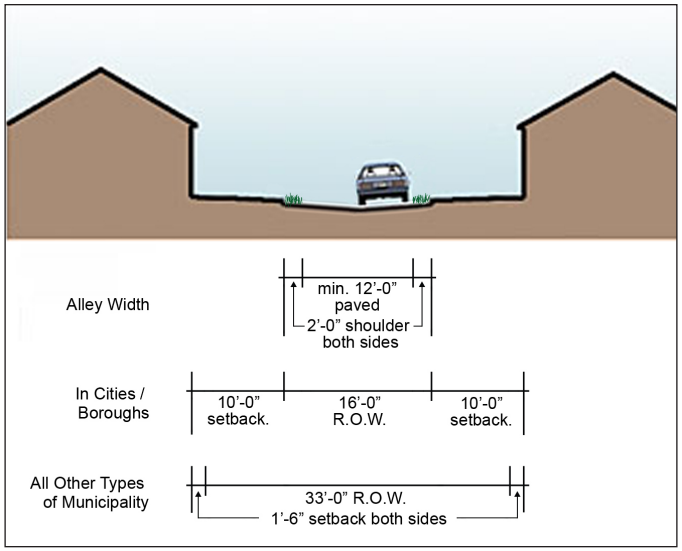


Figure 2.39. Alley Right-of-way

Source: The Hamer Center for Community Design Assistance (Ref. 2)

2.7.2 Parking

Parking is not permitted within alley rights-of-way. Adequate parking for residents and visitors must be provided on-lot or in separate, dedicated parking facilities. Temporary standing to the side of the right-of-way is permitted for up to 15 minutes as long as sufficient space exists for a vehicle to pass within the right-of-way.

2.7.3 Drainage

Recommended Standards

Drainage inlets shall be located along alley center-lines to limit the flow spread on the pavement to less than 8 feet during a 10-year-frequency event.

2.8 DIVIDED STREETS

With the exception of the cross-sectional geometry, boulevards and parkways shall be designed to the same standards as residential collectors.

2.8.1 Street Width

Tables 2-18 and 2-19 provide a design matrix for use in establishing street width for boulevards and parkways. Also see Appendices C and D.

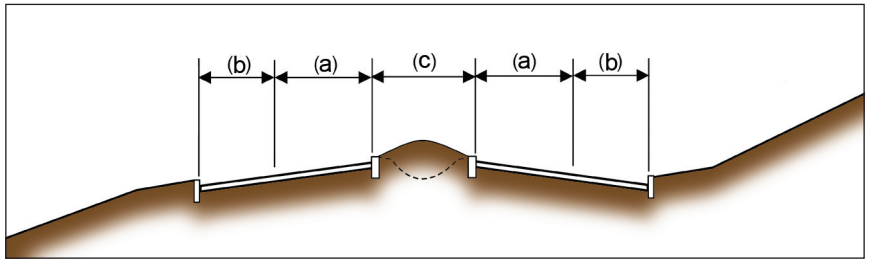


Figure 2.40. Cross-Section -- Divided Street, Boulevard with Curb

Table 2-18. Divided Streets -- Boulevard with Curb

Parking Type	(a) Lane Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Minimum Median Width (ft.)
No parking	11	0	10
Parallel	11	8	10
Angled parking ***	****	18	10

* Provide the number of lanes necessary to accommodate anticipated traffic
** Stabilized grass is acceptable
*** Only permitted where anticipated traffic volume is less than 1,500 ADT
**** Lane width must accommodate backing movement from parking space

Commentary

water under the wheel path of a standard vehicle. At the slow travel speeds characteristic of alleys, this will not cause a safety hazard.

In urban and growth expansion areas, boulevards can be designed to include a secondary access street on either side of the main travel lanes. In these instances, the access streets should be divided from the main travel lanes by a median. This condition is typical in older regions, especially when residential uses face boulevard streets. For a range of boulevard street types, see *The Boulevard Book: History, Evolution, Design of Multiway Boulevards* (Ref. 20).

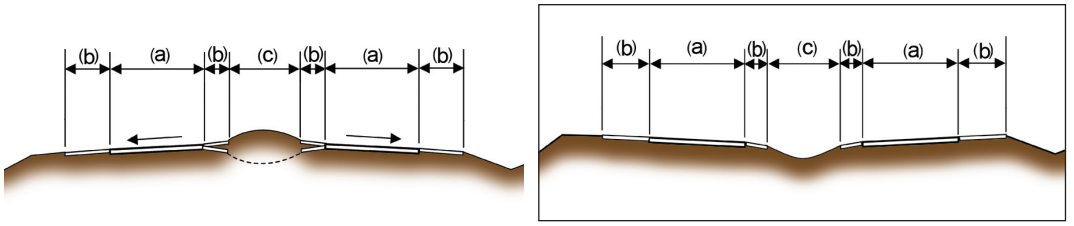
If travel lanes are designed to slope towards median, curbs can be designed with breaks to allow stormwater to drain into median, as shown in Illustration 2-hh.

Illustration 2-hh. Curb with Breaks for Drainage

Commentary

Restricting the number of lots that gain access from a stub street is intended to restrict their use for lot access except for those limited occasions when no other means of access is available based on site geometrics.

Recommended Standards



a. Parkway with drainage away from median b. Parkway with drainage toward median

Figure 2.41. Cross-Section Profile -- Divided Street, Parkway with Reinforced Shoulder

Table 2-19. Divided Streets - Parkway with Reinforced Shoulder

Parking Type	(a) Lane Width* (ft.)	(b) Shoulder Width (ft.)	(c) Minimum Median Width (ft.)
No parking	11	4 one side + 2 one side = 6	10

* Provide the number of lanes necessary to accommodate anticipated traffic.

2.8.2 On-street Parking

All on-street parking shall be delineated with white striping and shall meet the standards of Section 2.3.2.

2.8.3 Right-of-way Width

The rights-of-way shall be established to provide adequate space for the construction and maintenance of streets, shoulders, curbs, street gutters, and cross-drainage pipes and culverts. They may also accommodate sidewalks, snow storage, sight triangles, slope maintenance areas, and utilities such as water, sewer, storm drainage, electrical service, cable TV, and gas lines where appropriate.

2.9 STUB STREETS

Stub streets can be constructed for the future extension of residential access, collector, and mixed use collector streets as specified in section 2.2.4.3. Stub streets shall be designed in accordance with its street classification based on anticipated traffic volume and function.

No more than four (4) lots may gain access from a stub street. However, a temporary

Recommended Standards

turn-around must be provided if any residential lots gain access from the stub street. To reduce land disturbance, the temporary turn around shall comply with "T" or "Y" turnaround standards in Section 2.4.10.1.c.

2.10 RESIDENTIAL STREET CONSTRUCTION DETAILS

The street construction details contained herein are minimum standards. These standards are adequate to provide safe, durable residential streets. In no case shall a proposed design provide for less than these standards require. Designs in excess of these standards shall be required when conditions warrant. Materials and construction methods shall comply with the latest edition of PennDOT specifications contained in PennDOT Publication 408.

The municipality may approve alternate designs for material type, depth, and width when sound engineering analysis proves the acceptability of the alternate. In no instance shall a proposed alternate design be less than the minimum requirement contained herein.

2.10.1 Street Cross Section

The major elements of a street cross section include travel lanes, parking lanes, shoulder and curb areas, and area outside the defined street that can be used to provide for drainage, utility location (water, sewer, storm drainage, power, cable, gas, phone, etc), sidewalks, and landscaping. In addition to defining the location of critical cross-section elements, the sections define permissible cross slopes for each or the cross-section elements. The full cross-sections for curbed streets, uncurbed streets, alleys, parkways, and boulevards are provided in Figures 2.54 through 2.58 of Appendices A through D.

2.10.2 Pavement Structure

The pavement structure for each street classification shall be as identified in Figure 2.42. These pavement sections are based on an assumed subgrade strength defined by a California Bearing Ratio (CBR) of 3. Equivalent or alternate pavement sections may be used as defined below:

1. *Equivalent Pavement Section*: An equivalent pavement section is one that has the same Design Structural Number (SN) as the sections defined in Figure 2.42. The design structure number is given by the following equation:

$$SN = a_1d_1 + a_2d_2m_2 + \ldots + a_id_im_i$$

Commentary

A CBR of 3 is considered to represent a poor subgrade condition with a roadbed soil modulus of approximately 4,500 psi.

Structural coefficients tabulated in Reference 24 are provided in the following table for convenience.

Commentary

Table 2.-20. Structural Coefficients for Common Flexible Pavement Materials

Pavement Component	Structural Coefficient
Surface Course:	
Superpave 9.5 mm, 12.5 mm, 19 mm, 25 mm, (wearing and binder courses)	0.44
ID-2, ID-3 (wearing and binder courses)	0.44
FB-1, FB-2 (wearing and binder course)	0.20
FJ-1, FJ-1C, FJ-4 (wearing and binder course)	0.35
Base Course:	
Plain Cement Concrete (PCBC)	0.50
Lean Cement Concrete (LCBC)	0.40
Superpave 25 mm, 37.5 mm, base course	0.40
Bituminous Concrete (BCBC)	0.40
Crushed Aggregate (CABC)	0.14
Crushed Aggregate, Type DG (CABCDG)	0.18
Aggregate – Bituminous (ADDC)	0.30
Aggregate – Cement (ACBC)	0.40
Aggregate – Lime – Pozzolan (ALPBC)	0.40
Subbase:	
Open Graded Subbase	0.11
No. 2A Subbase	0.11
Asphalt Treated Permeable Base Course (ATPBC)	0.20
Cement Treated Permeable Base Course (CTPBC)	0.20

Recommended Standards

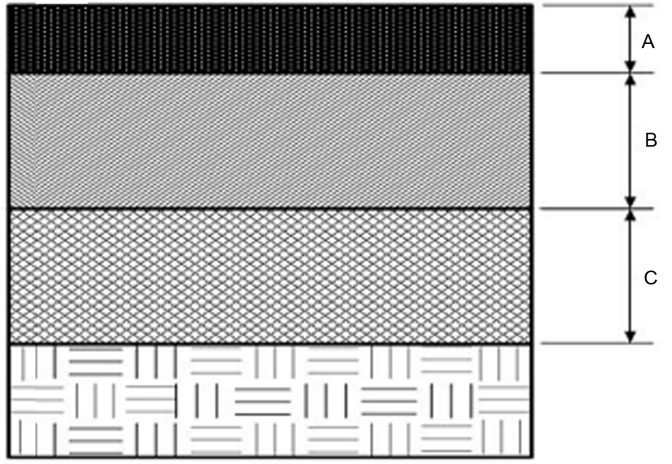
Where:

SN = Design Structural Number
a_i = Structural coefficient for layer i
d_i = Thickness of layer i
m_i = Drainage coefficient for layer i

Values of a_i and m_i, and minimum pavement layer thicknesses shall be in accordance with current PennDOT standards (see Reference 24).

Layer thicknesses for Equivalent Pavement Structures shall be provided in 0.5-inch increments.

Computations supporting the use of an Equivalent Pavement Section must be submitted and approved prior to use of an equivalent section. Said computations are to be prepared and sealed by a professional engineer licensed to practice in the Commonwealth of Pennsylvania.



(Not to Scale)

Recommended Standards

Course Designation		Street Classification			
		Residential and Residential Mixed-Use Collectors	Residential Access, Residential Collector, and Mixed-Use Collector	Residential Access	
		ADT < 3,000	ADT < 2,000	ADT < 1,000	ADT < 400
A	Bituminous Surface Course	1.5 inches	1.5 inches	1.5 inches	1.5 inches
B	Bituminous Base Course	6.0 inches	3.5 inches	4.0 inches	3.0 inches
C	Granular Subbase	6.0 inches	6.0 inches	6.0 inches	6.0 inches
Section Design Structural Number		3.7	3.3	2.7	2.5

Figure 2.42. Roadway Pavement Structure Detail

2. *Alternate Pavement Section*: Alternate pavement sections shall be allowed if street subgrade CBR values are demonstrated to be 4 or greater. Alternate pavement sections shall conform to the PennDOT full-depth pavement design procedure outlined in the most current version of Reference 24.

   The following information must be submitted in support of a request for use of an Alternate Pavement Section:

   a. Laboratory report documenting field and laboratory test procedures and results supporting a CBR value equal to or greater than 4. This report is to be certified by a professional geologist or engineer in responsible supervision of the laboratory testing who is licensed to practice in the Commonwealth of Pennsylvania.
   b. Pavement design computations sealed by a professional engineer licensed to practice in the Commonwealth of Pennsylvania.

2.10.3 Curb Detail

Figures 2.43 through 2.48 illustrate a variety of curb details that are applicable to residential streets.

Commentary

Rubblized Cement Concrete	0.20

Source: Ref. 24

Reference 24 recommends the that drainage coefficient, m_i, be set equal to 1.0 for all flexible pavement materials, and provides minimum and maximum layer thicknesses for various combinations of surface, base, and subbase materials.

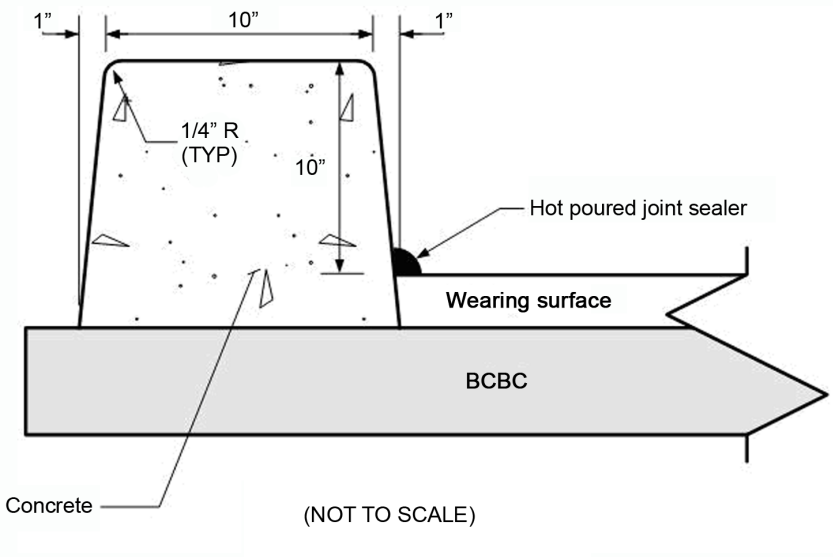
The pavement layer thicknesses identified in Figure 2.42 are based on PennDOT pavement design procedures as defined in Reference 24. The following assumed design values were used to determine the pavement section structural numbers identified in Figure 2.42.

Design Period: 25 years
Reliability: 85%
Standard Deviation: 0.45
Effective Roadbed Soil Modulus: 4500 psi (CBR = 3)
Serviceability Loss Due to Frost Heave:
1.5 local access streets
1.2 collectors
Total Design Serviceability Loss:
0.7 local access streets
0.5 collectors

In addition, axle loadings were considered for typical annual axle loads from passenger vehicles, school busses, garbage trucks, delivery trucks, trash and refuse pick-up, commercial delivery semi trucks and moving vans.

If a roadbed subgrade CBR value of 5 is found for a site, and all other pavement design parameters are assumed to remain as identified above, residential and mixed use collector streets with ADT < 3000 could be constructed with a 4-inch bituminous concrete base course instead of a 6-inch bituminous base course. Using 2006 cost data (Ref. 25) this equates to a savings of $20 per linear foot for a 30-foot wide street.

Recommended Standards



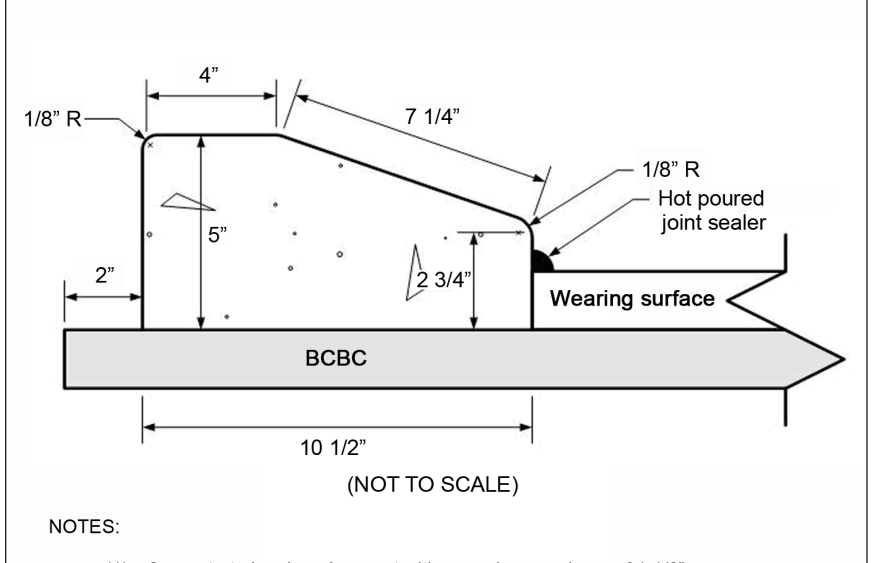
NOTES:

(1) Concrete to be class A except with a maximum slump of 1 1/2”.

(2) Place concrete using a slip form process on a bituminous concrete base coarse.

(3) Longitudinal joints to be as specified on a PaDOT RC-64 and in Publication 408, Section 705.4. Contraction joints to be as specified in Publication 408, Section 630.3.

Figure 2.43. Vertical Face Extruded Curb Detail



NOTES:

(1) Concrete to be class A except with a maxiumum slump of 1 1/2”.

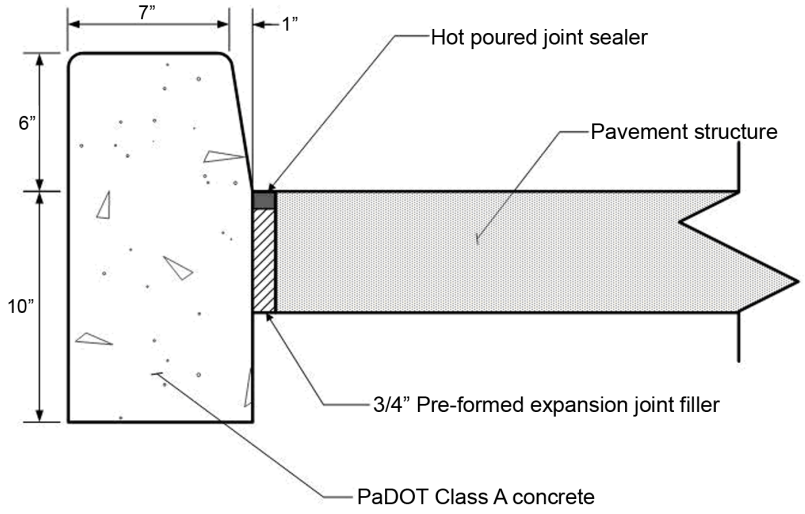
(2) Place concrete using a slip form process on a bituminous concrete base coarse.

(3) Longitudinal joints to be as specified on PaDOT RC-64 and in PaDOT Publication 408, Section 705.4

(4) Contraction joints to be as specified in PaDOT Publication 408, Section 630.3.

Figure 2.44. Mountable Extruded Curb Detail

Recommended Standards



(NOT TO SCALE)

NOTES:

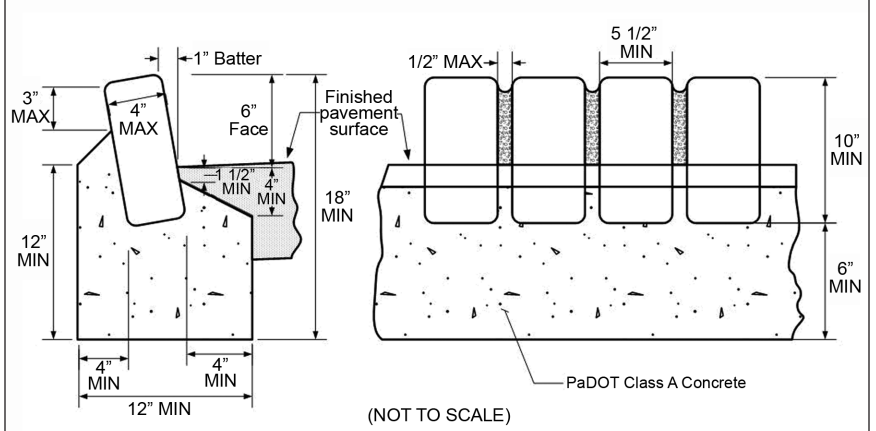
(1) All materials and installation to be in accordance with PaDOT Publication 408, section 630.

(2) Place 3/4” Pre-molded expansion joint filler material at structures (including adjacent sidewalks) and at the end of the work day.

(3) All corners to be rounded to a 1/4” radius.

(4) Space contraction joints in uniform lengths (maximum 20”, minimum 4’). Contraction joints to be as detailed on PaDOT RC-64.

Figure 2.45. Mountable Extruded Curb Detail



(NOT TO SCALE)

NOTES:

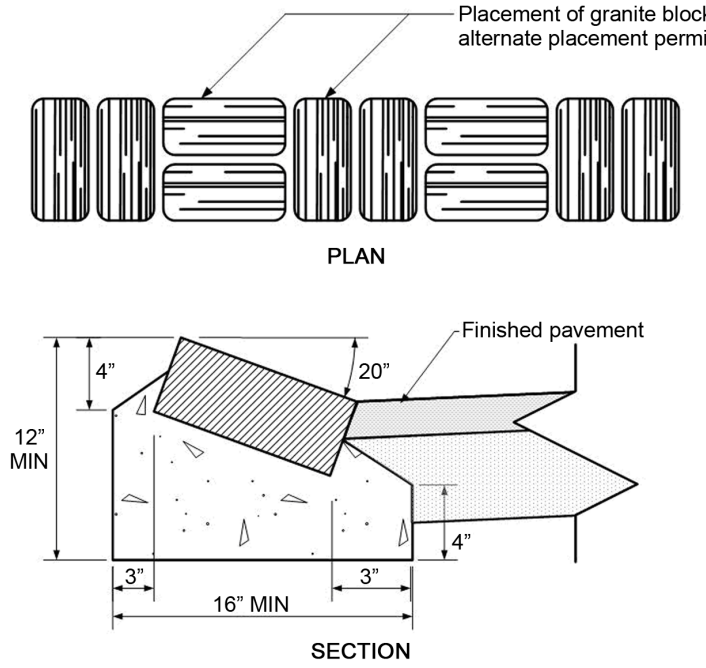
(1) Joints to be 1/2” wide using cement mortar struck with concrete tool.

(2) Concrete to be PaDOT Class A.

(3) Place 3/4” pre-molded expansion joint filler at structures and at the end of the day.

Figure 2.46. Granite Block Vertical Curb Detail

Recommended Standards



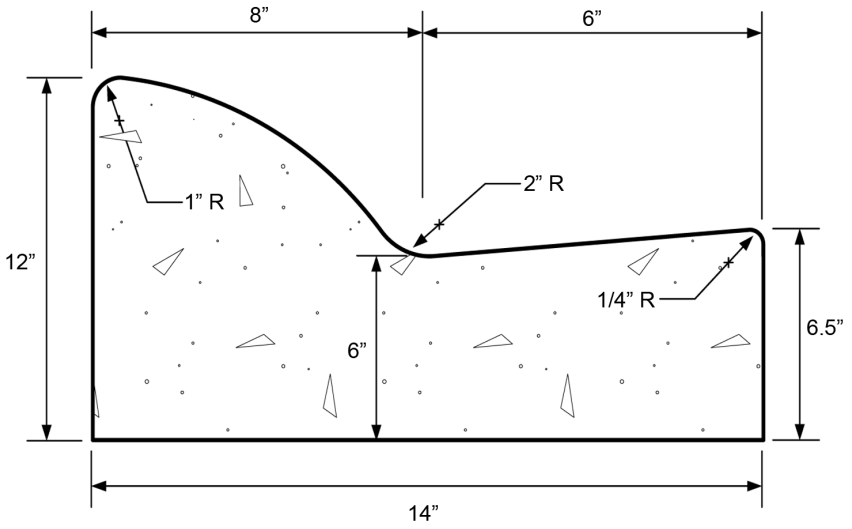
(NOT TO SCALE)

NOTES:

(1) Concrete to be PaDOT Class A.

(2) Place 3/4” pre-molded expansion joint filler at structures and at the end of work day.

Figure 2.47. Granite Block Mountable Curb Detail



(NOT TO SCALE)

NOTES:

(1) Concrete to be PaDot Class A.

(2) Place 3/4” pre-molded expansion joint filler material at structures (including adjacent sidewalks) and at the end of the the work day.

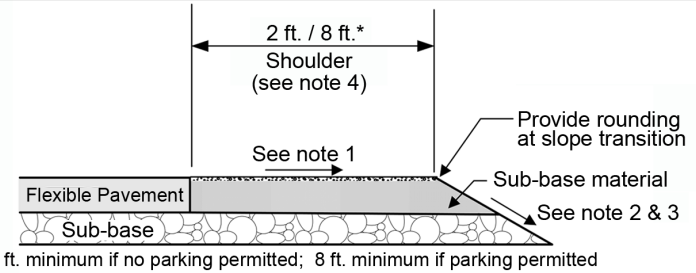
(3) Space contraction joints in uniform lengths (20’maxiumum and 4’ minimum).

Figure 2.48. Concrete Rolled Curb and Gutter Detail

Recommended Standards

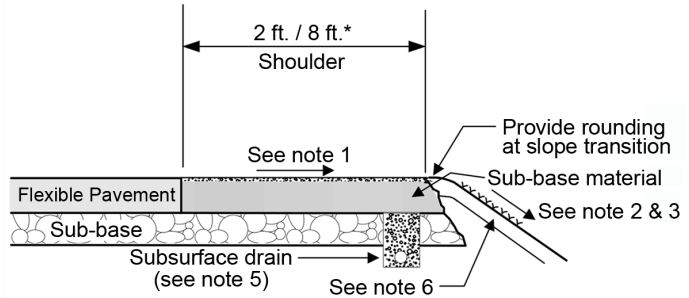
2.10.4 Shoulder Structure

Uncurbed streets shall be constructed with shoulder areas in accordance with the detail in Figure 2.49 and 2.50.



*2 ft. minimum if no parking permitted; 8 ft. minimum if parking permitted

a. Sub-base daylighted



*2 ft. minimum if no parking permitted; 8 ft. minimum if parking permitted

b. Sub-base outletted through drain

NOTES:

(1) Slope shoulder at 4% to 6%; sub-base to follow same slope as shoulder surface.

(2) Slope variable to 4:1 (H:V) maximum.

(3) Subsurface drain shall be used where sub-base is not outletted.

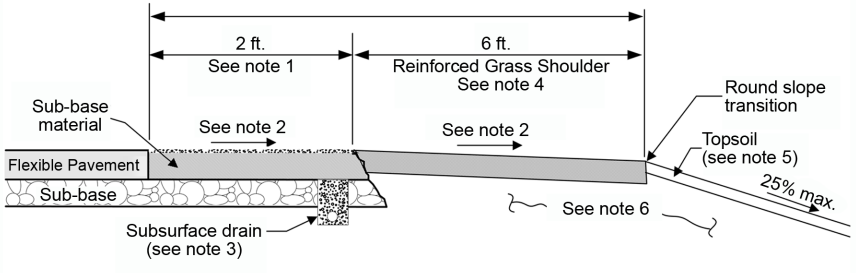
(4) Shoulder material and construction to be PaDOT type 3 shoulder as specified in latest version of PaDOT publication 408 and 70m (RC-25).

(5) Subsurface drain to be constructed as specified in latest version of PaDOT publication 408 & 70m (RC-30).

(6) Provide 4 inches of topsoil minimum over embankment material (fill section) or natural subsoil (cut section). Tamp and seed/sod.

Figure 2.49. PA DOT Type 3 Shoulder Detail

Shoulder Detail with Reinforced Grass Parking Strip



NOTES:

(1) Materials and construction to be PaDOT type 3 as specified in latest version of PaDOT publication 408 and 70m (RC-30).

(2) Shoulder slope 4% - 6%; sub-base to follow same slope as shoulder suface.

(3) Subsurface drain to be constructed as specified for subsurface drains in latest version of PaDOT publication 408 & 70m (RC-30).

(4) Grass shoulder to be reinforced using geotextile or other product to support AASHTO HS-20 loading. Reinforcement to be installed per manufacturers recommendations.

(5) Provide a minimum of 4 inches of topsoil over embankment fill or natural subsoil. Tamp and seed/sod. If cut is in rock provide minimum 1 foot topsoil as seed bed.

(6) Embankment fill (fill section) or natural subsoil (cut section).

Figure 2.50. Shoulder Detail with Reinforced Grass Parking Strip

Recommended Standards

2.10.5 Driveway Curb-Cut Details

Driveway curb-cuts shall be constructed as illustrated in Figures 2.51 – 2.53.

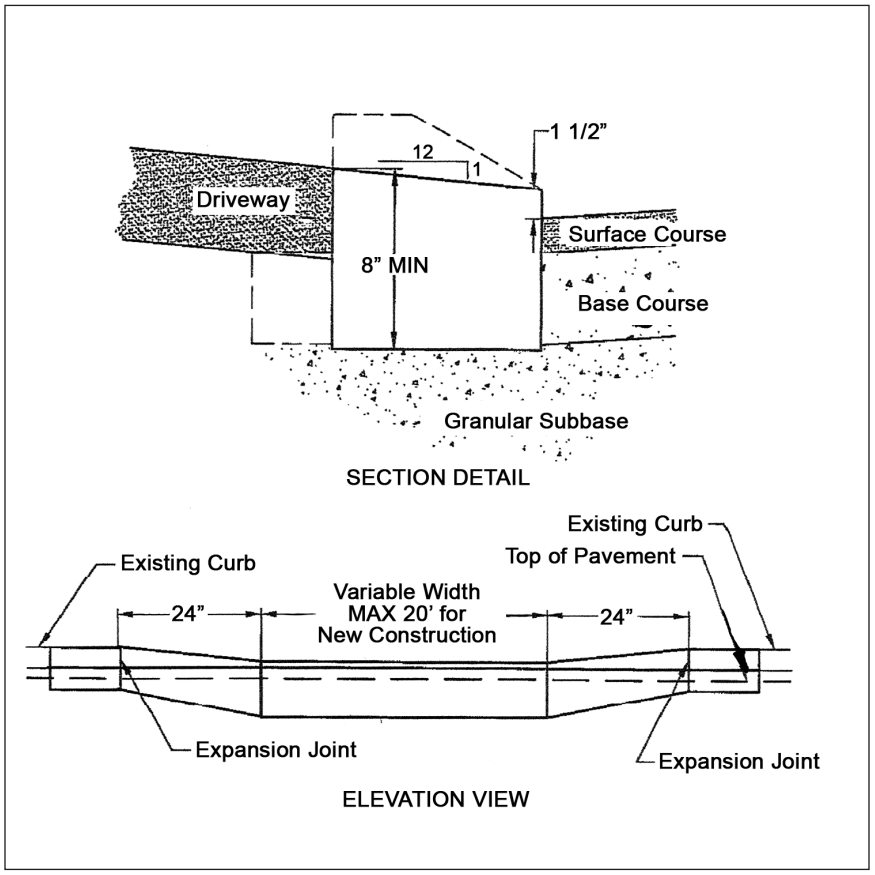


Figure 2.51. Driveway Curb-cut Detail for Extruded Curbs

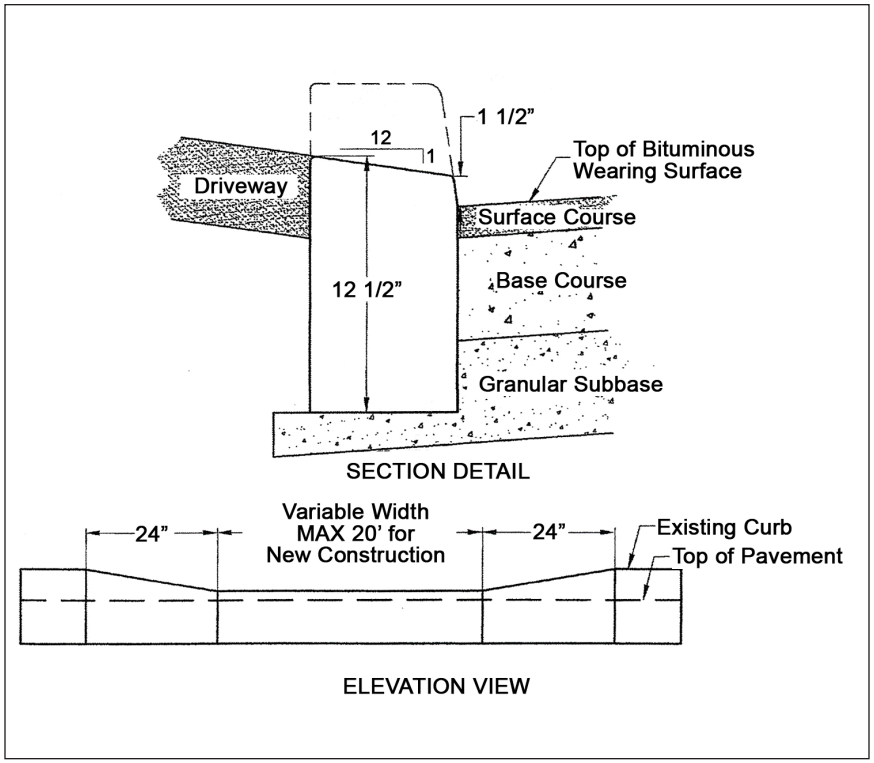


Figure 2.52. Driveway Curb-cut Detail for Full Depth Vertical Face Curb

Recommended Standards

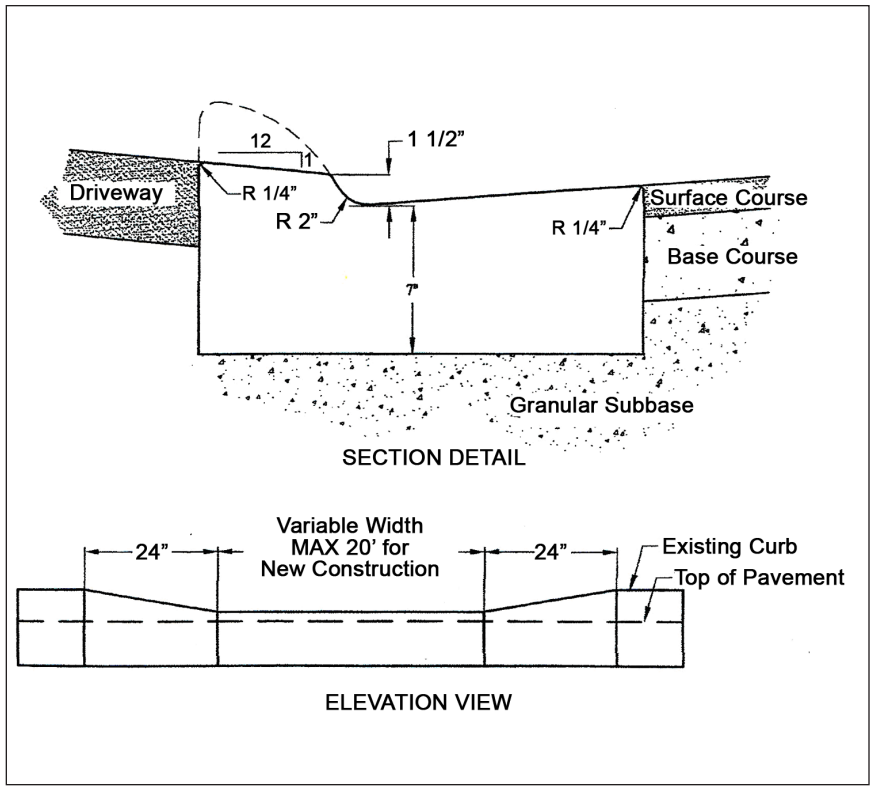


Figure 2.53. Driveway Curb-cut Detail for Rolled Curb

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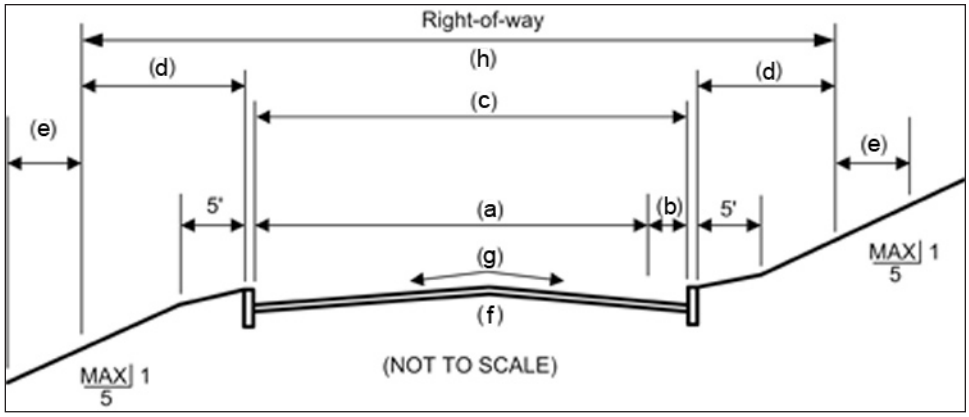

Figure 2.54. Cross-Section -- Curbed Streets

Table 2-9. Residential Access Type A -- Curbed

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Street Width (curb to curb)
Yield **	One Side or Alternating Sides	10	8	18
Slow	Alternating Sides	18	8	26
Free	No Parking	18	n/a	18
Free	One Side	18	8	26

* All travelway widths are for two-way streets; for one-way use ½ of travelway width except for "yield" traffic pattern.

** Use only when ADT less than or equal to 300.

Table 2-10. Residential Access Type B - Curbed

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Street Width (curb to curb)
Slow	Alternating Sides	20	8	28
Free	No Parking	20	n/a	20
Free	One Side	20	8	28
Free	Two Sides	20	8 each side	36

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

Table 2-14 .Residential Collector - Curbed

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Street Width (curb to curb)
Free	No Parking	24	n/a	26**

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

** One additional foot is provided on each side of the striped travel-way to provide for a drainage gutter.

Table 2-16. Residential Mixed-Use Collector -- Curbed

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Parking lane Width (ft.)	(c) Street Width (curb to curb)
Free	No Parking	22	0	22
Free	One Lane	22	8	30
Free	Two Lanes	22	8 each side	38

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

(a) Travelway width: See Tables 2-9, 2-10, 2-14, 2-16

(b) Parking lane width: See Tables 2-9, 2-10, 2-14, 2-16

(c) Curb to curb street width:
See Tables 2-9, 2-10, 2-14, 2-16

(d) Sidewalk / utility area within right-of-way (also see chapter 3, section 3.1.1, Sidewalk Location)
Width: Variable depending on cartway width.
Ground Slope: A maximum cross slope of +2% shall be maintained for a 5 foot distance behind the curb. Beyond this point, a maximum cross-slope of 4 horizontal to 1 vertical shall be permitted. If a sidewalk is to be located within this area, a 2% ground cross-slope (positive or negative) shall be maintained from the edge of curb to 3 feet beyond the outside edge of sidewalk. If utilities are to be located within this area, a minimum 10-foot width utility corridor shall be provided having a maximum cross slope of 5 horizontal to 1 vertical (+20%).

(e) Sidewalk / utility easement area outside right-of-way
Width: As needed.
Ground Slope: If utilities are to be maintained in this area, a minimum 10-foot width utility corridor shall be proviced having a maximum cross-slope of 5 horizontal to 1 vertical (+20%). If a sidewalk is located within this area a 2% ground cross-slope (positive or negative) shall be maintained across the sidewalk and within 3 feet of either side of the sidewalk.

(f) Crown Location: Centered on the travelway except for residential access type A. streets where it shall be located along one curb-line.

(g) Pavement cross slope:
2% minimum
4% maximum

(h) Right-of-way width: 50 feet. On residential collectors this width may be increased if a traffic study documents the need for more than one lane in each direction.

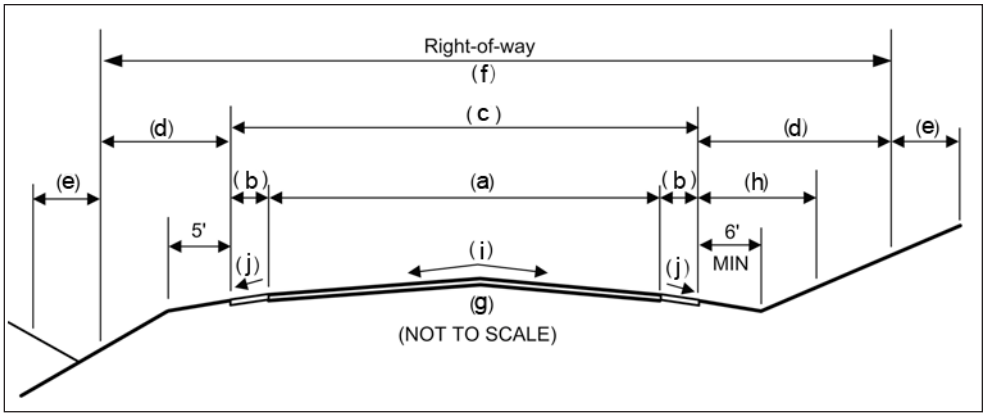

Figure 2.55. Cross-Section -- Uncurbed Streets with Reinforced Shoulder

Table 2-11. Residential Access Type A -- Reinforced Shoulder

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Shoulder Width (each side) (ft.)	(c) Street Width (shoulder to shoulder)
Free	No Parking	18	2 each	22
Free	One Side	18	2 on one side, 8 on parking side	28
Free	No Parking	18	8 each	34

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

Table 2-12. Residential Access Type B -- Reinforced Shoulder

Traffic Pattern	Parking Type	(a) Travelway width* (ft.)	(b) Shoulder Width (each side) (ft.)	(c) Street width (shoulder to shoulder)
Free	No Parking	20	2 each	24
Free	One Side	20	2 on one side, 8 on parking side	30
Free	Two Sides	20	8 each side	36

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

Table 2-15. Residential Collector -- Reinforced Shoulder

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Shoulder Width (each side) (ft.)	(c) Street width (shoulder to shoulder)
Free	No Parking	24	6 each	36

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

Table 2-17. Residential Mixed-Use Collector -- Reinforced Shoulder

Traffic Pattern	Parking Type	(a) Travelway Width* (ft.)	(b) Shoulder Width (each side) (ft.)	(c) Street Width (shoulder to shoulder)
Free	No Parking	22	6 each	34

* All travelway widths are for two-way streets; for one-way use ½ of travelway width

(a) Edge pavement to edge pavement street width:
See Tables 2-11, 2-12, 2-15, 2-17.

(b) Stabilized shoulder width:
See Tables 2-11, 2-12, 2-15, 2-17.

(c) Edge shoulder to edge shoulder street width:
See Tables 2-11, 2-12, 2-15, 2-17.

(d) Sidewalk / utility / drainage area within right-of-way:

	When in a cut section	When in a fill section
Width	Variable depending on street width and R.O.W.	Variable depending on street width and R.O.W.
Ground Slope	The maximum slope from the edge of swale to the right-of-way line shall be 4 horizontal to 1 vertical (25%). • If utilities are maintained within this area the utility corridor shall have a minimum width of 10 feet and a maximum ground cross slope of 5 horizontal to 1 vertical (20%). • If a sidewalk present, see Chapter 3 for standards (section 3-1).	The ground slope shall be maintained at no more than the shoulder slope -2% for a distance of 5 feet beyond the edge of the stabilized shoulder. Beyond this point the ground slope shall not exceed 4 horizontal to 1 vertical (25%) to the toe of slope. • If utilities are maintained within this area, the utility corridor shall have a minimum width of 10 feet and a maximum ground cross slope of 5 horizontal to 1 vertical (20%). • If a sidewalk is present adjacent to the roadway on the fill side, a 12-foot drainage swale must be located adjacent to the edge of shoulder similar to that on the cut side [see note (h)], and see Chapter 3 for sidewalk standards (section 3-1).

(e) Sidewalk / utility / drainage easement area outside right-of-way:
Width: As needed.
Ground Slope: If utilities are to be located within this area a the ground cross-slope shall not exceed 5 horizontal to 1 vertical (20%) to accommodate utility maintenance. If sidewalks and drainageways are to be included in this area, cross slopes shall be as previously described.

(f) Right-of-way width: 50 feet. On residential collectors this width may be increased if a traffic study documents the need for more than one lane in each direction.

(g) Crown Location: Centered on the travelway except for residential access type A streets where it may be located along one edge of pavement line.

(h) Drainage swale geometry (see chapter 5, Storm Water Conveyance Section)
Swale width: 12 foot minimum; as necessary to for adequate drainage.
Side slopes: 4 horizontal to 1 vertical maximum.

(i) Pavement cross-slope:
2% minimum to 4% maximum

(j) Shoulder cross-slope:
4% minimum to 6% maximum

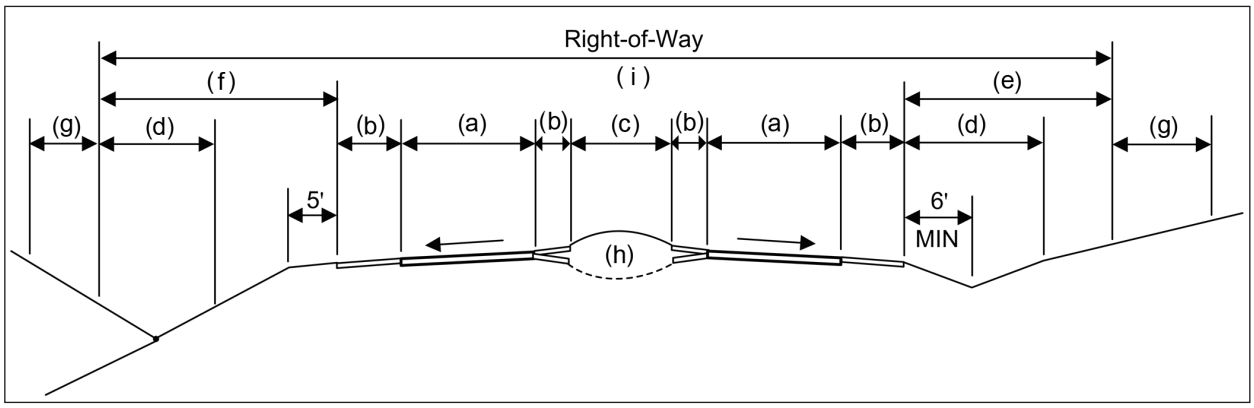

Figure 2.57. Cross-Section -- Parkway with Reinforced Shoulder, Drainage Away from Median

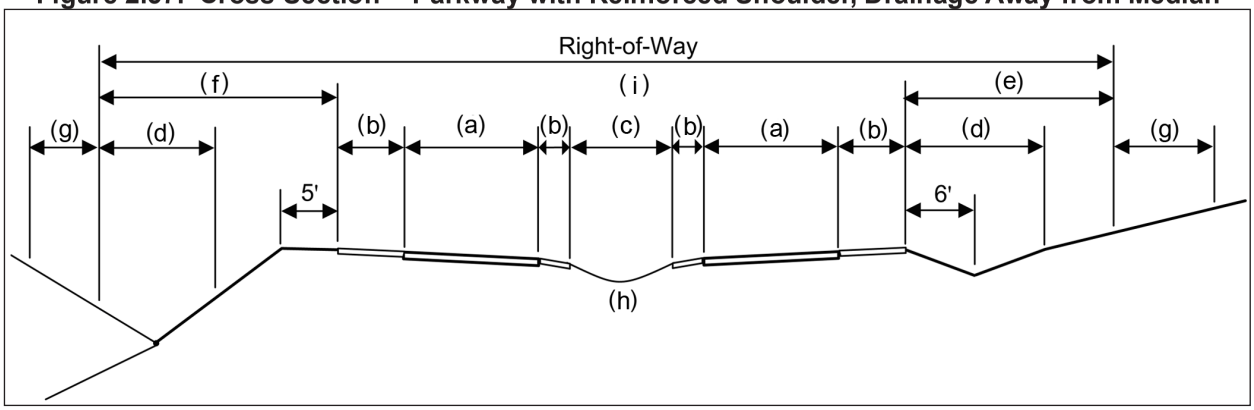

Figure 2.58. Cross-Section -- Curbed Streets with Reinforced Shoulder, Drainage towards Median

Table 2-19. Divided Streets -- Parkway with Reinforced Shoulder

Parking Type	(a) Lane Width* (ft.)	(b) Shoulder Width (ft.)	(c) Minimum Median Width (ft.)
No parking	11	4 one side + 2 one side = 6	10

* Provide the number of lanes necessary to accommodate anticipated traffic.

(a) Travelway
- Width: See Table 2-19
- Cross-slope: 2% to 4%

(b) Left stabilized shoulder
- Width: See Table 2-19
- Cross-slope: Travelway cross slope +2%

(c) Minimum median width
- See Table 2-19

(d) Drainage swale
- Location: Adjacent to shoulder or at toe of fill slope
- Shape: "V-ditch"
- Width: As needed for adequate drainage; 12-foot minimum
- Side-slopes: 4 horizontal to 1 vertical maximum

(e) Utility / sidewalk / drainage area inside right-of-way in cut section
- Minimum width: 10 feet
- Maximum ground slope: A drainage swale shall be located adjacent to the edge of shoulder [see note (6)]. The maximum slope from the edge of swale to the right-of-way line shall be 4 horizontal to 1vertical (25%). If utilities are maintained within this area the utility corridor shall have a minimum width of 10 feet and a maximum ground cross-slope of 5 horizontal to 1 vertical

(20%). If a sidewalk is located within this area, the sidewalk shall have a maximum cross-slope of 2% which shall extend for 3 feet on either side of the sidewalk.

(f) Utility / sidewalk / drainage area inside right-of-way in fill section
Minimum width: 10 feet
Maximum ground Slope: The ground slope shall be maintained at no more than the shoulder slope -2% for a distance of 5 feet beyond the edge of the stabilized shoulder. Beyond this point the ground slope shall not exceed 4 horizontal to 1 vertical (25%) to the toe of slope. If utilities are maintained within this area, the utility corridor shall have a minimum width of 10 feet and a maximum ground cross slope of 5 horizontal to 1 vertical (20%). A drainage swale shall be located at the toe of slope as defined in note (6). If a sidewalk is to be included adjacent to the roadway a 12-foot drainage swale must be located adjacent to the edge of shoulder similar to that on the cut side [see notes (6) and (7)].

(g) Utility / sidewalk / drainage easement outside right-of-way
Width: As necessary.
Maximum ground slope: When underground utilities are located in this area, the maximum ground slope shall be 5 horizontal to 1 vertical. For a sidewalk located in this area, the maximum ground slope for 3 feet on either side of the sidewalk shall be +2%. For drainage swales within this area, see note (6).

(h) Median area geometry
Shape: crowned or inverted
Maximum ground cross-slope: + 25%

(i) Minimum right-of-way width: 92 feet

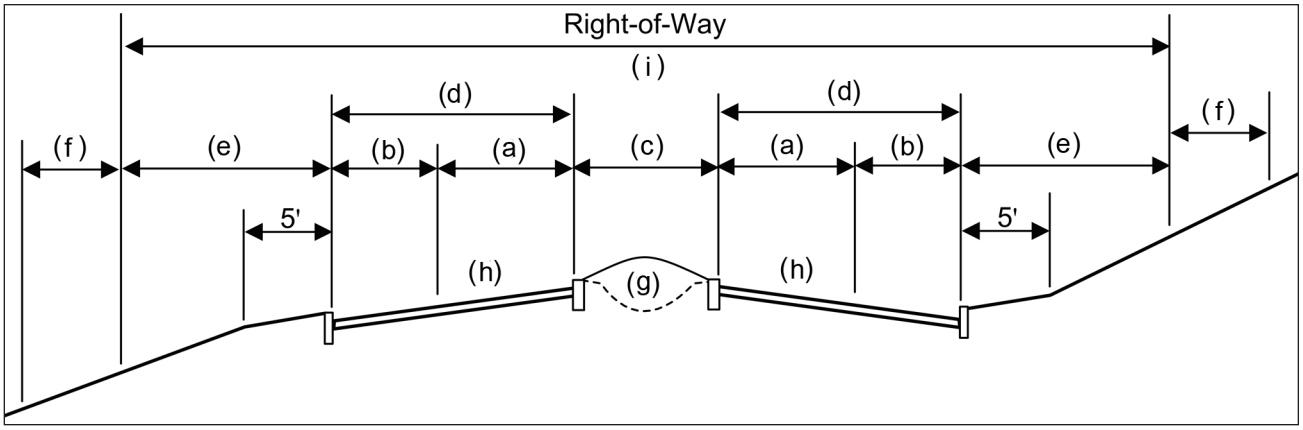

Figure 2.56. Cross-Section -- Boulevard with Curb

Table 2-18. Divided Streets -- Boulevard with Curb

Parking Type	(a) Lane Width* (ft.)	(b) Parking Lane Width (ft.)	(c) Minimum Median Width (ft.)
No Parking	11	0	10
Parallel	11	8	10
Angled Parking ***	****	18	10

* Provide the number of lanes necessary to accommodate anticipated traffic
** Stabilized grass is acceptable
*** Only permitted where anticipated traffic volume is less than 1500 ADT
**** Lane width must accommodate backing movment from parking space

(a) Travelway width: See Table 2-18
(b) Parking isle width: See Table 2-18
(c) Minimum median width: See Table 2-18
(d) Cartway width: See Table 2-18
(e) Sidewalk / utility area within right-of-way
Width: Variable depending on cartway width.
Ground Slope: A maximum cross slope of +2% shall be maintained for a 5-foot distance behind the curb. Beyond this point, a maximum cross slope of 4 horizontal to 1 vertical shall be permitted. If a sidewalk is to be located within this area, a 2% ground cross-slope (positive or negative) shall be maintained from the edge of curb to 3 feet beyond the outside edge of sidewalk. If utilities are to be located within this area, a minimum 10-foot width utility corridor shall be provided having a maximum cross slope of 5 horizontal to 1 vertical (+20%).
(f) Sidewalk / utility easement area outside right-of-way
Width: As needed.
Ground Slope: If utilities are to be maintained in this area, a minimum 10-foot width utility corridor shall be proviced having a maximum cross-slope of 5 horizontal to 1 vertical (+20%). If a sidewalk is located within this area a 2% ground cross-slope (positive or negative) shall be maintained across the sidewalk and within 3 feet of either side of the sidewalk.
(g) Median area geometry
Shape: Mounded or inverted (invert for stormwater management function)
Max. Ground Slope
4 horizontal to 1 vertical (+25%)
18 feet for angled parking
(h) Cartway cross-slope: Minimum +2% Maximum +4%
Negative cross- slopes indicate drainage towards median.
(i) Right-of-way width: 60 feet.