

**Texas Department of Transportation
Technical Provisions**

North Tarrant Express Project

Section 11 Attachments

Roadways

Appendix C

Driveway Design Guidelines

Section 1

Purpose

The purpose of this Appendix is to provide guidance on the location and design of driveway connections.

Because field conditions are highly variable with respect to driveways, the guidance provided herein may not always be completely applicable. Therefore, departures from this design guidance for driveways to meet field conditions are expected and do not require or constitute a need for any type of design exception or design waiver.

Additional information can also be found in *Regulations for Access Driveways to State Highways* for permitting guidelines and the TxDOT *Access Management Manual* for additional access discussion.

Section 2

Introduction

General Guidelines

Driveways provide the physical transition between the public highway and the abutting property. Driveways should be located and designed to minimize negative impacts on traffic operations while providing safe entry and exit from the development served. The location and design of the driveway should take into account characteristics of the roadway, the abutting property and the potential users. In order to assure that driveways provide for safe and efficient traffic movements, it is necessary to consider the driveway's critical dimensions and design features. This Appendix applies to new driveways, and modification of existing driveways

Definitions

Apron: On curb and gutter sections, that part of a driveway from the pavement to a selected point that is usually 6 inches in elevation above the edge of pavement (although it may vary by location or roadway) or to the right-of-way, whichever is greater. On sections with a drainage ditch, that part of a driveway from the edge of pavement to the right-of-way line.

Delivery Driveway: A driveway for use by trucks (typically SU or larger design vehicles as defined by AASHTO) to deliver merchandise to a retail outlet and/or for use by service vehicles, such as for solid waste collection.

Divided Driveway: A driveway providing a raised or depressed median, between the ingress/egress sides of a driveway. Medians can be painted (fully traversable) when curbing is not allowed within the right-of-way, slightly raised curb (mountable) when U-turns are allowed or curbed (traversable) when U-turns are not allowed.

Driveway: Facility for entry and/or exit such as driveway, street, road, or highway that connects to the road under the jurisdiction of the department or municipality.

Effective Turning Radius: The minimum radius appropriate for turning from the right-hand travel lane on the approach street to the appropriate lane of the receiving street. This radius is determined by the selection of a design vehicle appropriate for the streets being designed and the lane on the receiving street into which that design vehicle will turn. Desirably this should be at least 7.5 m [25 ft].

Farm/Ranch Driveway: A driveway providing ingress/egress for vehicles and farm/ranch equipment associated with the operation of the farm/ranch. Such driveways may also serve the residence of persons living and working on the farm/ranch and the other associated buildings.

Field Driveway: A limited-use driveway for the occasional/infrequent use by equipment used for the purpose of cultivating, planting and harvesting or maintenance of agricultural land, or by equipment used for ancillary mineral production.

Non-Residential/Commercial Driveway: Driveway having a traffic volume in excess of 20 vehicles per day and is not a Public Street/Road or a Residential Driveway.

Non-simultaneous Two-Way Driveway: A driveway intended to accommodate both entering and exiting traffic but not at the same time. For example, if an exiting vehicle is present in the driveway, the entering vehicle must wait until the exiting vehicle has cleared the driveway.

One-way Driveway: A driveway designed for either an ingress/egress maneuver but not both.

Public Driveway (Streets and Roads): A driveway providing ingress/egress from a roadway for which the right-of-way is deeded to and the roadway maintenance is performed by a village, town, city, county or municipal utility district.

Radial Return or Flare Drop Curb: For Residential Driveways onto Collector and Local streets is Maximum of 10 feet and minimum of 3 feet. A radial return is always used where the posted or operating speed is greater than 45 mph and the design vehicle type exceeds 30 feet in length.

Residential Driveway: A driveway serving a single-family residence or duplex and has less than 20 vehicles per day using the driveway.

Service Driveway: A driveway for occasional or infrequent use by vehicles or equipment to service an oil or gas well, electric substation, water well, water treatment plant, sewage lift station, waste water treatment plant, detention basin, water reservoir, emergency services, automated or remotely controlled pumping station, logging road, and other activities that may be identified by TxDOT.

Shared Driveway: A driveway shared by adjacent owners.

Simultaneous Two-Way Driveway: A driveway designed with a combination of return radius and throat width that allows a selected design vehicle to enter at the same time that another selected design vehicle is exiting the driveway.

Throat Length: The length of driveway as measured from the right-of-way line to the first on-site intersection or parking stall.

Throat Width: The driveway width measured at the end of the return radii. Refer to Figure C-2.

Section 3

Driveway Design Principles

General Guidelines

The following guidelines apply to all driveways to a state highway.

1. The driveway placement should be such that drivers approaching from the main roadway will have sufficient sight distance to ascertain the driveway's location in order to safely decelerate and complete the entry maneuver. Also, the driveway placement should be such that an exiting driver will have sufficient sight distance to judge a safe gap in oncoming traffic. For selecting appropriate driveway spacing distance, refer to the TxDOT Access Management Manual.
2. Each driveway radius should accommodate the appropriate design vehicle. This will generally be the passenger car (AASHTO P design vehicle) unless the driveway will routinely be expected to handle more than four larger vehicles per hour. Examples of facilities for which a larger design vehicle would normally be appropriate include truck terminals, bus terminals, and connections that serve the loading docks of shopping centers. Figure C-1 illustrates the effects of the radius on the right-turn entry and exit maneuver.

Figure C-2 illustrates various driveway design elements including return radius, entry width, exit width, throat width, and throat length.

3. With the exception of private residential driveways, farm/ranch driveways, field driveways, and driveways that are designed and signed for one-way operation (i.e. ingress or egress only but not both), driveways should be designed to accommodate simultaneous entry and exit by the appropriate design vehicle.
4. Driveways that cross sidewalks are located in a developing area where pedestrian traffic can be expected, should be designed to maintain an accessible route that is at least four feet wide across the driveway.
5. One-way driveways should have a minimum throat length of 50 feet (15 m) and preferably 75 feet (23 m).

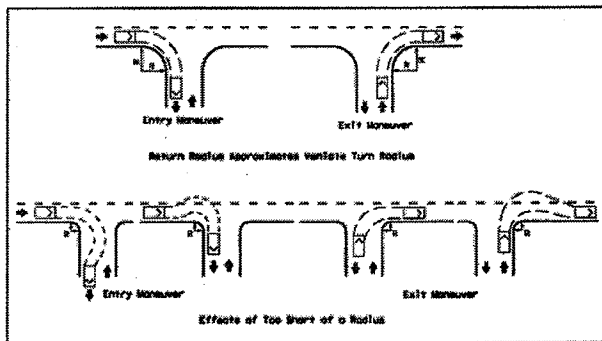


Figure C-1. Effects of Return Radius on the Right-Turn Maneuver

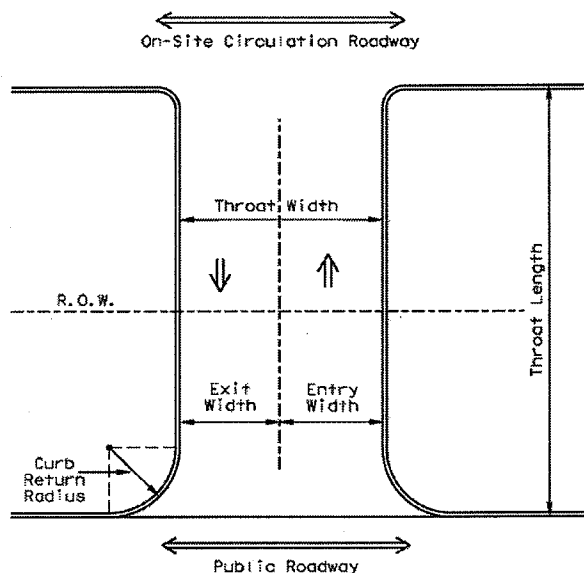


Figure C-2. Driveway Design Elements

Geometrics for Two-Way Driveways

The following are standards for two-way driveways.

1. Private Residential Driveway – Driveways serving single-family or duplex residences are normally designed as non-simultaneous two-way driveways. Standard design criteria for private residential driveways are provided in Table C-1. However, for existing cases where the criteria cannot be obtained, every attempt should be made to match the existing driveway width at the ROW line.
2. Commercial Driveways – At locations where the expected volume of large vehicles is four or more per hour, the design should be based on the appropriate design vehicle. Such situations include, but are not limited to, truck stops, warehouses, concrete batch plants, sources of

aggregate, RV sales/truck sales and RV parks. The design should also consider future roadway traffic and local conditions and incorporate simultaneous two-way driveways if justified.

Table C-1. Design Criteria for Private Residential Driveways

Radius	Throat Width		Radius	Throat Width	
US Customary Units			Metric Units		
(ft.)	Standard (ft.)	Maximum (ft.)	(m)	Standard (m)	Maximum (m)
15 ¹	14	24	4.5	4.2	7.2
¹ Reference Regulations for Access Driveways to State Highways for suggested minimum values.					

Two exit lanes are recommended when the expected driveway exit volume exceeds 200 vph.

In cases where one-way operation is appropriate, a condition of the driveway permit should require that appropriate one-way signing be installed and maintained.

Table C-2 provides standard design criteria for two-way commercial driveways that would be expected to accommodate only P and SU design vehicles.

Table C-2. Designs for Two-Way Commercial Driveways

Condition	US Customary Units		Metric Units	
	Radius (R) (ft)	Throat Width (W) (ft)	Radius (R) (m)	Throat Width (W) (m)
One entry lane and one exit lane, fewer than 4 large vehicles per hour (see Fig. C-3)	25	28	7.5	8.4
One entry lane and one exit lane, 4 or more SU vehicles ³ per day (see Fig. C-3)	30	30	9.0	9.0
One entry lane and two exit lanes, without divider (see Fig. C-4)	25	40	7.5	12.0
One entry lane and two exit lanes, with divider (see Fig. C-5)	25	44 ⁽¹⁾ -50 ⁽²⁾	7.5	13.2 ⁽¹⁾ -15.0 ⁽²⁾
Two entry lanes and two exit lanes, with divider (see Fig. C-6)	25	56 ⁽¹⁾ -62 ⁽²⁾	7.5	16.8 ⁽¹⁾ -18.9 ⁽²⁾
(1)4 ft. [1.2 m] wide divider, face-to-face of curbs (2)10 ft. [3.0 m] wide divider, face-to-face of curbs (3)Driveway designs for larger vehicles will be considered on a case by case basis				

3. Service Driveways – Service driveways should be designed considering the vehicle type and frequency of use, current and future traffic operations on the state highway, and other local conditions.
4. Field Driveways – The distance from the edge of the shoulder to a gate should be sufficient to accommodate the longest vehicle (or combination of vehicles such as a truck and trailer) expected. At a minimum, this will normally be a truck with trailer.
5. Farm/Ranch Driveway – A typical design for a farm/ranch driveway should provide a 25-foot return radii and a 20-foot throat width. The distance from the edge of pavement must be sufficient to store the longest vehicle, or combination of vehicles, expected. At a minimum, this will normally be a truck with trailer.

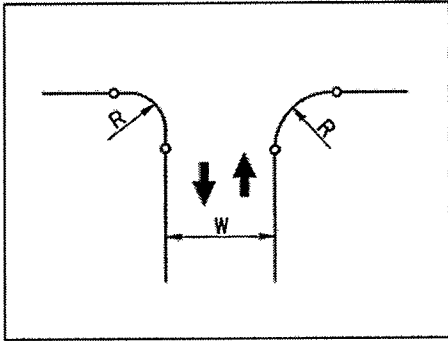


Figure C-3. One Entry Lane/One Exit Lane

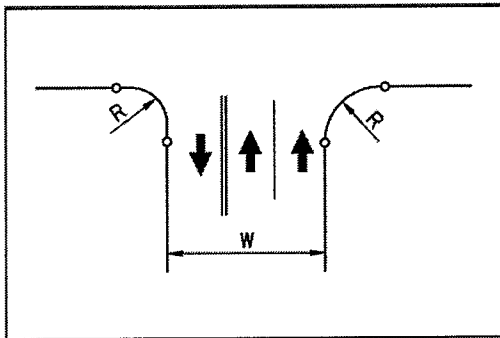


Figure C-4. One Entry Lane/Two Exit Lanes (Without a Divider)

See Table C-2 for Suggested Dimensions Based on Conditions.

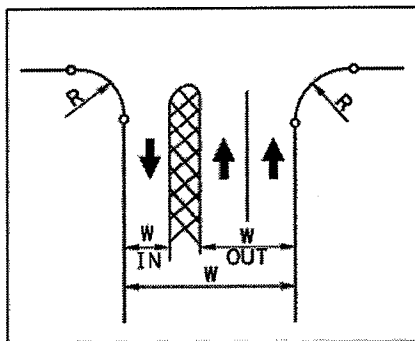


Figure C-5. One Entry Lane/Two Exit Lanes (With a Divider)

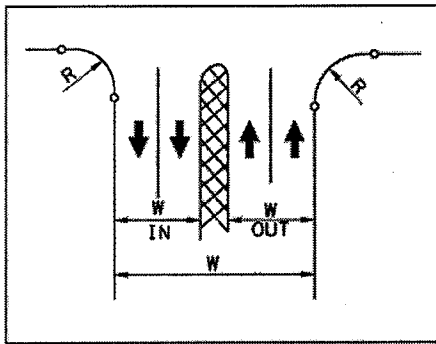


Figure C-6. Two Entry Lanes/Two Exit Lanes (With a Divider)

See Table C-2 for Suggested Dimensions Based on Conditions.

Divided Driveways

A raised or depressed separation between the entry and exit sides of a divided driveway needs to be visible to drivers. Suggested treatments and divider sizes are shown in Table C-3:

Table C-3. Dimensions for Dividers in the Driveway Throat to Separate Entry and Exit Sides of the Driveway

Treatment	Width	Length
Slightly raised ⁽¹⁾ (4 in [100 mm]) with contrasting surface ⁽¹⁾	4 -15 ft [1.2 - 4.5 m]	20 ft [6.0 m]
⁽¹⁾ For Rural - Rounded edges, 30° to 45° slope. (See Figure C-7)		

Figure C-7 illustrates a slightly raised divider (height 4 inches [100 mm]).

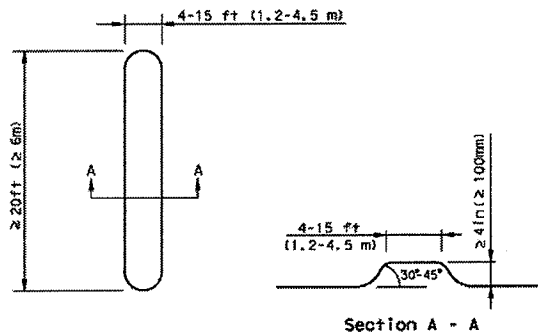


Figure C-7. Illustration of Slightly Raised Divider

A divided driveway is desirable in the following situations:

1. There are a total of four or more entering and exiting lanes.
2. A large number of pedestrians (30 or more in a one-hour interval) routinely cross the driveway.

Locating signing and lighting within a divider may assist approaching drivers in determining the driveway's location and geometrics.

An excessively wide divider may confuse drivers and cause them to think there are two closely spaced, two-way driveways. To avoid this problem, the recommended maximum width of a divider is 15 feet [4.5 m]. On the other hand, a divider that is too small may not be adequately visible to the motorist. Therefore the recommended minimum width of a slightly raised divider (height > 4 inches) is 4 feet [1.2 m].

Section 4

Profiles

Public driveways and commercial driveways should be constructed with a vertical curve between the pavement cross-slope and the driveway approach and between changes in grade within the driveway throat length. A private residential driveway may be constructed without vertical curves provided that a change in grade does not adversely affect vehicle operations. Typically a change in grade of three percent (3%) or less and a distance between changes in grade of at least eleven feet [3.3 m] accommodates most vehicles. However, literature suggests that a six percent (6%) to eight percent (8%) change in grade may operate effectively. Individual site conditions should be evaluated to accommodate the vehicle fleet using the driveway.

Driveway Grades

To achieve satisfactory driveway profiles, some of the significant factors to be considered are:

1. Abrupt grade changes, which cause vehicles entering and exiting driveways to move at extremely slow speeds, can create:
 - The possibility of rear end collisions for vehicles entering the driveway.
 - The need for large traffic gaps that may be unavailable or infrequent, causing drivers to accept inadequate gaps.
2. Where sidewalks are present, or in developing areas where pedestrians may be expected now or in the future, slower turning speeds may be beneficial and special design requirements apply. See Section 6 for more information.
3. The comfort of vehicle occupants and potential vehicle damage, (i.e., prevent the dragging of center or overhanging portion of passenger vehicles).
4. Grades must be compatible with the site requirements for sight distance and drainage, to prevent excessive drainage runoff from entering the roadway or adjacent property.

Because a large combination of slopes, tangent lengths, and vertical curves will provide satisfactory driveway profiles, some generalizations should be considered relative.

On curb and gutter sections, placement of vertical curves should be at the extended gutter line and not closer to the travel lanes unless curb and gutter returns and proper drainage are provided. On curb and gutter sections, the entire curb and gutter for the length of the curb cut should be removed and the gutter pan recast as an integral part of the driveway apron.

As shown in Table C-4, the suggested changes in driveway grades with a vertical curve (between the pavement cross slope and the driveway apron slope) are approximately 10 percent for private residential driveways and approximately 8 percent for all other driveways.

Table C-4. Suggested Change in Grade with a Vertical Curve

Driveway	Change in Grade (A) ⁽¹⁾
Private Residential Driveways	10%
All Other Driveways	8%

(1) Change in grade between the pavement cross-slope and the driveway apron slope

Construction practice can provide a suitable sag vertical curve between the pavement cross-slope and the driveway apron when the apron length L_a (see Figure C-8) is equal to or greater than 20 feet [7 m].

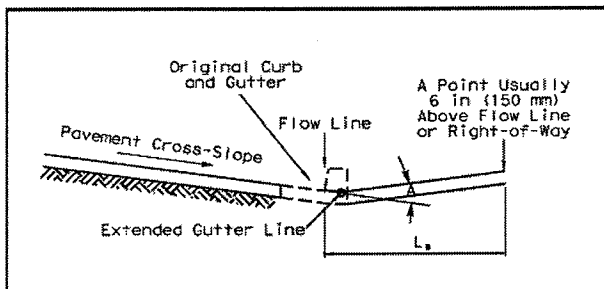


Figure C-8. Suggested Dimensions to Achieve an Appropriate Vertical Curve

Maximum driveway grades should be limited to 12 percent for private residential driveways and to 8 percent for other driveways. Where possible, the driveway grade should be limited to 6 percent or less within the roadway right-of-way.

A construction easement is required for construction beyond the right-of-way line. For construction beyond the right-of-way, it is necessary for the property owner to furnish the construction easement or right of entry required.

Also, within the limits of curb return radii, no drop curb should be allowed except as required for curb ramps.

The length of the vertical curve between the pavement cross-slope and the driveway apron is a function of the algebraic difference in the grades. Table C-5 provides the desirable and minimum lengths for these vertical curves.

**Table C-5. Length of Vertical Curve L (feet)
For a Change in Grade Between the Pavement Cross-Slope and the
Driveway Apron Slope**

Change in Grade, A	Crests		Sags	
	Des.	Min.	Des.	Min.
	ft (m)	ft (m)	ft (m)	ft (m)
	4-5%	5 (1.5)	3 (0.9)	7 (2.1)
6-7%	6 (1.8)	4 (1.2)	8 (2.4)	5 (1.5)
8-10%	8 (2.4)	5 (1.5)	10 (3.0)	7 (2.1)

Rounded: Parabolic curvature. The plans may specify a particular type of curvature.
Des.: Desirable Minimum Length
Min.: Minimum Length
Where practical, greater lengths should be provided to achieve a flatter and smoother profile.
C-9 through C-11 illustrate typical driveway profiles.

The length of the vertical curve at other points of driveway grade change is also a function of the algebraic difference in the grades. Table C-6 provides the typical lengths for these vertical curves.

Figures C-9 through C-11 illustrate typical driveway profiles.

**Table C-6. Typical Length of Vertical Curve, L,
For Change in Grade in Driveway Profile**

Change in Grade A	Crest		Sag	
	Private Residential Driveways	Other Driveways	Private Residential Driveways	Other Driveways
	ft (m)	ft (m)	ft (m)	ft (m)
4-5%	2 (0.6)	5 (1.5)	3 (0.9)	6 (1.8)
6-7%	3 (0.9)	5 (1.5)	5 (1.5)	7 (2.1)
8-10%	4 (1.2)	6 (1.8)	6 (1.8)	8 (2.4)

Profiles on Curb and Gutter Sections

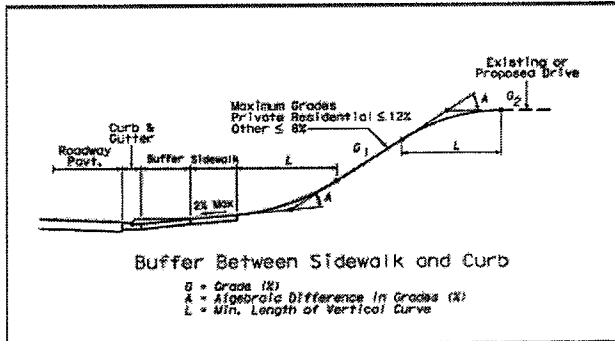


Figure C-9. Roadway with Curb and Gutter, Driveway Profiles on an Upgrade

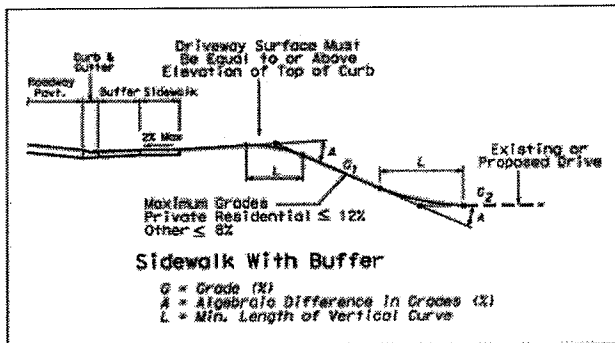


Figure C-10. Roadway with Curb and Gutter, Driveway Profiles on a Downgrade

See Tables C-5 and C-6 for lengths of vertical curves.

Profiles with Drainage Ditch

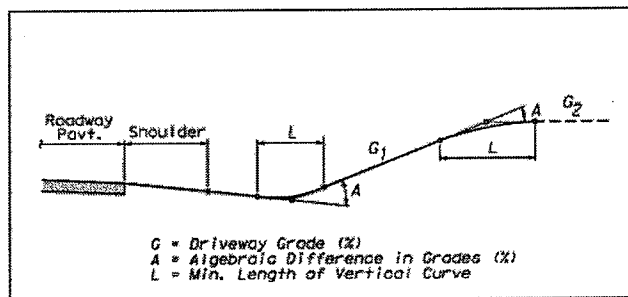


Figure C-11. Driveway Profiles on Roadway with Drainage Ditch

See Tables C-5 and C-6 for lengths of vertical curves.

Section 5

Driveway Angle

Two-way driveways should intersect the roadway at an angle of ninety degrees unless it is determined that a lesser angle will provide satisfactory traffic operations for the highway. Suggested limiting values on driveway angles are:

Residential Driveway: 75°

Commercial Driveway: 75°; commercial driveways expected to have a volume of 400 vehicles per day or two or more trucks/large vehicles in a one-hour period shall be designed as normal intersections (public driveway).

Normal Intersection (Public Driveway), Service Driveway and Field Driveway: 80°.

The angle of intersection between the centerline of a one-way driveway and the edge of pavement of the public roadway may be between forty-five (45°) and ninety degrees (90°). Sixty degrees (60°) is a commonly used angle for one-way driveways.

Section 6

Pedestrian Considerations

General Guidelines

Accommodating pedestrians and vehicular traffic at the junctions of sidewalks and driveways presents a variety of challenges. Some general principles are:

- ◆ The maximum cross-slope at any point on a sidewalk (including the crossing of a driveway) is two percent (2%)
- ◆ Consider using right-turn deceleration/storage lanes so that right-turning drivers can safely wait in the auxiliary lane, clear of through traffic, while pedestrians are present in, or near, the driveway.
- ◆ Consider using a triangular island for pedestrian refuge in a high-volume driveway. The minimum refuge area is 5 feet x 5 feet and preferably larger. (See Figure C-12).
- ◆ Locate sidewalks far enough from the curb, or edge of pavement, to provide a suitable vertical curve transition between the pavement cross-slope and the driveway apron and to allow the driveway to cross the sidewalk at the sidewalk's normal elevation (see Section 4, Profiles on Curb and Gutter Sections for illustrations of driveway profiles.)

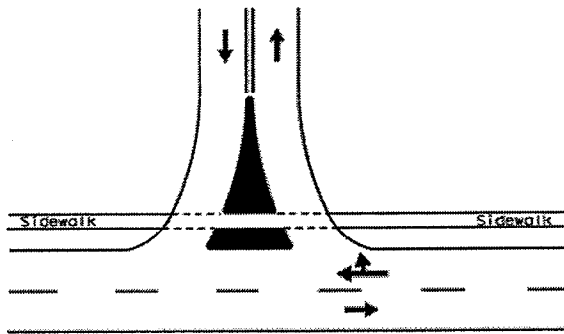


Figure C-12. Channelizing Island to Provide Pedestrian Refuge

- ◆ Where driveways are closely spaced, consider the use of right-in/right-out driveways to eliminate conflicts between left-turning vehicles and pedestrians and bicyclists. In this case it is recommended that provisions be made for the left-turns only at locations where the vehicular-pedestrian conflict can be safely addressed by appropriate design and traffic control.
- ◆ Provide adequate throat length so that a vehicle backing out of a space does not back over the sidewalk (see Figure C-13). Vehicles should not block the sidewalk when parked in driveway.

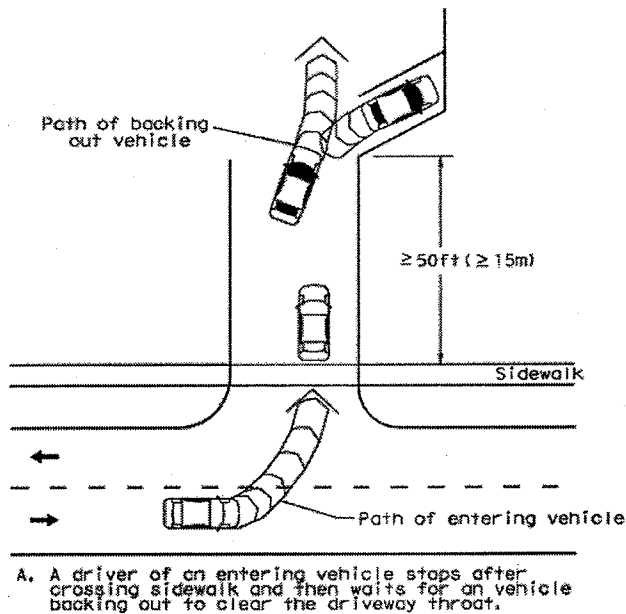


Figure C-13. Throat Length is of Sufficient Length to Allow Entering Vehicle to Clear the Through Traffic Lane

Sidewalk and Driveway Intersections

Driveways crossing a sidewalk should be designed so that both pedestrians and drivers are able to negotiate the sidewalk-driveway crossing efficiently and safely. When the change in cross slope is too severe, one wheel of a wheelchair or one leg of a walker may lose contact with the ground. Pedestrians are also more prone to stumble on surfaces with rapidly changing cross slopes. For this reason, the maximum cross-slope at any point on a sidewalk (including the crossing of a driveway) is two percent (2%). Wherever possible the sidewalk should be carried across the driveway without a change with respect to the normal sidewalk profile. When the sidewalk abuts the back of the curb, a “walk-around” (see Figure C-14) should be considered. This design transitions the sidewalk laterally to provide greater distance between the flow line of the gutter and the sidewalk. This allows the sidewalk to remain at normal elevation without requiring an excessive driveway slope. The “walk around” design may not be possible if there is insufficient right-of-way available. In this case, the sidewalk grade must be lowered but preferably not all the way to street grade so that drainage in the gutter is maintained.

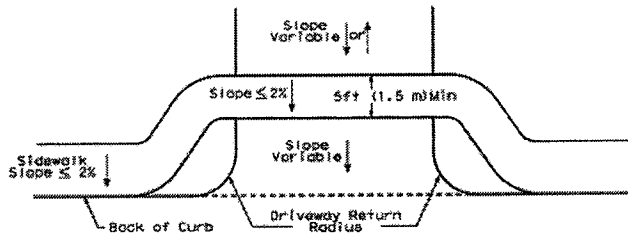


Figure C-14. Illustration of a "Walk-Around" Design

Section 7

Visibility

Drivers must be able to locate a driveway in time to reduce speed and negotiate the entry maneuver. Signing and lighting can be used to provide drivers with information regarding driveway opening locations a considerable distance in advance. On divided driveways, the sign should be located within the divider separating the entrance and exit sides of the driveway. Lighting can illuminate the junction of the driveway and the highway.

Section 8

References

1. A Policy on the Geometric Design of Highways and Streets, American Association of Highway and Transportation Officials, 2001.
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3. Access Management Manual, Transportation Research Board, 2003.
4. Draft Guidelines for Accessible Public Rights-of-Way, November 25, 2003.
5. R. J. Jaeger, Guidelines for the Investigation and Remediation of Potentially Hazardous Bicycle and Pedestrian Locations, Traffic Engineering and Safety Management Branch, North Carolina Department of Transportation, August 2003.
6. Charles V. Zegeer, Cara Seiderman, Peter Lagerway, Mike Cynecki, Michael Ronkin and Robert Schneider, "Pedestrian Facilities Users Guide – Providing Safety and Mobility," Publication No. FHWA No. FHWA-RD-01-102, Federal Highway Administration, US Department of Transportation, March 2002