Driveway Design Criteria

A. General

For efficient and safe operations, access drives and minor public street intersections can be improved by the following:

- Smooth vertical geometrics
- Adequate driveway throat width and curb return radii
- Provide adequate sight distance
- Additional egress lane
- Quality driveway construction
- Define the ingress and egress sides of the access drive

Refer to NCHRP Report 659 - Guide for the Geometric Design of Driveways for supplemental information.

B. Width Measurement

1. The width of an entrance with a radius return or with a flared taper that connects to a curb and gutter roadway is measured at a point 10 feet back from the roadway curb. The curb opening may exceed the maximum allowable width of the entrance to accommodate the allowable radius or taper.

2. The width of an entrance that connects to a rural roadway (no curb and gutter) is measured across the top of the entrance at the culvert line or at the location where a culvert would normally be placed.

C. Dimensions

Figure 5L-4.01: Entrance Dimensions

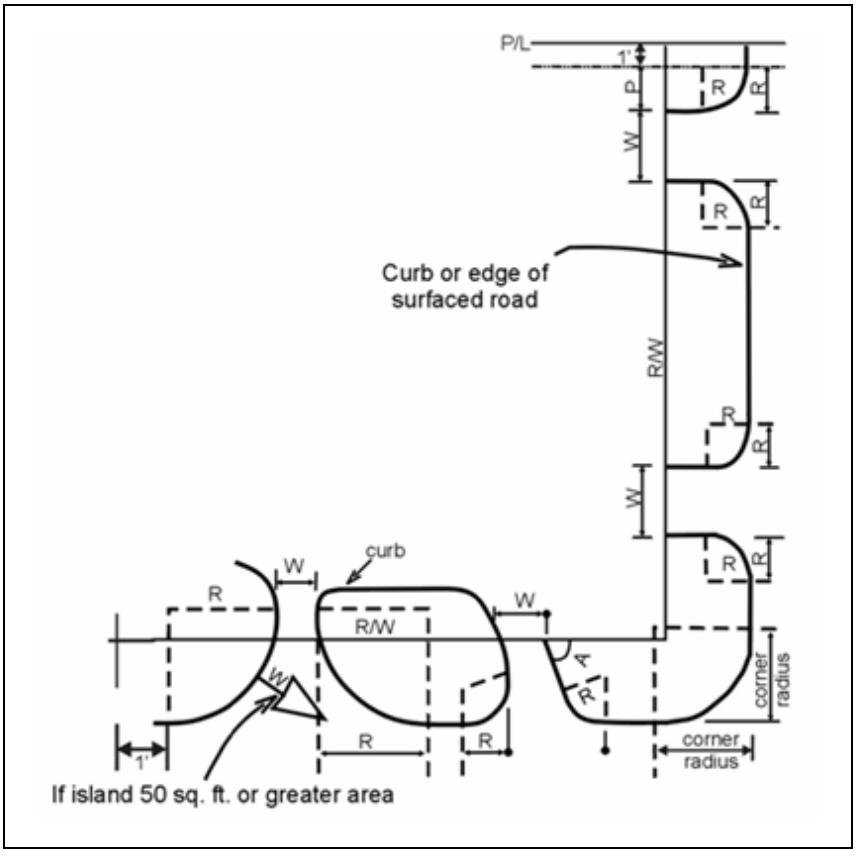


Table 5L-4.01: Driveway Dimensions[1]
(all dimensions are in feet)

Dimension Reference (See Figure 5L-4.01)		Major Arterial Street				Minor Arterial Street				Collector (Major and Minor)				Local Street			
		Residential	Commercial	Industrial	Agricultural	Residential	Commercial	Industrial	Agricultural	Residential	Commercial	Industrial	Agricultural	Residential	Commercial	Industrial	Agricultural
Width																	
Minimum	W	15	24	24	20	15	24	24	20	10	24	24	20	10	24	24	20
Maximum		30	45	45	30	30	45	45	30	24	40	45	30	24	32	40	30
Right-turn Radius[2]																	
Minimum	R	10	10	25	25	10	10	25	25	10	10	25	25	10	10	10	20
Maximum		25	35	50	35	25	35	50	35	25	35	50	35	15	20	30	35
Min. Acute Angle[3]	A	60°	70°	70°	70°	60°	70°	70°	70°	60°	70°	70°	70°	60°	70°	70°	70°
Pref. Acute Angle		90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°	90°
Min. Pavement Thickness (inches)	T	6/8	7/9	*	6	6	7	*	6	6	7	*	6	6	7	*	6

[1] Major entrances require special design.
[2] 3 foot flares (F) may be used for residential and agricultural entrances.
[3] Any variation from 90° will be evaluated on a case by case basis. The minimum acute angle (measured from the edge of the pavement) is 60°.
* Requires special design.

1. The width (W) shown applies to rural routes and city streets including neighborhood business, residential, and industrial streets. For joint entrances centered on property lines, the entrance width may increase 5 feet rounded to the nearest 5 foot interval but should not exceed 45 feet. In rural areas (open ditch roadways) widths for paved entrances should include an additional 4 feet for shoulders (Minimum 2 feet shoulders each side).

2. The radius (R) for agricultural uses will vary according to the following intersecting acute angles:

Table 5L-4.02: Agricultural Acute Angle and Radius

Acute Angle	Acute Radius Decrease (feet)	Obtuse Radius Increase (feet)
85° to 90°	0	0
75° to 85°	5 feet	5 feet
65° to 75°	5 feet	10 feet
60° to 65°	10 feet	15 feet

Where the entrance radius specified is greater than the distance between the back of curb and the front edge of the sidewalk the radius may be reduced to meet the available space but should be no less than 10 feet. An option to the radius under this condition is the use of flared entrances. When a flare is used, it should be 3 feet wide and should be constructed from the back of curb to the sidewalk. If no sidewalk exists, flares should be 10 feet long.

3. For individual properties, the number of entrances should be as follows:

   a. Single Family (SF) Residential: Each SF residential property is limited to one access point. However, where houses are located on corner lots, have extra wide frontage, or on heavy traveled roadway more than one access point may be allowed to eliminate backing out on a heavily traveled roadway.

   b. Multi-family (MF) Residential: Access is determined by information provided by the Owner/Developer in a Traffic Impact Report and by comments generated during the Jurisdiction Engineer's review and acceptance of that report.

   c. Commercial: Commercial property having less than 150 feet of frontage and located mid-block is limited to one access point to the street. An exception to this rule may be where a building is constructed in the middle of a lot and parking is provided for each side of the building. A second access point may be allowed for commercial property having more than 150 feet of frontage. For commercial property located on a corner, one access to each street may be allowed, provided dimensions are adequate from the intersecting street to the proposed entrance. (See Section 5L-3 - Access Location, Spacing, Turn Lanes, and Medians).

   d. Industrial: Access is determined on a case-by-case basis. The Jurisdiction will consider good traffic engineering practice and may require information to be provided by the applicant in a Traffic Impact Report. (See Section 5L-3 - Access Location, Spacing, Turn Lanes, and Medians).

   e. Agricultural: Access with adequate frontage may be authorized with more than two accesses at not less than 300 feet intervals provided a minimum distance of 30 feet is maintained from the inlet and outlet of two adjacent culverts.

In all cases, the location of the access will be such that the taper or radius does not extend beyond the extension of the property line. In general, all construction must occur only on the property owner's frontage.

4. Minimum acute angle (A) is measured from the edge of pavement and is generally based on one-way operation. For two-way driveways, and in high pedestrian activity areas, the minimum angle should be 70 degrees. Entrances should be placed at 90 degrees whenever possible.

5. The entrance pavement thickness (T) is based on the following:

   PCC - Class "A" or "C" - 4,000 psi
   HMA - Greater than or equal to 100K ESAL (optional for rural area).

   For those entrances not paved, 6 inches (min.) of Class "A" gravel should be required.

D. Sight Distance

1. Sight distance is based upon AASHTO stopping sight distance criteria. However, the height of an object is increased from 2.0 feet to 3.5 feet to acknowledge an approaching vehicle as the "object" of concern. Therefore, sight distance at an access location is measured from the driver's height of eye (3.5 feet) to the height of approaching vehicle (3.5 feet).

2. An access location should be established where desirable sight distance is available, as shown below.

Table 5L-4.03: Desirable Sight Distances

Design Speed (mph)	**Intersection Sight Distance (feet)**	
	Left Turn from Stop	***Right Turn from Stop and Crossing Maneuver***
55	610	530
50	555	480
45	500	430
40	445	385
35	390	335
30	335	290
25	280	240

Note: the sight distances shown above are for a stopped passenger car to turn onto or cross a two lane roadway with no median and grades of 3% or less. For conditions other than those stated, refer to the 2004 AASHTO "Green Book" for additional information.

Source: Based on Exhibit 9-55 and Exhibit 9-58 of the 2004 AASHTO "Green Book."

3. On a four lane divided primary highway where access is proposed at a location not to be served by a median crossover, sight distance is required only in the direction of the flow of traffic.

E. Driveway Grades

1. **Slopes vs. Speed Differential:** Driveway slope is important due to speed differential. Turning vehicles must slow appreciably to enter a driveway. The steeper the driveway, the more vehicles must slow in order to prevent "bottoming out", increasing the speed differential with through traffic and increasing the possibility of rear-end collisions.

Table 5L-4.04: Driveway Slope and Entry Speed

Driveway Slope	Typical Driveway Entry Speed
Greater than 15%	Less than 8 mph
14 to 15%	8 mph
12 to 13%	9 mph
10 to 11%	10 mph
8 to 9%	11 mph
6 to 7%	12 mph
4 to 5%	13 mph
2 to 3%	14 mph
0 to 2%	About 15 mph

Source: Oregon State University, 1998

A speed differential much above 20 miles per hour begins to present safety concerns. When the speed differential becomes very large (say, 30 to 35 miles per hour), the likelihood of traffic crashes involving fast-moving through vehicles colliding with turning vehicles increases very quickly. Rear-end collisions are very common on roads and streets when large speed differentials exist and the density of commercial driveways is high. When the speed differential is high, it is also more likely that when crashes do occur they will be more severe, causing greater property damage and a greater chance of injury or fatalities. Keeping the speed differential low is very important for safety reasons, as the table below indicates.

Table 5L-4.05: Speed Differential and Crashes

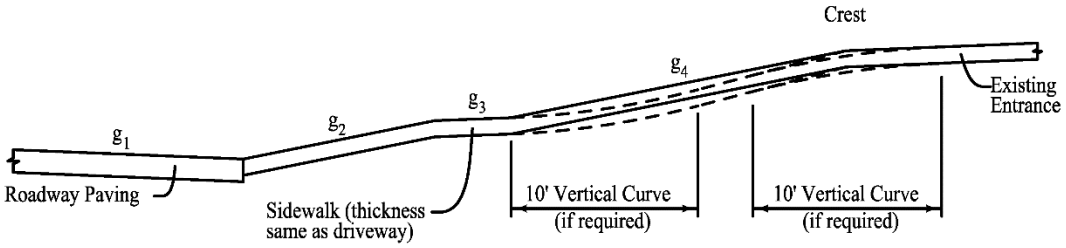
When the Speed Differential Between Turning and Through Traffic Is:	The Likelihood of Crashes Is:
10 mph	Low
20 mph	3 times greater than at 10 mph
30 mph	23 times greater than at 10 mph
35 mph	90 times greater than at 10 mph

Source: Oregon State University, 1998

2. **Vertical Profile:** A driveway's vertical profile should allow a smooth transition to and from the roadway. The National Highway Institute's course workbook on Access Management recommends the following maximum driveway slopes for urban/suburban streets:
   - Arterial 3 to 4%
   - Collector 5 to 6%
   - Local Less than 8% (may use 9% in special areas)

   These slopes were chosen to keep the speed differential at or below 20 miles per hour. See Figures 5L-4.02A and 5L-4.02B.

Figure 5L-4.02A: Typical Section - Commercial/Industrial and Residential Entrance



1. Algebraic Difference Between g1 and g2:
   a. Commercial/Industrial: Not to exceed 9%
   b. Residential: Not to exceed 12%

2. Algebraic Difference Between g2 and g3:
   a. Commercial/Industrial: Not to exceed 6%
   b. Residential: Not to exceed 8%

3. Maximum Slope of g3 = 2% (ADA compliance)

4. Algebraic Difference g3 to g4:
   a. Commercial/Industrial: Not to exceed 5%
   b. Residential: Not to exceed 8%
   c. 10 foot vertical curve required for change in grade exceeding 5%

5. Maximum Slope of g4:
   a. Commercial/Industrial: 7%
   b. Residential: 10%

6. 10 foot vertical curve required for change in grade from g4 to existing exceeding 5%

7. If the above grade restrictions require a depressed sidewalk through the driveway, a transition section should be provided between the normal sidewalk grade and the depressed section. As a general rule, use the following transition lengths:

Elevation Difference from Normal Sidewalk Grade (inches)	**Transition Distance (feet)**
1 to 2	8
2 to 4	12
4 to 6	16
Greater than 6	Desirable max. slope is 16:1 Absolute max. slope is 12:1

3. Non-curb and Gutter Roadways:

a. Private drive access to local, collector, or arterial streets that have no curb and/or gutter improvements should be constructed with grades and dimensions as shown in Figure 5L-4.03. Heavily used driveways connected to existing gravel roadways may require an 8 inch deep compacted Class "A" crushed stone base material. The driveway pavement should be extended to the proposed roadway pavement width, if known, or 15.5 feet from the centerline, if not known. A culvert properly sized for the ditch flow should be installed at the established roadside ditch flowline beneath the private drive access. Culvert should be 15 inches minimum and 18 inches desirable. The culvert should be either corrugated metal or reinforced concrete pipe with minimum of 1 foot of cover over the pipe per the Jurisdiction's requirements.

b. For Farm to Market (FM) roads, when grading on new construction, or complete reconstruction projects on paved (or to be paved) FM roads, the following will apply:
   1) When a culvert is not required, the following slopes will apply.
      - 10:1 slope of flatter from shoulder line to ditch bottom in clear zone area.
      - 6:1 slope or flatter from clear zone area to the right-of-way line.
      - 10:1 to 6:1 transition zone.
   2) When a culvert is required, the following slopes will apply.
      - 8:1 slope or flatter from shoulder line to normal placement of a culvert.
      - 6:1 slope or flatter from culvert area to the right-of-way line.
      - 8:1 to 6:1 transition zone.

      For remaining open ditch roadways (paved or non-paved), the sideslopes will be 6:1 for posted speeds of 40 mph or greater, and 4:1 for posted speeds of less than 40 mph.

F. Other Criteria

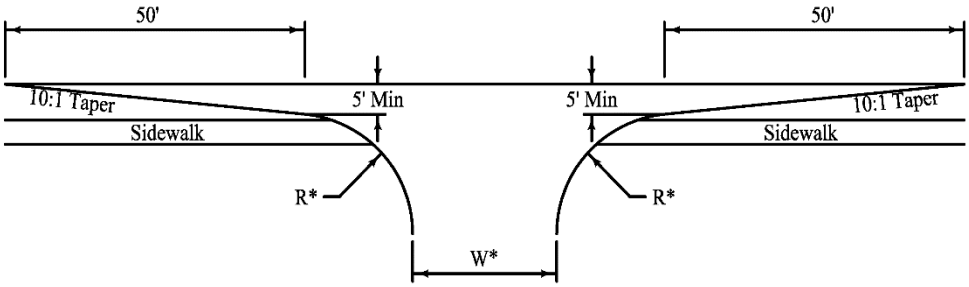
1. Utility Conflicts: Any adjustments made to utility poles, street light standards, fire hydrants, catch basins or intakes, traffic signs and signals, or other public improvements or installations, which are necessary as the result of the curb openings or driveways, should be accomplished with no additional cost to the Jurisdiction.

2. Access Signs: Driveway approaches, whereby the driveway is to serve as an entrance only or as an exit only, should be appropriately signed by, and at the expense of, the property owner subject to approval of the Jurisdiction Engineer.

3. Abandoned Driveways: Any curb opening or driveway that has been abandoned should be restored by the property owner.

4. Offset Radius and Driveway Tapers: For driveways without a right turn lane on the street approach, providing an offset radius and driveway taper can help reduce speed differential between turning and through traffic, reducing the possibility of rear-end crashes. Figure 5L-4.03 shows a typical taper system that can be effectively used. The downstream taper for right turns from the driveway may be considered optional. Right-of-way restrictions may limit the use of this method.

Figure 5L-4.03: Offset Radius and Driveway Tapers



*Driveway radii and widths vary depending on entrance type, street classification, and zoning.

5. **Sidewalks:** For driveways that intersect pedestrian circulation paths and pedestrian access routes (sidewalks and shared use paths), all ADA requirements must be met. See Chapter 12 - Sidewalks and Bicycle Facilities.

G. References

Institute of Traffic Engineers. *Transportation and Land Development*. 1988.

Oregon Department of Transportation. *Driveway Profile Study - Summary of Results*. 1998.

Transportation Research Board - National Cooperative Highway Research Program (NCHRP). *NCHRP Report 659: Guide for the Geometric Design of Driveways for Supplemental Information*. National Academy Press. Washington, DC. 2010.