

# Safe and Efficient Driveway Design

## Driveway Throat Length

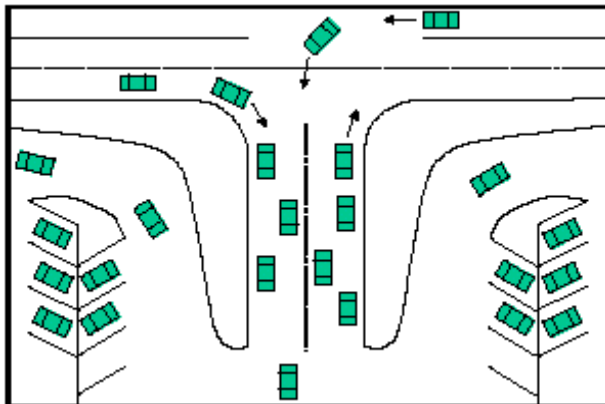
### What is the “throat length” of a driveway and why is it important?

The throat length is the distance between the street and the end of the driveway inside the land development. The following table provides recommended throat lengths:

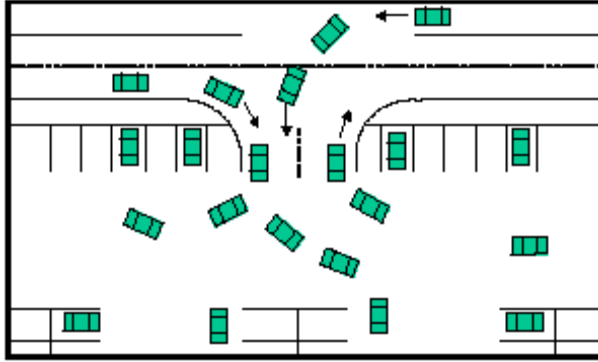
Commercial Development Type	Recommended Driveway Throat Length
Large and medium shopping centers with greater than 200,000 gross leaseable square feet in floor area	200 to 250 feet (about 15 car lengths)
Small developments with signalized access driveways	80 to 90 feet (5-6 car lengths)
Small developments with unsignalized driveways	30 to 50 feet (2-3 car lengths)

Source: Florida Department of Transportation.

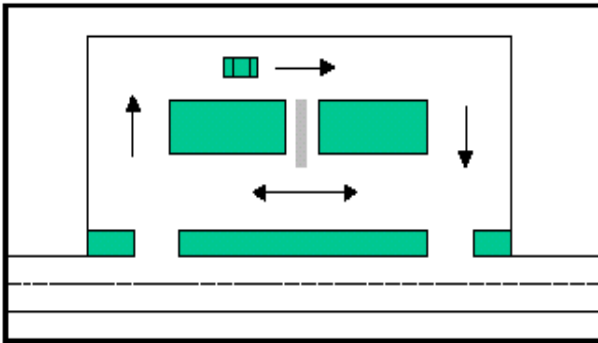
Inadequate driveway throat length is a common problem when internal land development circulation is poorly designed. Note that, particularly in the last category of the table (small commercial developments with unsignalized driveways), short driveway throat lengths are quite common. Most commercial developments do not include a two to three car length driveway. This can lead to situations in which traffic circulation within the commercial development is chaotic. It can also lead to situations in which traffic turning into a development queues on the arterial roadway while waiting for vehicles to clear the short driveway. This is unsafe and may cause accidents on the main highway.



Adequate throat length allows stacking, or queuing, to occur on site. This reduces driver confusion, traffic problems, and unsafe conditions.



Insufficient throat length and poor site planning can cause unsafe conditions and result in vehicles backing out onto the main highway (arterial), interrupting traffic flow.



Complete on-site circulation and cross access between adjacent properties allow vehicles to travel between adjacent businesses without having to re-enter the main highway (arterial).

**Are there issues that should be considered in conjunction with internal circulation?**

Driveway throat length is closely related to the following access management subjects:

- Driveway turn radius
- Driveway width
- Driveway grade
- Shared/joint driveways and/or cross access
- Speed differential between turning vehicles and through traffic.

**Driveway Grade and Speed Differential**

Along older urban arterial streets, it is common to find steep driveways with grades (or slopes) of 5–10 percent or more. Driveways with steep grades were often constructed to allow the driveway and connecting parking lots to drain more efficiently and to save earth-moving costs. On the other hand, more recently constructed arterials typically feature very gentle driveway grades. Driveway grade is an important—yet often overlooked—safety consideration.

The maximum practical grade for driveways varies between 8–14 percent for low-volume driveways and five percent for high-volume driveways (a 30-foot long driveway with a 14% grade would rise or fall about four feet along its length). Furthermore, the maximum practical change in grade is about 12%. Above this value, many vehicles will scrape their bumpers or

other low-hanging parts on the driveway, potentially causing damage to the vehicle and driveway or roadway surface. While this may be the maximum practical grade, it is much safer to use a smaller grade. A minimal grade (e.g., 2%) is still needed for drainage.

**Why is driveway grade important?**

Driveway grade is important because it affects *speed differential*. Turning vehicles must slow appreciably to enter a driveway. The steeper the driveway, the greater the reduction in speed required to prevent “bottoming out.” The following table shows typical driveway entry speeds for varying degrees of driveway grade.

<b>Driveway Grade Change (percent)</b>	<b>Typical Driveway Entry Speed (mph)</b>
Greater than 15 percent	Less than 8 mph
14 - 15	8
12 - 13	9
10 - 11	10
8 - 9	11
6 - 7	12
4 - 5	13
2 - 3	14
0 - 2	Approximately 15 mph

Source: Oregon State University (1998)

Speed differential is the difference between the speed of vehicles that are continuing along the main roadway versus that of those that are turning into or out of the driveway. For instance, if through traffic generally moves at 35 miles per hour and cars have to slow to 10 miles per hour to enter a driveway, the speed differential at that driveway is 25 miles per hour. A speed differential above 20 miles per hour begins to present safety concerns. When the speed differential becomes greater than 30 to 35 miles per hour, the likelihood of crashes involving fast moving through vehicles and turning vehicles increases very quickly.

Rear-end collisions are very common on roads and streets with large driveway speed differentials and a high density of commercial driveways. When the speed differential is high, it is also more likely that crashes will be more severe, cause greater property damage, and have a greater chance of injury or fatalities. Keeping the speed differential low is very important for safety reasons, as the table below indicates.

<b>Speed Differential between Turning and Through Traffic</b>	<b>Likelihood of Accidents</b>
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

### **What is a reasonable driveway grade?**

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 initial driveway grade angles (these grades were all chosen to keep the speed differential at or below 20 miles per hour):

<b>Roadway Classification</b>	<b>Desirable Change in Grade (percent)</b>	<b>Maximum Change in Grade (percent)</b>
Major Arterial	Less than 3	5
Minor Arterial	Less than 4	5
Collector Street	Less than 5	6
Local Street	Less than 6	8

Source: National Highway Institute

### **When is driveway grade most important?**

Steep driveways are not ideal under any circumstances; however, they are more easily tolerated on local streets and roads that carry little or no through traffic. Steep driveways are also tolerable at residential properties more than at retail businesses because residences generate much less traffic. Reducing driveway grade is an important consideration along roadways that:

- Carry considerable through traffic volumes,
- Have relatively high travel speeds (say, 35 to 40 miles per hour or more), or
- Have commercial land uses along them, especially retail and service businesses that generate high volumes of automobile trips

### **Driveway Width**

Along older urban arterial streets, it is common to find many narrow driveways. Older commercial driveway and parking lot designs tended to use 10 - 15 foot wide driveways. This type of design will safely accommodate only one vehicle at a time, either an entering or an exiting vehicle. Another common problem is driveways in urban and rural areas that are too wide. In some cases, the driveway may have no discernable boundaries or curbs. Both situations create operational and safety concerns. A properly designed driveway helps turning traffic move off the roadway more quickly and reduces the likelihood of crashes.

### **Why is driveway width important?**

Driveway width is important because it affects *speed differential*, the difference between the speeds of vehicles that are continuing along the main roadway versus those that are turning into driveways. The more a turning vehicle must slow to enter a driveway, the greater the speed differential. As the speed differential increases, the likelihood of crashes involving faster-moving through vehicles and turning vehicles increases quickly. When the speed differential is high, it is

also more likely that crashes will be more severe, cause greater property damage, and have a greater chance of injury or fatalities.

In general, vehicles must slow to a greater extent to negotiate narrower driveways than wider driveways – although the use of longer turn radii and/or tapers will improve operating performance. An additional concern is created when a driveway is so narrow that it can only operate in one direction at a time. In this case, vehicles must wait for others to exit the driveway before entering. This can create a dangerous situation of left-turning or right-turning vehicles stopped in a through traffic lane.

At the other extreme, driveways that are too wide may create confusion for motorists, who may have a hard time deciding where to position themselves. Likewise, too-wide driveway are difficult for pedestrians, who will have a greater distance of pavement to cross where they are vulnerable to being struck by an entering or exiting vehicle. Such driveways create opportunities for crashes that are injurious or fatal.

### **What is a reasonable driveway width?**

*Commercial* driveways may vary in size depending on the number of lanes needed. The optimal width for a one-way in or out driveway is 14 to 16 feet. Maximum width driveways usually have two inbound and three outbound lanes, with each lane being at least 11 feet wide. Where more than one inbound and outbound lane is provided, a median divider is generally desirable. This median should be at least 4 feet wide; however, median widths of 10 to 16 feet are preferable because they improve driver maneuvering and provide opportunities for landscaping. Median widths over 16 feet are undesirable because they create turning problems and greatly expand the intersection size. (Source: NCHRP Report 348)

Driveways that enter the public roadway at traffic signals should have at least two outbound lanes—one for right turns and one for left turns (with a minimum width of 22 feet) and one inbound lane of 14 feet minimum width. Dual left-turn lanes into driveways and dual right-turn lanes onto public streets should be used only with traffic control.

All *noncommercial* (residential) driveways should normally have a width between 14 feet and 24 feet. Where larger vehicles (farm equipment or trucks) will use a driveway, at least a 20-foot width should be provided.

Many different combinations of turn radius and driveway width provide the same level of driveway operations. For a given level of service, shorter radii require wider driveways than longer radii. For example, a 33-foot wide two-lane driveway with 5-foot turn radii provides about the same level of service as a 37-foot wide drive with a square corner. NCHRP Report 348 recommends that agencies select a very limited number of standard designs for driveways so designs are consistent.

### **When is driveway width most important?**

Narrow driveways are not ideal under any circumstances, however they are tolerable on local streets and roads that carry little or no through traffic. Narrow driveways are tolerable for

residential properties more than for retail businesses, since businesses generate many more vehicles entering and exiting driveways per hour. Increasing driveway width thus becomes a very important consideration along roadways that:

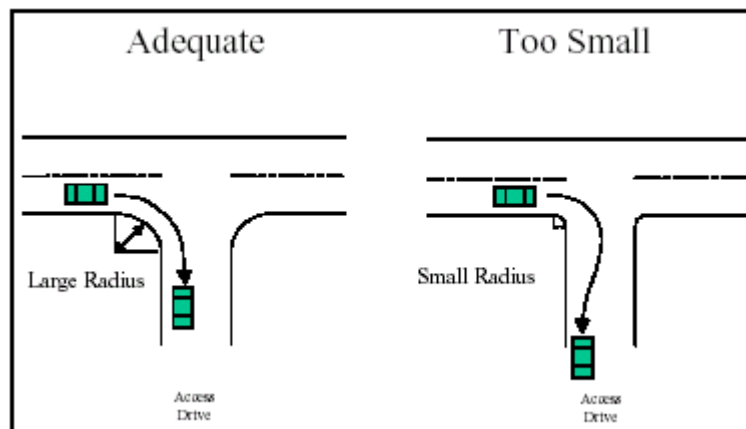
- Carry considerable through traffic volumes;
- Have relatively high travel speeds—say 35 to 40 miles per hour or more;
- Have commercial land uses along them, especially retail and service businesses that generate many hourly auto trips.

### **Driveway Turn Radius**

Turn radius refers to the extent that the edge of a commercial driveway is “rounded” to permit easier entry and exit by turning vehicles. Driveway entrances with longer turn radii help slower, turning traffic move off the arterial more quickly. They also help traffic leaving a driveway turn and enter the stream of traffic more efficiently. Guidelines for turn radii are generally applied to nonresidential developments and subdivisions.

#### **Why is turning radius important?**

Driveway turn radius is important because it affects *speed differential*, the difference between the speed of vehicles that are continuing along the main roadway versus those that are turning into or out of the driveway. Keeping the speed differential low is very important for safety reasons. Turning vehicles must slow appreciably to enter a driveway. Longer turn radii allow vehicles to turn into and out of driveways at a higher speed (see figure below). They also prevent turning vehicles from encroaching upon oncoming traffic or traffic in adjacent lanes.



A longer turn radius creates a more rounded corner. This allows the vehicle to enter and exit the driveway more quickly and without encroaching upon traffic in adjacent lanes.

#### **When is turn radius most important?**

Longer radii are most desirable in situations where vehicles are exiting from a higher speed roadway or when a high volume of driveway traffic is expected. In practice, sufficiently long turn radii can be achieved by designing the driveway to accommodate the largest vehicle expected to

use the driveway. For example, designing a driveway to accommodate the unrestricted entry of the occasional delivery truck or bus ensures a higher entry speed for automobiles.

### **What is a reasonable turn radius?**

A minimum 25-foot turn radius is recommended in urban areas, although a 35-foot radius may be needed to accommodate buses and single unit trucks. In most suburban settings, 25 to 50 foot radii are desirable; however, longer radii are desirable where turning islands or dual turning lanes are provided. A minimum 15-foot radius is recommended in areas of heavy pedestrian traffic such as business districts and school crossings. Shorter radii are recommended only for residential drives from low-speed roadways.

### **What factors should influence the turn radius?**

The preferred turn radii will depend, primarily, on the type of vehicles to be accommodated, the number of pedestrians crossing the driveway, and the operating speeds of the accessed roadway. Because larger vehicles require longer turn radii, the turn radii should be designed to accommodate the largest vehicle generally expected to use the driveway. For example, a driveway to a service station should be designed to accommodate a gasoline delivery truck. Tight radii should only be used for serving residential drives from low-speed roadways. In addition, turning radii and driveway throat width are interrelated.

Many different combinations of turn radius and driveway width provide the same level of driveway operations. For example, a 33-foot wide two-lane driveway with 5-foot turn radii provides about the same level of service as a 37-foot wide drive with a square corner. Finally, it is recommended that agencies and communities select a very limited number of standard designs for consistency.

### **How does the turn radius impact pedestrian safety?**

The use of longer turning radii should also consider the impact on pedestrian safety. A tradeoff may be involved where pedestrian safety is a key concern. Longer turning radii increase the distance of the pedestrian crossing and allow for higher vehicle speeds. Solutions include shortening the turning radii or introducing a pedestrian refuge island in the driveway.