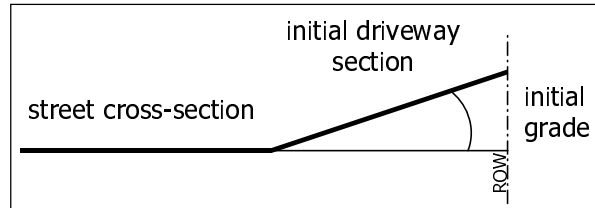


Driveway Grade

Along older urban arterial streets, it is common to find rather 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 percent grade would rise or fall about four feet along its length). Furthermore, the maximum practical change in grade is about 12 percent. 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 (say, two percent) is still needed for drainage.

Why is driveway grade important?

Driveway grade is important because it impacts *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.

Driveway Grade Change (percent)	Typical Driveway Entry Speed (mph)
Greater than 15	Less than 8
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

Source: Oregon State University, 1998.



High-grade driveway on an older-configuration arterial route in Des Moines, Iowa—grade change forces the motorist to reduce speed to negotiate driveway

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.

Speed Differential between Turning and Through Traffic (mph)	Likelihood of Accidents
10	Low
20	3 times greater than at 10 mph
30	23 times greater than at 10 mph
35	90 times greater than at 10 mph

Source: Oregon State University, 1998.

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):

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

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 more tolerable at residential properties than at retail businesses because residences generate much less traffic. Reducing driveway grade is 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 high volumes of automobile trips