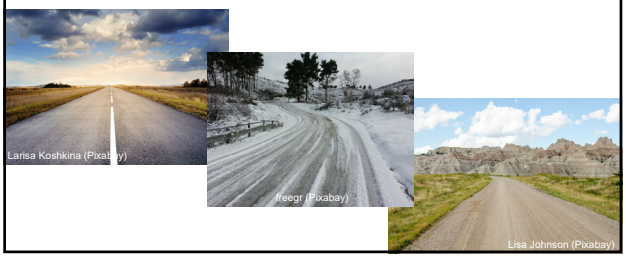
Braking and Stopping Distance

Credit: davidblyons (Public Domain)

Braking Distance

- When you put your foot on the brake of a car, the car starts to slow down and will eventually stop.
- The distance required to stop is related to the road conditions (friction between tires and road) and the friction within the brakes.

- Different road conditions provide different amounts of friction.
  - An icy road will provide less friction than dry asphalt.
  - Gravel or dirt move and therefore provide less overall friction.



- Braking distance can be calculated as follows:

$$d = kv^2$$

Where:

- *d* is the braking distance
- *k* is a constant representing road conditions
  - smaller k means more friction
- *v* is the velocity of the car

Example

Calculate the braking distance of a car traveling at 15 m/s on dry pavement.

k=0.06 m/s

$$d = kv^2$$
$$d = (0.06)(15)^2$$
$$d = 13.5\ m$$

Reaction Time

- In real life, there is a delay between when a driver sees the need to stop and when braking begins.
  - Reaction time
- During this time, the car continues to move forward at the same speed.
  - Newton's first law

Example 2

- A driver's reaction time is 0.75 s. How far does a car with a speed of 15 m/s travel during this time?

$$v = \frac{d}{t}$$

$$d = (15)(0.75)$$

$$d = 11.25 \text{ m}$$

- The total distance required to stop should include the distance traveled during the reaction time.

Total Stopping Distance = Reaction Distance + Braking Distance

$$d = vt + kv^2$$

Example 3

- A car is traveling at 15 m/s on dry pavement (k=0.06 m/s). The driver's reaction time is 0.75 s. How far does the car travel while stopping?

Total Stopping Distance = Reaction Distance + Braking Distance

$d = vt$
$d = (15)(0.75)$
$d = 11.25$ m

$d = kv^2$
$d = (0.06)(15)^2$
$d = 13.5$ m

Total Stopping Distance $= 11.25 + 13.5 = 24.75$ m

Factors that Influence Stopping Distance

- Speed
  - Faster speeds mean longing braking distance
- Friction
  - Road conditions
- Reaction time
  - Age of driver
  - Distracted driver
  - Lack of sleep
  - Drugs and/or alcohol consumption