

An Investigation into the Effects of Speeding

Initial Conditions

I'm driving through town at the legal speed limit of 30 mph and as I approach a school I slow down to a new speed restriction of 20 mph. 40 feet ahead of me a child suddenly steps out into the road and I immediately brake, stopping just short of the child who is shaken but unharmed.

Assumptions

Assume the stopping distance is made up of thinking distance and braking distance which is by constant deceleration. The thinking distance is 1 foot per mph.

Determining Braking Factor

At 20 mph thinking distance is 20 feet so 20 feet left for braking

$$v^2 = u^2 + 2as \text{ where } u = 20 \text{ mph and}$$

$v = 0$ because I just manage to stop.

$$u^2 = -2as$$

$$20^2 = -2a(20)$$

$$a = -(10 \text{ mph})^2 / \text{foot}$$

negative because this is a deceleration.

Speeding at 30 mph ?

In an alternative reality I fail to slow down to 20 mph and the child steps out as before. At what speed do I hit him?

At 30 mph thinking distance is 30 feet so 10 feet left for braking

$$v^2 = u^2 + 2as$$

where $u = 30$ mph and v to be found.

$$v = 30^2 - 2(10)(10)$$

$v = 26.5$ mph which may be thought surprisingly high.

Speeding at 40 mph

What speed would I hit him if I'd been travelling at 40 mph when he stepped out?

At 40 mph the thinking distance is 40 feet so there is no space for braking so

$$v = 40 \text{ mph}$$

General Solution

$$v^2 = u^2 + 2(-10)(40 - u)$$

$$v = \sqrt{(u + 40)(u - 20)}$$

$$\text{for } 20 \leq v \leq 40$$

Descriptively the kinetic energy of the car which has to be dissipated by the brakes is a function of speed **squared**. In increasing from 20 mph to 30 mph the available braking distance reduces by 50% and the kinetic energy increases by a factor of $30^2 / 20^2$ ie 125%.

So a small increase over the speed limit has a devastating effect on the ability to stop in an emergency.

✕ rg

An Investigation into the Effects of Speeding

Initial Conditions

I'm driving through town at the legal speed limit of 30 mph and as I approach a school I slow down to a new speed restriction of 20 mph. 40 feet ahead of me a child suddenly steps out into the road and I immediately brake, stopping just short of the child who is shaken but unharmed.

Assumptions

Assume the stopping distance is made up of thinking distance and braking distance which is by constant deceleration. The thinking distance is 1 foot per mph.

Determining Braking Factor

At 20 mph thinking distance is 20 feet so 20 feet left for braking

$v^2 = u^2 + 2as$ where $u = 20$ mph and $v = 0$ because I just manage to stop.

$$u^2 = -2as$$

$$20^2 = -2a (20)$$

$$a = -(10 \text{ mph})^2 / \text{foot}$$

negative because this is a deceleration.

Speeding at 30 mph ?

In an alternative reality I fail to slow down to 20 mph and the child steps out as before. At what speed do I hit him?

At 30 mph thinking distance is 30 feet so 10 feet left for braking

$$v^2 = u^2 + 2as$$

where $u = 30$ mph and v to be found.

$$v = 30^2 - 2 (10) (10)$$

$v = 26.5$ mph which may be thought surprisingly high.

Speeding at 40 mph

What speed would I hit him if I'd been travelling at 40 mph when he stepped out?

At 40 mph the thinking distance is 40 feet so there is no space for braking so

$$v = 40 \text{ mph}$$

General Solution

$$v^2 = u^2 + 2 (-10) (40 - u)$$

$$v = \sqrt{(u + 40)(u - 20)}$$

$$\text{for } 20 \leq v \leq 40$$

Descriptively the kinetic energy of the car which has to be dissipated by the brakes is a function of speed **squared**. In increasing from 20 mph to 30 mph the available braking distance reduces by 50% and the kinetic energy increases by a factor of $30^2 / 20^2$ ie 125%.

So a small increase over the speed limit has a devastating effect on the ability to stop in an emergency.

✕ rg