Ex: A car of $m=1600 \text{ kg}$ travels at a constant speed of $v=20 \text{ m/s}$ along a flat, circular road of radius $R=190 \text{ m}$. What is the minimum value of $\mu_s$ that will prevent the car from slipping?

○ Begin with free-body diagram of the car.

○ Now use Newton’s 2\textsuperscript{nd} law.

$$\Sigma F_y = ma_y : \quad N - mg = ma_y = 0, \quad N = mg$$

$$\Sigma F_r = ma_r : \quad f_s = \frac{mv^2}{R}, \quad f_s^{\text{max}} = \mu_s N = \mu_s mg$$

$$\Rightarrow \quad \mu_s mg = \frac{mv^2}{R}, \quad \mu_s = \frac{v^2}{gR}$$

○ Now plug in the known parameters.

$$\mu_s = \frac{(20 \text{ m/s})^2}{(9.81 \text{ m/s}^2)(190 \text{ m})} = 0.21$$

○ Note two things:

1). $\mu_s \propto v^2$; $\mu_s$ increases with velocity.

2). $\mu_s$ does not depend on the vehicle’s mass.