Problem 2

Kinetics with Normal Tangential Coordinates Worked Example

- A 2500 lb car is traveling 40 ft/s. The car's tires have a coefficient of friction with the road of $\mu_s = .9$
- Assuming the car maintains a constant speed, what is the minimum radius of curvature before slipping?
- Assuming the car is speeding up at a rate of 10 ft/s^2, what is the minimum radius of curvature before slipping?

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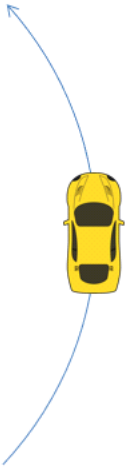
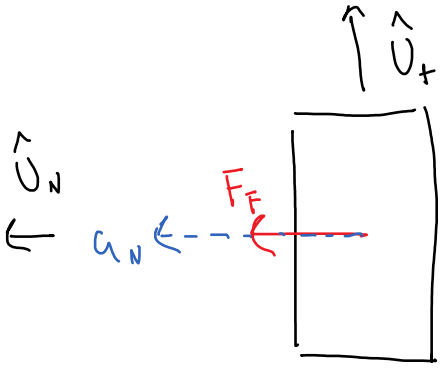




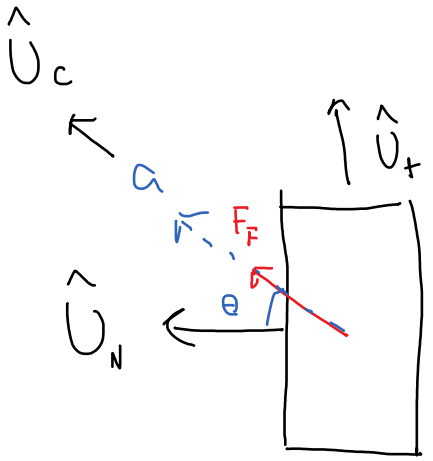
$$\sum F_z = F_g - F_N = 0$$

$$F_g = F_N = 2500 \text{ lbs}$$

$$\sum F_N = F_F = m a_N$$

$$(.9)(2500 \text{ lbs}) = \left(\frac{2500}{32.2}\right)\left(\frac{(40 \text{ ft/s})^2}{\rho}\right)$$

$$\boxed{\rho = 55.2 \text{ ft}}$$



$$\sum F_t = F_F \sin\theta = m\, a_t$$

$$\sum F_N = F_F \cos\theta = m\, a_N$$

$$\sum F_c = F_F = m\, a_c$$

$$(.9)(2500) = \left(\frac{2500}{32.2}\right)\sqrt{a_t^2 + a_N^2}$$

$$(.9) = \frac{1}{32.2}\sqrt{10^2 + \left(\frac{40^2}{\rho}\right)^2}$$

$$(28.98)^2 = 100 + \frac{2.56 \times 10^6}{\rho^2}$$

$$\boxed{\rho = 58.8 \text{ ft}}$$