

Intermediate Principle of Impulse and Momentum Video

Inspiration: 19-10 Hibbeler



A city engineer is working on a cargo transport system utilizing gears and racks. She is considering a **30 kg** gear with a radius of gyration of $k_G = 125 \text{ mm}$ and a radius of $r = 0.15 \text{ m}$. The gear is in contact with a **20 kg** rack. If it takes the gear **0.6125 s** to reach an angular velocity of **$\omega = 20 \text{ rad/s}$** , starting from rest, determine the moment that the gear is subjected to. Assume there is no friction between the rack and the ground.

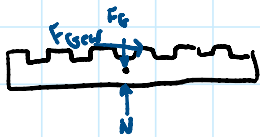
$$v_{\text{rack}_2} = \omega_2 r = 20(0.15) = 3$$

$$m(v_{\text{rack}_1}) + \sum \int_{t_1}^{t_2} F dt = m(v_{\text{rack}_2})$$

$$0 + Ft = 20(3)$$

$$Ft = 60$$

$$F(0.6125) = 60 \quad F = \frac{4400}{49}$$



$$I_G \omega_1 + \sum \int_{t_1}^{t_2} M_{\text{ext}} dt = I_G \omega_2$$

$$0 + Mt - Frt = I_G \omega_2 = mk_G^2 \omega_2$$

$$M(0.6125) - \frac{4400}{49}(0.15)(0.6125) = 30(0.125)^2(20)$$

$$M = 30 \text{ Nm}$$

