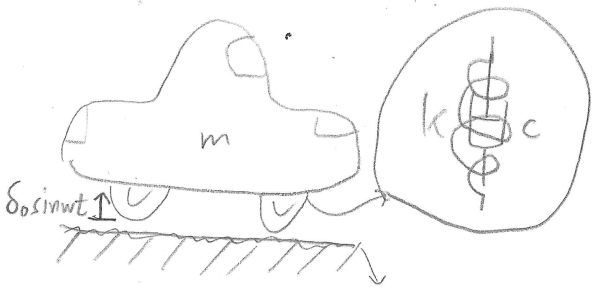
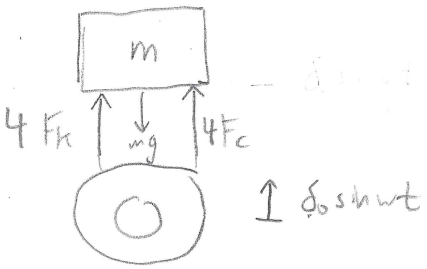
20-R-VIB-DY-48 Advanced

A coilover is a damper integrated with a spring used for car suspension. Four of these are used to support the $m = 1500\,kg$ body of a car. Driving on the road produces a periodic displacement of $\delta = 0.005 \sin 20t$ at each wheel simultaneously. If the damping and spring constant are equal, determine the damper/spring constant that will produce the largest steady-state vibration amplitude.

Solution: FBD



inside



$\Sigma F_y = -ma_y \quad 4ky + 4c\dot{y} + m\ddot{y} = 0$

$4k(y - \delta_0 \sin\omega t) + 4c\dot{y} + m\ddot{y} = 0$

$4ky + 4c\dot{y} + m\ddot{y} = 4k\delta_0 \sin\omega t$

$$D = \frac{\delta_0}{\sqrt{\left[1 - \frac{\omega_0^2 m}{k}\right]^2 + \left[2\frac{c\,\omega_0}{\sqrt{4mk}\sqrt{\frac{k}{m}}}\right]^2}}$$

$$2\frac{x\,\omega_0}{2k}$$

$k = c = x$

$$\frac{\delta_0}{\sqrt{\left[1 - \frac{\omega_0^2 m}{x}\right]^2 + \left[\omega_0\right]^2}} = D$$

at max $\frac{\omega_0^2 m}{x} = 1$

$x = \omega_0^2 m = 600000$

$k = 600\,000\ N/m$

$c = 600\,000\ N\cdot s/m$