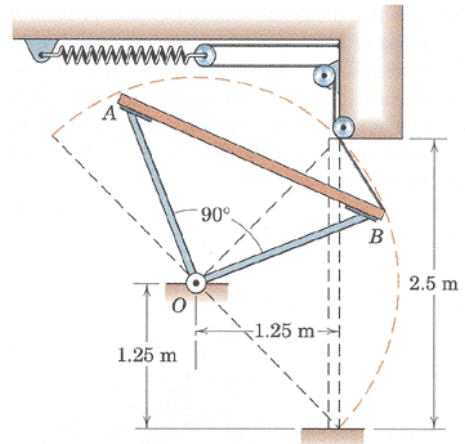


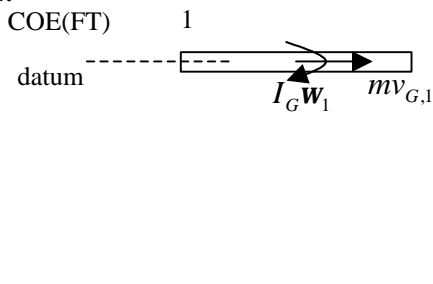
Example Problem - Le 12

6.121 AB is the cross section of a garage door which is a rectangular 2.5m by 5m panel of uniform thickness with a mass of 200 kg. The door is supported by the struts of negligible mass and hinged at O. Two spring-and-cable assemblies, one on each side of the door, control the movement. When the door is in the horizontal open position, each spring is unextended. If the door is given a slight push from the open position and allowed to fall, determine the spring constant k for each spring which will limit the angular velocity of the door to 1.5 rad/s when edge B strikes the floor. (taken from *Engineering Mechanics, 4th Edition by Meriam & Kraige*)



System: garage door, springs, and cable

Kinetics:



$$\Delta E_{sys} = W = 0$$

$$E_{K1} + E_{G1} + E_{S1} = E_{K2} + E_{G2} + E_{S2} \tag{1}$$

$$E_{K1} = 0 \tag{2} \quad E_{K2} = \frac{1}{2}mv_{G,2}^2 + \frac{1}{2}I_G w_2^2 \tag{5}$$

$$E_{G1} = 0 \tag{3} \quad E_{G2} = -mgh \tag{6}$$

$$E_{S1} = 0 \tag{4} \quad E_{S2} = 2\left(\frac{1}{2}kx^2\right) \tag{7}$$

unk	eqs
k	1
E_{K1}	2
E_{G1}	3
E_{S1}	4
E_{K2}	5
E_{G2}	6
E_{S2}	7
$v_{G,2}$	8
x	9

Kinematics:

relate velocities $v_{G,2} = w_2 r_{G/O}$ (8)

dependant motion $2x + y = L \Rightarrow x = \frac{y}{2}$ (9)

Other:

$$w_2 = 1.5 \text{ rad/s} \quad r_{G/O} = 1.25 \text{ m} \quad y = 2.5 \text{ m}$$

$$m = 200 \text{ kg} \quad h = 1.25 \text{ m} \quad I_G = 1/12 mL^2 \text{ kgm}^2$$

Solving:

$k = 1270 \text{ N/m}$