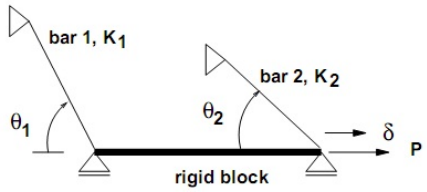
PROBLEM 1

Consider the following structure with an applied load $P$. The horizontal block (drawn as a thick line) is rigid and supported on rollers. The other two bars have stiffnesses $K_1$ and $K_2$ and form angles $\theta_1$ and $\theta_2$ with the horizon. As result of the application of the force $P$, the rigid block moves by a small displacement $\delta$.




I need to solve for an equation for $\delta$ in respect to both K values, P, and angles.
Force Equations

$$F_1 * cos(\theta_1) + F_2 * cos(\theta_2) = P \tag{1}$$

$$F_1 = \frac{P - F_2 * cos(\theta_2)}{cos(\theta_1)} \tag{2}$$

Elongation Force Relations

$$e_1 = \frac{F_1}{K_1} \tag{3}$$

$$e_2 = \frac{F_2}{K_2} \tag{4}$$

Compatibility Equations

$$\delta = \frac{e_1}{cos(\theta_1)} = \frac{e_2}{cos(\theta_2)} \tag{5}$$

Rest is algebra to solve for $\delta$

$$\frac{P - F_2 cos(\theta_2)}{K_1 * cos(\theta_1)^2} = \frac{F_2}{K_2 * cos(\theta_2)} \tag{6}$$

$$F_2 = \frac{\frac{P}{K_1 * cos(\theta)^2}}{\frac{1}{K_2 * cos(\theta_2)} + \frac{cos(\theta_2)}{K_1 * cos(\theta)^2}} \tag{7}$$

After solving for $F_2$, we go back to the equation for $\delta$.

$$\delta = \frac{e_2}{cos(\theta_2)} \tag{8}$$

Final Equation for Delta:

$$\frac{\frac{F_2}{K_2}}{cos(\theta_2)} \tag{9}$$