SOLUTION

***ME 323: Mechanics of Materials*** ***Homework Set H01***

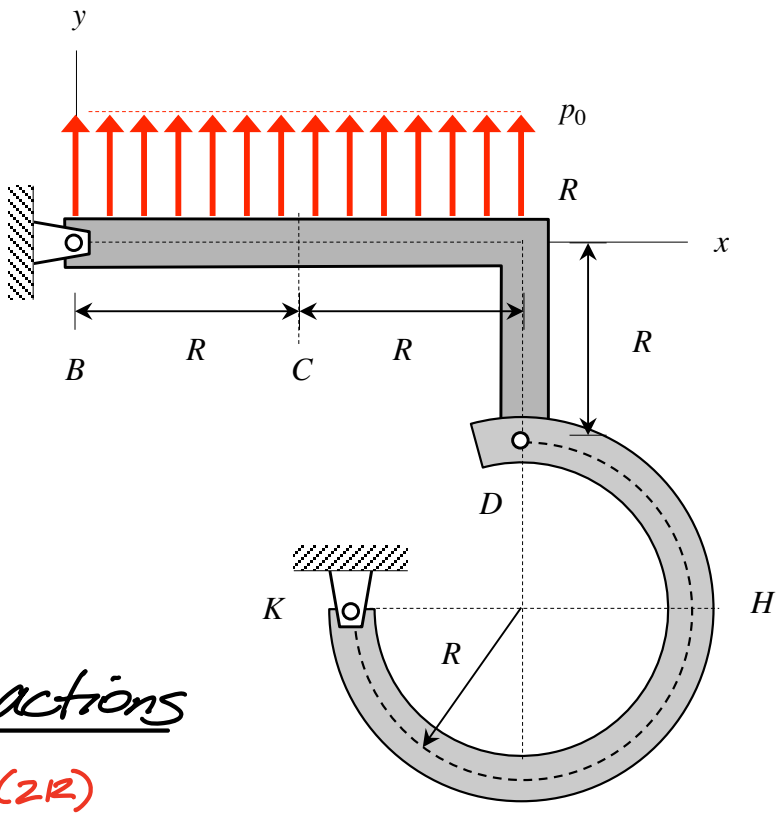
***Summer 2024*** ***Assigned/Due: June 10/June 12***

Frame member shown is loaded with a line load $p_0$ (force/length) over section BR. Ends B and K of the two members are connected to ground with pin joints, and members BD and DK are joined with a pin joint at D.

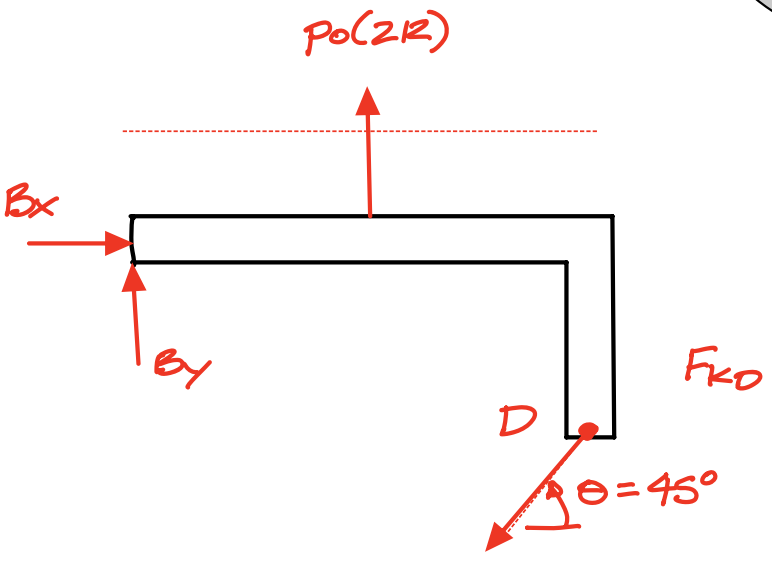
a) Determine the external reactions on the two members at B and K.

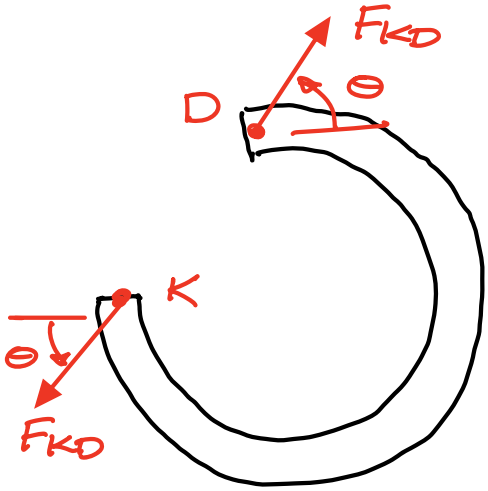
b) Determine the internal resultants (shear force, axial force and bending moment) at point C on BD.

c) Determine the internal resultants (shear force, axial force and bending moment) at point H on DK.




a) External reactions



From FBD of BRD

- $\sum M_B = (2p_oR)R - (F_{KD}\cos\theta)R - (F_{KD}\sin\theta)(2R) = 0$

  ↳ $F_{KD} = \dfrac{2p_oR}{\cos\theta + 2\sin\theta} = \dfrac{2p_oR}{\frac{\sqrt{2}}{2} + 2\frac{\sqrt{2}}{2}} = \underbrace{\dfrac{2\sqrt{2}}{3}p_oR}_{\text{tension}}$

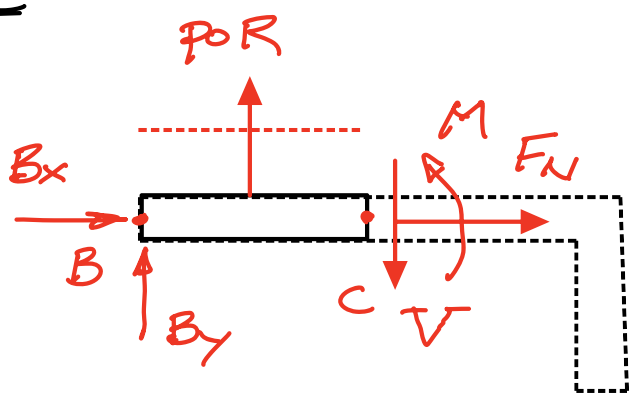
- $\sum F_x = B_x - F_{KD}\cos\theta = 0 \Rightarrow$

  $B_x = \dfrac{\sqrt{2}}{2}\left(\dfrac{2\sqrt{2}}{3}p_oR\right) = \dfrac{2}{3}p_oR$

- $\sum F_y = 2p_oR + B_y - F_{KD}\sin\theta = 0 \Rightarrow$

  $B_y = -2p_oR + \left(\dfrac{2\sqrt{2}}{3}p_oR\right)\dfrac{\sqrt{2}}{2} = -\dfrac{4}{3}p_oR$

b) Internal resultants at C




- $\sum F_y = B_y + p_oR - V = 0$

  ↳ $V = p_oR + B_y$

  $= p_oR - \frac{4}{3}p_oR$

  $= -\frac{1}{3}p_oR$ (up)

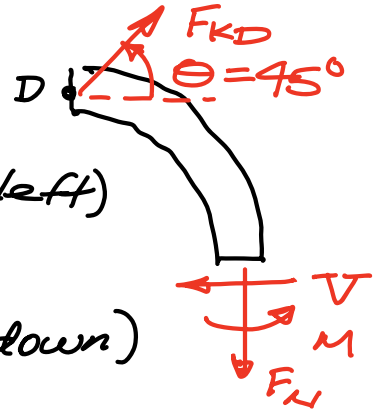
- $\sum F_x = B_x + F_N = 0$

  ↳ $F_N = -B_x = -\frac{2}{3}p_oR$ (to left)

- $\sum M_B = (p_oR)\left(\frac{R}{2}\right) - V(R) + M = 0$

  ↳ $M = VR - \dfrac{p_oR^2}{2} = -\frac{1}{3}p_oR^2 - \frac{1}{2}p_oR^2 = -\frac{5}{6}p_oR^2$ (CW)

c) Internal resultants at H




- $\sum F_x = F_{KD}\cos\theta - V = 0$

  ↳ $V = \dfrac{2\sqrt{2}}{3}\left(\dfrac{\sqrt{2}}{2}\right)p_oR = \frac{2}{3}p_oR$ (to left)

- $\sum F_y = F_{KD}\sin\theta - F_N = 0$

  ↳ $F_N = \dfrac{2\sqrt{2}}{3}\dfrac{\sqrt{2}}{2}p_oR = \frac{2}{3}p_oR$ (down)

- $\sum M_D = -F_N R - VR + M = 0 \Rightarrow M = \frac{4}{3}p_oR^2$ (CCW)