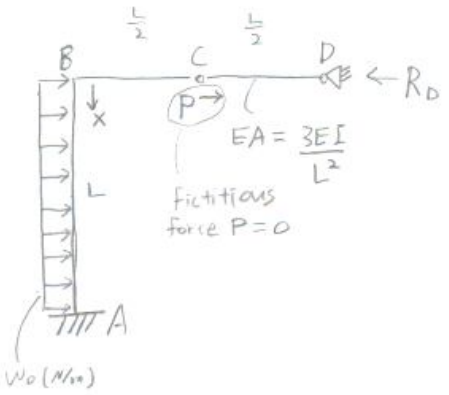
Problem 8



Find: R_D, Δ_C ($\rightarrow$)

$$\varepsilon = \frac{\sigma}{E} = \frac{R_D}{EA}$$

$$\Delta_C = \varepsilon \cdot \frac{L}{2} = \frac{R_D}{EA}\frac{L}{2} = \boxed{\frac{L^3}{6EI} R_D} \ (\rightarrow)$$

$$M_{AB} = \frac{w_0 x^2}{2} - (R_D - P)x$$

$$\frac{\partial M_{AB}}{\partial P} = x$$

BC

$$M_{BC} = 0$$

$$\Delta_C = \frac{\partial U}{\partial P} = \frac{1}{EI}\int_0^L \left(\frac{w_0 x^2}{2} - (R_D - P)x\right)(x)\,dx$$

$$= \frac{1}{EI}\left[\frac{1}{8} w_0 x^4 - \frac{1}{3} R_D x^3 + \frac{1}{3} P x^3\right]_0^L$$

$$= \frac{1}{EI}\left(\frac{1}{8} w_0 L^4 - \frac{1}{3} R_D L^3\right) = \frac{L^3}{6EI} R_D$$

$$R_D = \frac{w_0 L}{4}$$

$$\Delta_C = \frac{w_0 L^4}{24EI} \ (\rightarrow)$$

Compression in CD $= R_D = \frac{w_0 L}{4}$