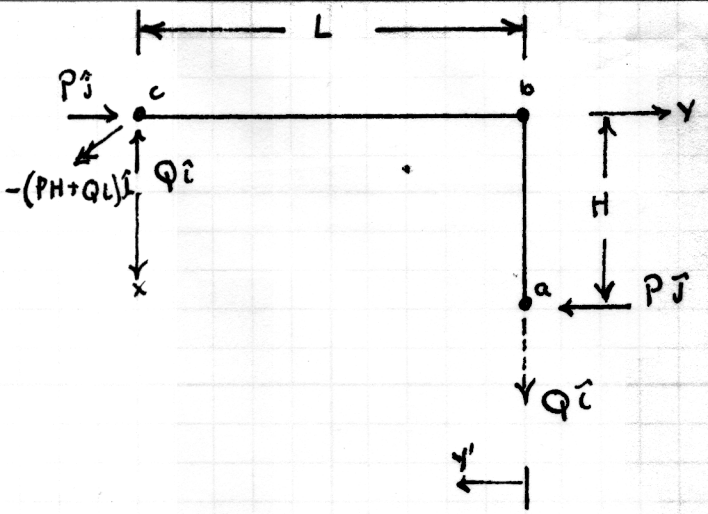


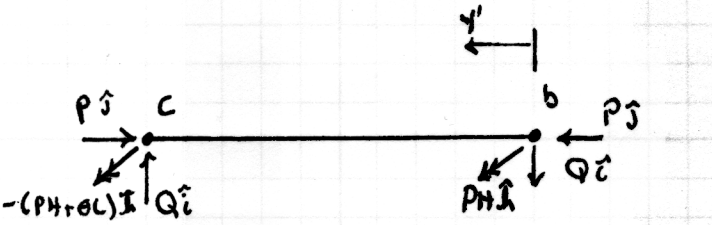
STARTING WITH ab

$$U = U_b + U_N + \cancel{U_S}^{\to 0}$$

$$U_b = \int_0^H \frac{M^2}{2EI}\,dx' = \int_0^H \frac{(Px')^2}{2EI}\,dx'$$

$$= \frac{P^2}{2EI}\int_0^H x'^2\,dx = \frac{P^2H^3}{6EI}$$

$$U_N = \frac{Q^2H}{2EA}$$



IN cb

$$U = U_B + U_N$$

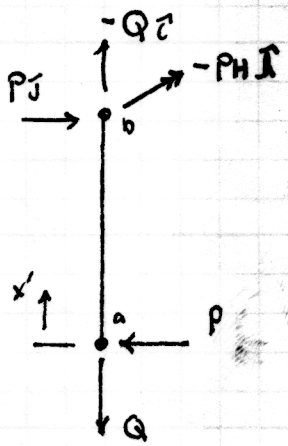
$$U_b = \int_0^L \frac{M^2}{2EI}\,dy' = \frac{1}{2EI}\int_0^L (Qy' + PH)^2\,dy'$$

$$= \frac{1}{2EI}\left[\int_0^L \left(\frac{Q^2y'^2}{2} + 2P\cdot QHy' + P^2H^2\right)dy'\right.$$

$$= \frac{1}{2EI}\left[\frac{Q^2y'^3}{6} + 2\frac{PQH}{2}y'^2 + P^2H^2y\right]_0^L$$

$$= \frac{1}{2EI}\left[\frac{Q^2L^3}{6} + PQHL^2 + P^2H^2L\right]$$

$$U_N = \frac{P^2L}{2EA} =$$



$$U_T = \frac{P^2H^2}{6EI} + \frac{Q^2H}{2EA} + \frac{P^2L}{2EA} + \frac{1}{2EI}\left[\frac{Q^2L^3}{6} + PQHL^2 - P^2H^2L\right]$$

$$\delta_Q = \frac{\partial U}{\partial Q} = \frac{QH}{EA} + \frac{QL^3}{6EI} + \frac{PHL^2}{2EI} \xrightarrow{Q=0} \delta_Q = \frac{PHL^2}{2EI}$$