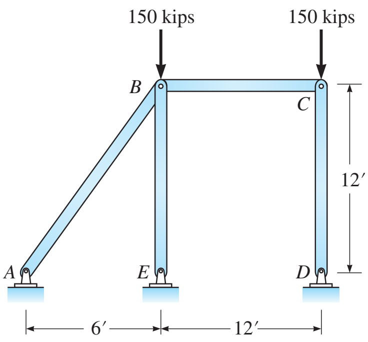
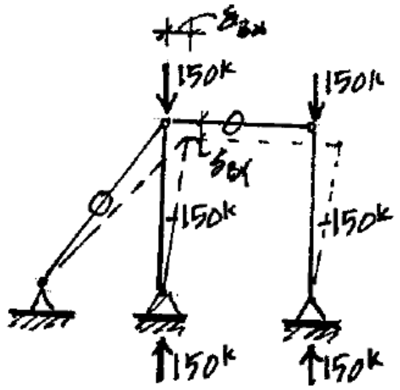
P8.5. The pin-connected frame in Figure P8.3 is subjected to two vertical loads. Compute the vertical displacement of joint *B*. Will the frame sway horizontally? If yes, compute the horizontal displacement of joint *B*. The area of all bars = 5 in.^{2}, and E = 29,000 kips/in.^{2}.



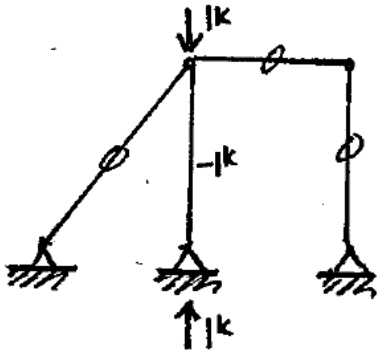
P8.5



$$\Sigma Q \cdot \delta_P = \Sigma F_Q \frac{F_P L}{AE}$$

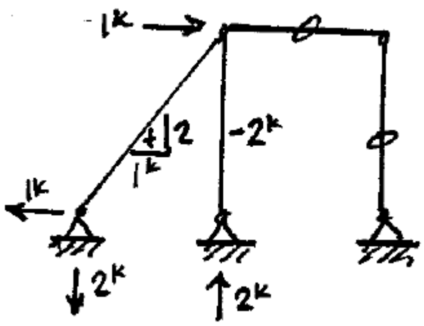
$$1^k \cdot \delta_{By} = \frac{-1\ (-150^k)(12' \times 12\%)}{5\ \text{in}^2 (29000\ \text{k/in}^2)}$$

$$= \boxed{0.149'' \downarrow}$$

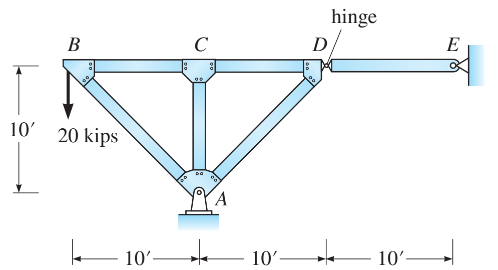


$$1^k \cdot \delta_{Bx} = \frac{-2^k(-150^k)(12' \times 12\%)}{5\,\text{in}^2 (29{,}000\,\text{k/in}^2)}$$

$$= \boxed{0.298'' \rightarrow}$$



P8.9. When the 20-kip load is applied to joint *B* of the truss in Figure P8.9, support *A* settles vertically downward 3/4 in. and displaces 1/2 in. horizontally to the right. Determine the vertical displacement of joint *B* due to all effects. The area of all bars = 2 in.^{2}, and E = 30,000 kips/in.^{2}.



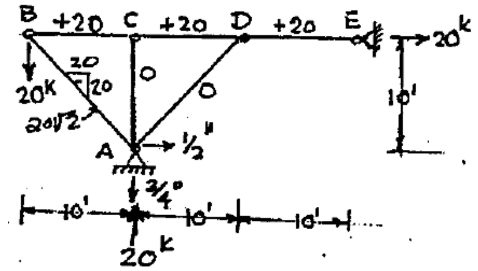
P8.9

$A = 2\ \text{in}^2,\ E = 30{,}000\ \text{k/in}$

$$\Sigma Q \cdot \delta_P = \Sigma F_Q F_P \frac{L}{AE}$$

$$1^k \cdot \delta_{By} - \frac{1''}{2} \times 1^k - \frac{3''}{4} \times 1^k = \Sigma F_Q F_P \frac{L}{AE} \qquad (1)$$

$$\Sigma F_Q F_P \frac{L}{AE} = \left[\frac{1^k \times 20^k (10\times 12)}{2\times 30{,}000}\right]3 + (-\sqrt{2})(-20\times\sqrt{2})\frac{\overbrace{(10\sqrt{2})12}^{L}}{2\times 30{,}000} \qquad (2)$$

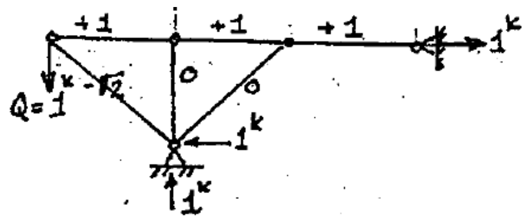


P-System

Substitute (2) in to (1)

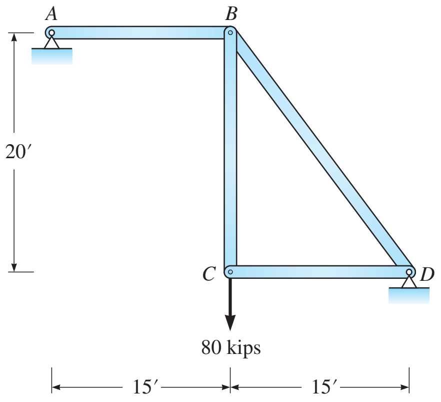
$$\delta_{By} = \frac{1}{2} + \frac{3}{4} + [0.04]3 + 0.113$$

$$\boxed{\delta_{BY} = 1.483'' \downarrow}$$



Q-System

P8.11. Determine the horizontal and vertical deflection of joint C of the truss in Figure P8.11. In addition to the load at joint C, the temperature of member BD is subject to a temperature increase of 60°F. For all bars, $E = 29{,}000$ kips/in.^{2}, $A = 4$ in.^{2}, and $\alpha = 6.5 \times 10^{-6}$ (in./in.)/°F.



P8.11

δ_{BD}^{T} Due to $\Delta T = +60^{\circ} F$

$$\delta_{BD}^{T} = \alpha \cdot \Delta T \cdot L = 6.5 \times 10^{-6}(60)(25 \times 12) = 0.117\,\text{in}$$

Bar deformation due to 80^k load at "C"

$$\Delta L_{AB} = \frac{PL}{AE} = \frac{-60(15 \times 12)}{EA} = -0.093''$$

$$\Delta L_{BC} = \frac{80(20 \times 12)}{EA} = 0.1655''$$

$$\Delta L_{BD} = \frac{-100(25 \times 12)}{EA} = -0.2586''$$

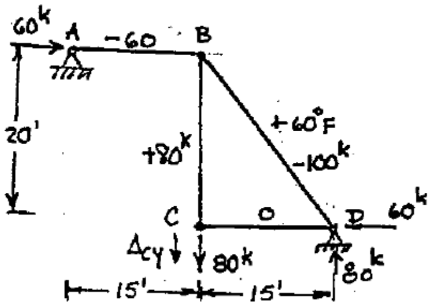
$$\Delta_{Cy}:\ Q_1 \cdot \Delta_{Cy} = \Sigma F_{Q_1} (\Delta L + \alpha \Delta T L)$$

$$\Delta_{Cy} = \left[-\frac{3}{4}(-0.093) + 1(0.1655) + -\frac{5}{4}(-0.2586 + 0.117)\right]$$

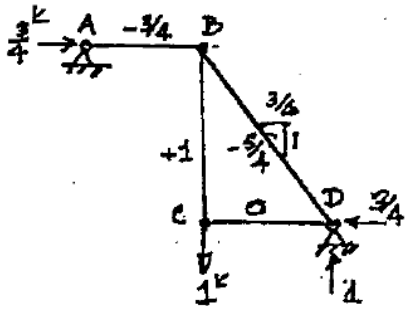
$$\boxed{\Delta_{Cy} = 0.41''\downarrow}$$

$$\Delta_{Cx}:\ Q_2 - \Delta_{Cx} = \Sigma F_{Q2}(\Delta L + \alpha \Delta T L)$$

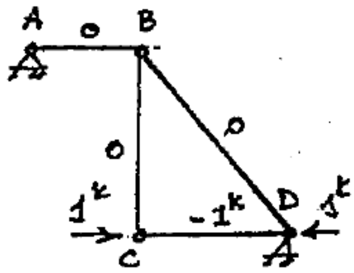
$$\Delta_{Cx} = 1(0+0) = \boxed{0}$$



P-System



Q-System



Q_2-System