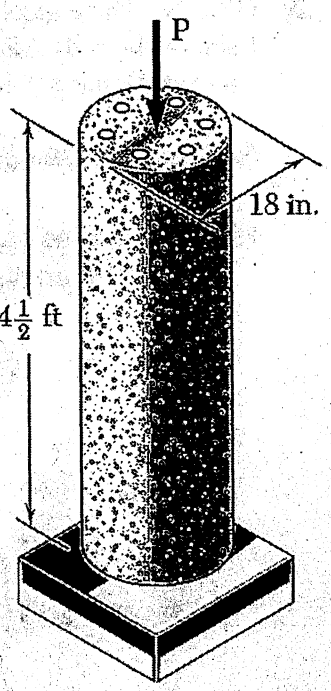
1) GIVEN: The concrete column is reinforced with six Ø1-1/8in. steel rods.
$E_s = 29\text{x}10^6$ psi and $E_c = 4.2\text{x}10^6$ psi.
REQ'D: Normal stresses in the steel and concrete if P = 350 kips. (B9.27)



$$\Delta L = \frac{P_c L}{E_c A_c} \Rightarrow P_c = \frac{E_c A_c \Delta L}{L}$$

$$\Delta L = \frac{P_s L}{E_s A_s} \Rightarrow P_s = \frac{E_s A_s \Delta L}{L}$$

$$P = P_c + P_s = (E_c A_c + E_s A_s)\varepsilon$$

$$\varepsilon = \frac{P}{E_c A_c + E_s A_s}$$

$$A_s = \frac{\pi}{4}(1.125\,in)^2 \times 6 = 5.964\ in^2$$

$$A_c = \frac{\pi}{4}(18\ in)^2 - 5.964\ in^2 = 248.5\ in^2$$

$$\varepsilon = \frac{-350\times10^3\ lb\ (c)}{4.2\times10^6 psi\,(248.5\ in^2) + 29\times10^6 psi\,(5.964\ in^2)}$$

$$= \underline{-287.7\times10^{-6}\ in/in}$$

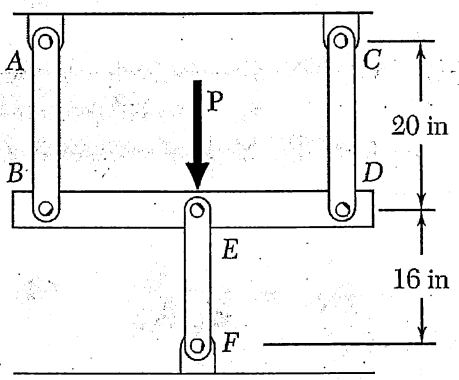
$$\sigma_c = E_c\varepsilon = 4.2\times10^6 psi\,(-287.7\times10^{-6}\ in/in)$$

$$= \underline{\underline{-1.21\ ksi\ (c)}}$$

$$\sigma_s = E_s\varepsilon = 29\times10^6 psi\,(-287.7\times10^{-6}\ in/in)$$

$$= \underline{\underline{-8.343\ ksi\ (c)}}$$

2) GIVEN: Three steel rods ($E = 29 \times 10^6$ psi) support an 8.5-kip load **P**. Each of the rods AB and CD has a 0.32-in^2 cross-sectional area and rod EF has a 1-in^2 cross-sectional area. (B9.29)



Neglect any deformation of rod BED.

REQ'D: (a) Find the change in length of rod EF
(b) Find the stress in each rod.

$P_{AB} = P_{CD}$ By $\Sigma M_E = 0$

$\Sigma F_y = 0$

$P_{AB} + P_{CD} + P_{EF} - P = 0$

$P = 2P_{AB} + P_{EF}$

SINCE BED IS RIGID

$\delta_B = \delta_E = \delta_D$

$$\frac{P_{AB} L_{AB}}{E A_{AB}} = \frac{P_{EF} L_{EF}}{E A_{EF}} \Rightarrow P_{AB} = P_{EF} \frac{L_{EF}}{E A_{EF}} \frac{E A_{AB}}{L_{AB}}$$

$$P_{AB} = P_{EF}\left(\frac{16}{20}\right)\left(\frac{.32\ in^2}{1\ in^2}\right) = .256\ P_{EF}$$

$P = 2(.256\ P_{EF}) + P_{EF}$

$= 1.512\ P_{EF}$

$$P_{EF} = \frac{P}{1.512} = \frac{8.5\ kips}{1.512} = \underline{5.627\ kips}$$

$P_{AB} = P_{CD} = .256(5.627\ kips) = \underline{1.439\ kips}$

a) $$\Delta L_{EF} = \frac{P_{EF} L_{EF}}{A_{EF} E_{EF}} = \frac{5.627\ kips(16in)}{1in^2(29\times10^6 psi)} = \underline{\underline{.003106\ in}}$$

b) $$\sigma_{AB} = \sigma_{CD} = \frac{P_{AB}}{A_{AB}} = \frac{1.439\ kips}{.32\ in^2} = \underline{\underline{4.497\ ksi}}$$

$$\sigma_{EF} = \frac{P_{EF}}{A_{EF}} = \frac{5.627\ kips}{1\ in^2} = \underline{\underline{5.627\ ksi}}$$