PROB#2.28

Using 4#10 bars ($5.06\ in.^2$)

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{(5.06)(60)}{(0.85)(4)(16)} = 5.58\ in.$$

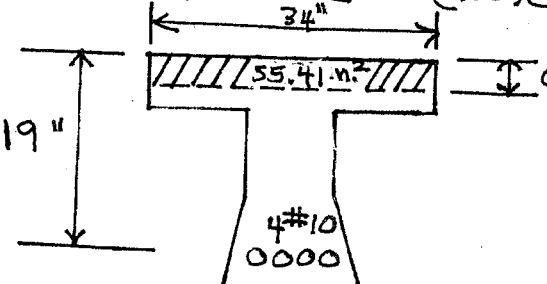
$$M_m = A_s f_y \left(d - \frac{a}{2}\right) = (5.06)(60)\left(25 - \frac{5.58}{2}\right)$$

$$= 6743\ in.-k = \boxed{561.9\ ft-k}$$

PROB # 2.36

Using 4 #8 bars (3.14 in.²)

$$A_c = \frac{A_s f_y}{0.85 f'_c} = \frac{(3.14)(60)}{(0.85)(4)} = 55.41 \text{ in.}^2$$

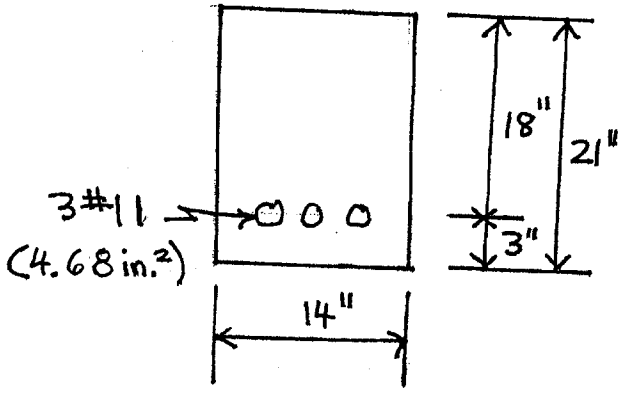


$$a = \frac{55.41}{34} = 1.63 \text{ in.}$$

$$M_n = A_s f_y \left(d - \frac{a}{2}\right) = (3.14)(60)\left(19 - \frac{1.63}{2}\right)$$

$$= 3426 \text{ in.-k} = \boxed{285.5 \text{ ft-k}}$$

PROB# 3.8



$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{(4.68)(75)}{(0.85)(5)(14)} = 5.90 \text{ in.}$$

$$\beta_1 = 0.85 - \left(\frac{f'_c - 4000}{1000}\right)(0.05) = 0.85 - \left(\frac{5000-4000}{1000}\right)(0.05)$$

$$= 0.80$$

$$c = \frac{a}{\beta_1} = \frac{5.90}{0.80} = 7.37 \text{ in.}$$

$$\epsilon_t = \frac{d-c}{c}(0.003) = \left(\frac{18-7.37}{7.37}\right)(0.003)$$

$$= \underline{0.00432} < 0.005 \quad \therefore \phi < 0.9$$

and $\phi = 0.65 + 0.25\left(\frac{18}{7.37} - \frac{5}{3}\right) = 0.844$

$$\phi M_m = \phi A_s f_y \left(d - \frac{a}{2}\right) = (.844)(4.68)(75)\left(18 - \frac{5.90}{2}\right)$$

$$= 4458 \text{ in.-k} = \underline{371.5 \text{ ft-k}} \quad \checkmark \text{JCM}$$

PROB #4.10

Assume beam wt = 500 #/ft

$w_u = (1.2)(3.5) = 4.2$ k/ft

$P_u = (1.6)(30) = 48$ k

$$M_u = \frac{(4.2)(20)^2}{8} + \frac{(48)(20)}{4} = 450.0 \text{ ft-k}$$

$\rho = \frac{1}{2}\rho_b = \frac{1}{2}(.0285) = 0.01425$ ← Table A.7

$\frac{M_u}{\phi b d^2} = 749.4$ from Appendix Table A.13

$$bd^2 = \frac{M_u}{\phi\, 749.4} = \frac{(12)(450{,}000)}{(0.9)(749.4)}$$

$= 8006$ { 14 x 23.91 ; 15 x 23.10 ← ; 16 x 22.37

USE 15 x 26 beam (d = 23.5 in.)

Beam wt $= \frac{(15)(26)}{144}(150) = 406$ #/ft < 500 #/ft OK

$A_s = \rho b d = (.01425)(15)(23.5) = 5.02$ in.^{2}

USE 4 #10 Bars (5.06 in.^{2})

$$\rho = \frac{A_s}{bd} = \frac{5.06}{(15)(23.5)} = 0.01435$$

$> \rho_{min} = 0.0033$ and $< \rho_{max} = 0.0181$ from Table A.7

∴ Section is ductile and $\phi = 0.90$

Beam Cross Section

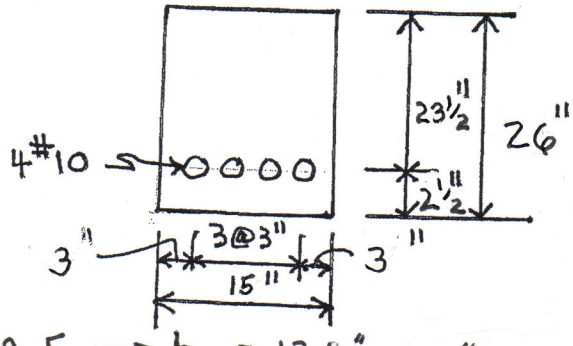


Table A.5 → $b_{min} = 12.9" < 15"$ OK

PROB # 4.2

Column Loads

9-1 $P_u = (1.4)(120) = 168\ k$

9-2 $P_u = (1.2)(120) + (1.6)(40) = 208\ k$

9-3 $P_u = (1.2)(120) + (1.0)(40) = 184\ k$

$P_u = (1.2)(120) + (0.8)(60) = 192\ k$

$P_u = (1.2)(120) + (0.8)(-80) = 80\ k$

9-4 $P_u = (1.2)(120) + (1.6)(60) + (1.0)(40) = 280\ k \leftarrow$

$P_u = (1.2)(120) + (1.6)(-80) + (1.0)(40) = -56\ k$

9-5 $P_u = (1.2)(120) + (1.0)(40) = 184\ k$

9-6 $P_u = (0.9)(120) + (1.6)(60) = 204\ k$

$P_u = (0.9)(120) + (1.6)(-80) = -20\ k$ uplift $\leftarrow$

9-7 $P_u = (0.9)(120) = 108\ k$

Ans. $P_u = 280\ k$ compression or $20\ k$ tension

rgcMc