PROB# 4.16

Assume beam wt = 500#/ft

$w_u = (1.2)(3.5) + (1.6)(1) = 5.80\ k/ft$

$M_u = (5.80)(12)(6) = 417.6\ ft\text{-}k$

$\rho = \dfrac{0.18 f'_c}{f_y} = \dfrac{(0.18)(4)}{60} = 0.012$

$\dfrac{M_u}{\phi b d^2} = 643.5$ from Appendix Table A.13

$bd^2 = \dfrac{M_u}{\phi\, 643.5} = \dfrac{(12)(417{,}600)}{(0.9)(643.5)}$

$= 8653$ $\begin{cases} 14 \times 24.86 \\ 16 \times 23.25 \leftarrow \\ 18 \times 21.92 \end{cases}$

USE 16 × 26 beam (d = 23.5 in.)

Beam wt $= \dfrac{(16)(26)}{144}(150) = 433\#/ft < 500\#/ft$ **OK**

$A_s = \rho bd = (0.0120)(16)(23.5) = 4.51\ in^2$

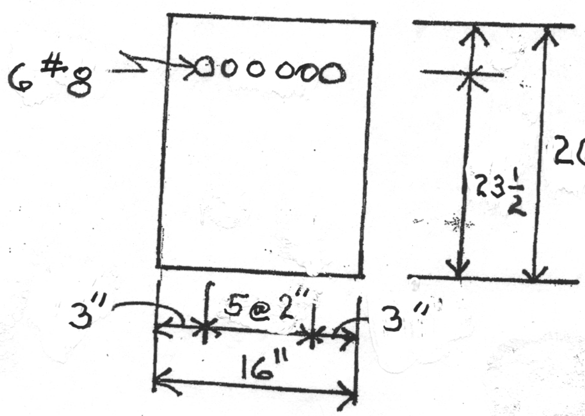
USE 6 #8 Bars (4.71 in.²), $b_{min} = 15.3'' < 16''$ OK

$\rho = \dfrac{A_s}{bd} = \dfrac{4.71}{(16)(23.5)} = 0.0125$

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

∴ Bm. is ductile & $\phi = 0.9$

BEAM Cross Section



~JCMc

PROB # 4.20

Assume beam wt = 950 #/ft

$w_u = (1.2)(2.95) = 3.54$ k/ft

$M_u = (3.54)(16)^2/(2) + (1.6)(3.0)(8) + (1.6)(20)(16) = 1349$ ft-k

$\rho = \frac{1}{2}\rho_{max} = \left(\frac{1}{2}\right)(0.0181) = 0.00905$

$\frac{M_u}{\phi b d^2} = 499.5$ from Appendix Table A.13

$bd^2 = \frac{M_u}{\phi 499.5} = \frac{(12)(1349000)}{(0.9)(499.5)}$

$= 36012 \begin{cases} 18 \times 44.72 \\ 20 \times 42.43 \\ 22 \times 40.45 \end{cases}$

Use 20 x 45 beam (d = 42.50 in.)

Beam wt $= \frac{(20)(45)}{144}(150) = 938$ #/ft < 950 #/ft ok

$A_s = \rho b d = (0.00905)(20)(42.5) = 7.69$ in.^{2}

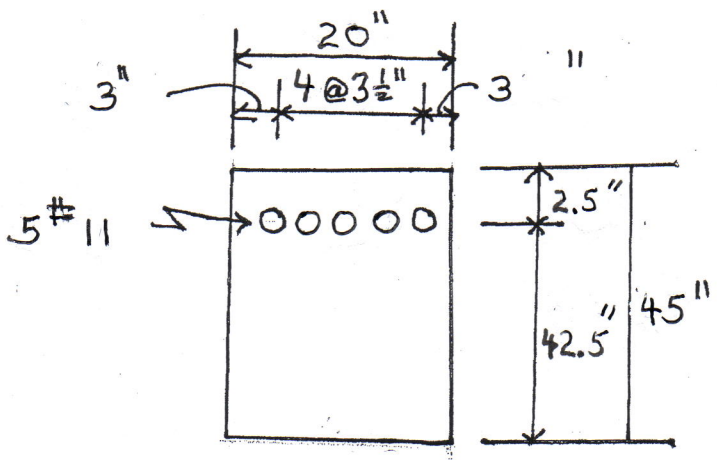
Use 5 #11 bars (7.81 in.^{2}), $b_{min} = 16.6" < 20"$ OK

$\rho = \frac{A_s}{bd} = \frac{7.81}{(20)(42.5)} = 0.00919$

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

$\therefore$ Section is ductile and $\phi = 0.9$

Sketch of Beam Cross Section



PROB # 4.26

Assume $7\frac{1}{2}$ in. slab ($d = 6\frac{1}{4}$ in.)

$$D = \frac{7.5}{12}(150) = 93.75\ \#/ft$$

$$w_u = (1.2)(93.75) + (1.6)(150) = 352.5\ \#/ft$$

$$M_u = \frac{(0.353)(24)^2}{8} = 25.38\ ft\text{-}k$$

$$\rho = \frac{1}{2}\rho_b = \left(\frac{1}{2}\right)(0.0285) = 0.01425$$

$$\frac{M_u}{\phi b d^2} = 747.15 \text{ from Appendix Table A.13}$$

$$d = \sqrt{\frac{(12)(25,380)}{(0.90)(12)(747.15)}} = 6.14 \text{ in.}$$

USE $7\frac{1}{2}$-in. slab ($d = 6.25$ in.)

$$\frac{M_u}{\phi b d^2} = \frac{(12)(25,380)}{(0.90)(12)(6.25)^2} = 721.9$$

$\rho = 0.0137$ from Appendix Table A.13

$$A_s = \rho b d = (0.0137)(12)(6.25) = 1.03\ in.^2/ft$$

USE #8 @ 9 in. ($1.05\ in.^2/ft$)

Shrinkage and temperature A_s

$$A_s = (0.0018)(12)(7.5) = 0.162\ in^2/ft$$

USE #3 @ 8 in. ($0.17\ in.^2/ft$)

JCM

PROB # 4.30

(a) Moment @ base of stem

$$M_u = (1.6)(\tfrac{1}{2})(500)(18)(\tfrac{18}{3}) = 43{,}200 \text{ ft-lbs}$$

$$\rho = \tfrac{1}{2}\rho_b = 0.5\,(.0285) = .01425$$

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

$$bd^2 = \frac{(12)(43{,}200)}{(0.9)(749.4)} = 768.6 \text{ in}^3$$

$$d = \sqrt{\frac{768.6}{b}} = \sqrt{\frac{768.6}{12}} = 8.00 \text{ in.}$$

(b) use 11 in. thick wall ($d = 8.50$ in.)

$$A_s = \rho\, b d = (0.01425)(12)(8.5) = 1.45 \text{ in.}^2/\text{ft}$$

USE #8 bars $6\tfrac{1}{2}$ in. O.C. (1.45 in.^{2}) Table A.6

$$\rho = \frac{1.45}{(12)(8.5)} = 0.0142$$

$$\rho_{min} = 0.0033 < \rho = 0.0142 < \rho_{max} = 0.0181$$

from Appendix Table A.7

∴ Stem is ductile and $\phi = 0.9$

VJCMC