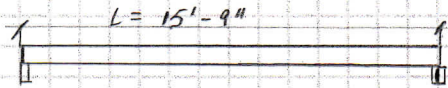


FREE BEAM DESIGN BEAM E 1-2



GIVEN:

$f'_c = 3 \text{ ksi}$ $f_y = 60 \text{ ksi}$ # 3 STIRRUPS

$L = 15'-9'' = 15.75' \Rightarrow 189'$ $D_L = 0.15 \text{ kof}$

$L_L = 0.12 \text{ kof}$

$T_N = \frac{27'-0''}{2} = \frac{324''}{2} = 162'' \Rightarrow 13.5'$

$D_L = (0.15 \text{ kof}) \times (13.5') = 2.025 \text{ k/ft}$

$L_L = (0.12 \text{ kof}) \times (13.5') = 1.62 \text{ k/ft}$

$W_u = 1.2 (D_L) + 1.6 (L_L) = 1.2 (2.025) + 1.6 (1.62) = 5.022 \text{ k/ft}$

$M_u = \frac{W_u L^2}{8} = \frac{5.022 \text{ k/ft} (15.75')^2}{8} = 155.72 \text{ k-ft}$

FROM TABLE A-5

$\rho = 0.0090$ $\bar{c} = 0.4828 \text{ ksi}$

ASSUME $b = 22''$

$d = \sqrt{\frac{M_u}{\rho b \bar{c}}} = \sqrt{\frac{155.72 \text{ k-ft} \times 12}{0.9 \times 22'' \times 0.4828}} = 13.98 \text{ in} \Rightarrow 14''$

check $1.5 \leq \frac{22''}{13.98''} \leq 2.2$

$1.5 \leq 1.57 \leq 2.2 \quad \checkmark$

$h = d + \text{cover} + d \text{ stirrup} + \frac{1}{2} d \text{ rebar}$

$= 13.98 + 1.5 + 9.375 + \frac{1}{2} \times (1'') = 16.355$

\Downarrow
17''

ADDING MOMENT DUE THE SELF WEIGHT

$$W_u = 1.2 \left(0.15 \frac{\text{k}}{\text{ft}} \times \frac{22'' \times 17''}{144''^2} \right) = 0.4675 \frac{\text{k}}{\text{ft}}$$

$$M_u = \frac{w_u l^2}{8} = \frac{0.4675 \frac{\text{k}}{\text{ft}} \times (15.75'')^2}{8} = 14.496 \text{ k-ft} \Rightarrow 14.5 \text{ k-ft}$$

$$M_u = 155.72 + 14.5 = 170.22 \text{ k-ft}$$

checking d

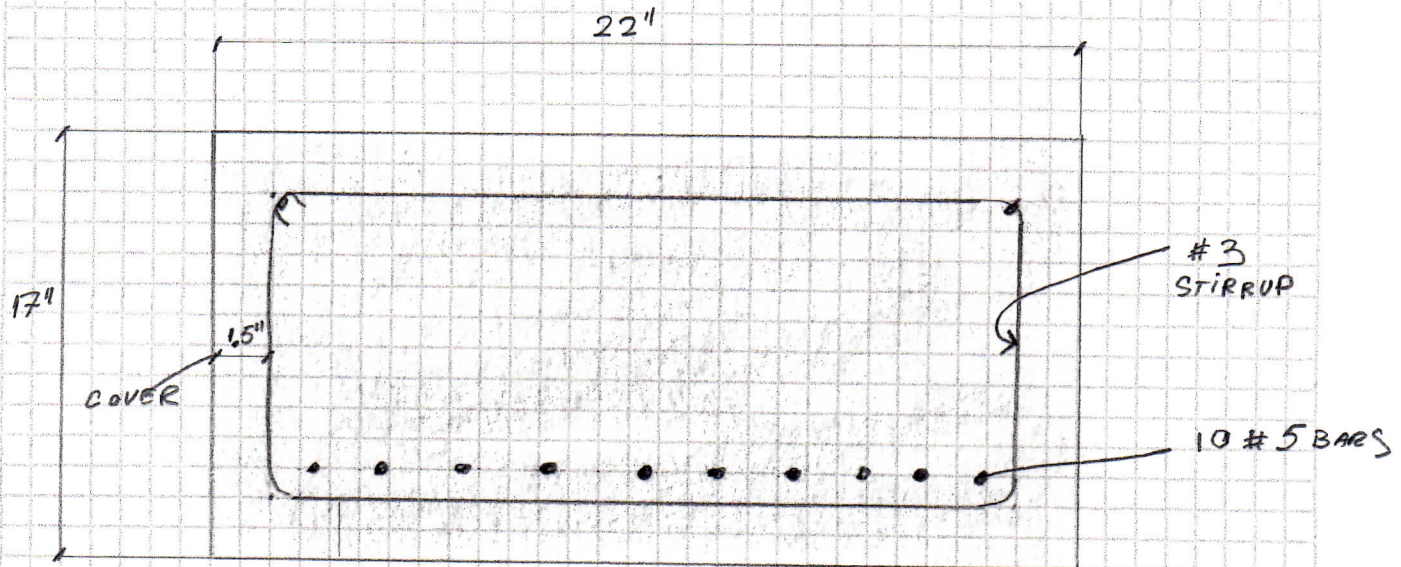
$$d = \sqrt{\frac{M_u}{\phi b k}} = \sqrt{\frac{170.22 \times 12}{0.9 \times 22 \times 0.4929}} = 14.617'' \Rightarrow 15''$$

$$d = 15''$$

$$A_s = \rho \times b \times d = 0.0090 \times 22'' \times 15'' = 2.97 \text{ in}^2$$

FROM TABLE A-2

10 # 5	3.10 in ²	min b = 19"
7 # 6	3.08 in ²	min b = 15"
4 # 8	3.16 in ²	min b = 11"
3 # 9	3.00 in ²	min b = 9.5"



CHECK: DETERMINE TOTAL BEAM DEPTH

$$\begin{aligned}
 h &= d + \text{cover} + d \text{ stirrup} + \frac{1}{2} d \text{ rebar} = \\
 &= 14.617' + 1.5 + 0.375 + \frac{.625}{2} = 16.80 \text{ in} \Rightarrow 17'' \checkmark
 \end{aligned}$$

* THIS DESIGNED BEAM WILL MEET LOAD REQUIREMENTS.