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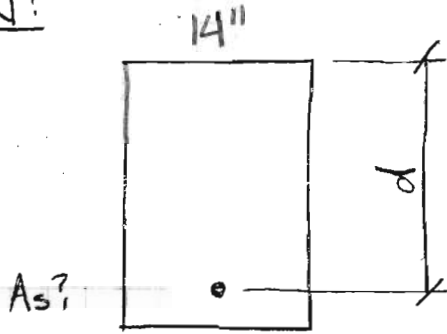
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EXAMPLE: CONCRETE BEAM DESIGN
WORKING STRESS METHOD

GIVEN:



$M = 200 \text{ k}$

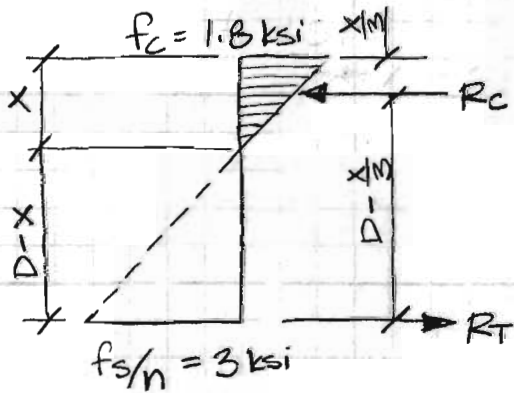
$E_s = 29,000 \text{ ksi}$; $f_s = 24 \text{ ksi}$
 $E_c = 3,625 \text{ ksi}$; $f_c = 1.8 \text{ ksi}$

DESIGN THE SECTION SO THAT IT IS EXACTLY BALANCED.

22-141 50 SHEETS
 22-142 100 SHEETS
 22-144 200 SHEETS
 ANAPAD

1. MODULAR RATIO: $n = \frac{E_s}{E_c} = \frac{29,000}{3,625} = 8$

2. FIND DEPTH, D, SO THAT BOTH MATERIALS ARE STRESSED TO ALLOWABLE:



$\frac{1.8}{x} = \frac{3}{D-x}$

$\rightarrow 1.8D - 1.8x = 3x$

$D = 2.67x$

CONSIDERING THE INTERNAL COUPLE: $M = R_c(D - \frac{x}{3})$

$R_c = \frac{f_c(B)(x)}{2} = \frac{(1.8 \text{ ksi})(14'')(x)}{2} = 12.6x$

$M = R_c(D - \frac{x}{3})$

$200 \text{ k} * 12'' = 12.6x(2.67x - \frac{x}{3})$
 $2400 \text{ k} = 33.64x^2 - 4.20x^2$
 $= 29.44x^2$

$\rightarrow x = 9.0''$

$D = 2.67x = 2.67(9'') = \underline{\underline{24.1''}}$

3. FIND AREA OF STEEL:

$$\begin{aligned} R_c &= \frac{f_c (B)(x)}{2} = 12.6 x \\ &= 12.6 (9.0") \\ &= 113.4^k \end{aligned}$$

$$R_t = R_c$$

$$R_t = A_s f_s$$

$$113.4^k = A_s (24 \text{ ksi}) \quad \rightarrow \quad \underline{A_s = 4.73 \text{ in}^2}$$