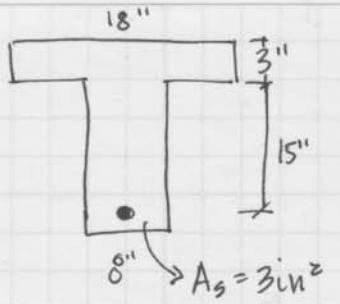
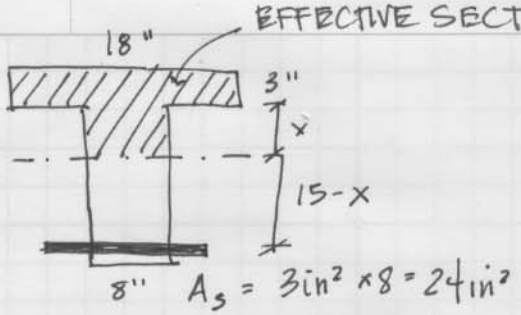
open.michigan

13-1 (B)



$E_c = 3625$ ksi

$n = 8$ (Data Sheet D-23)



(1) Determine Neutral Axis of the Effective section:

$$A_c\bar{x}_c = A_t\bar{x}_t$$

$$(18" \times 3")(x + 1.5") + (8" \times x)(x/2) = 24in^2\,(15 - x)$$

$$54x + 81 + 4x^2 = 360 - 24x$$

$$4x^2 + 78x - 279 = 0$$

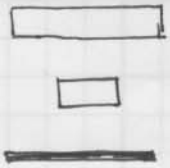
Solve using quadratic formula:

$$x = \frac{-78 \pm \sqrt{78^2 - (4)(4)(-279)}}{(2)(4)}$$

(Disregard negative answer)

$$\boxed{x = 3.088"}$$

(2) Transformed Moment of Inertia:



$bd^3/12 = \frac{18(3)^3}{12} = 40.5in^4 + Ay^2 = (18)(3)(3.088 + 1.5")^2 = 1136.7in^4$

$bd^3/3 = \frac{8(3.088)^3}{3} = 78.52in^4$

$Ay^2 = (24in^2)(11.912in)^2 = 3405in^4$

$$\boxed{I_{TR} = 4661.2in^4}$$

(3) Resisting Capacity of Concrete & Steel:

Concrete $f' = 1.8$ ksi $\quad M = \frac{F'I_{TR}}{c} = \frac{(1.8ksi)(4661in^4)}{6.088"} = 1378"k$

Steel $F' = 20$ ksi $\quad M = \frac{F'I_{TR}}{cn} = \frac{(20ksi)(4661in^4)}{(11.912")(8)} = \boxed{978"k}$

Steel Governs.

(4) Actual stress in concrete:

$$f = \frac{Mc}{I_{TR}} = \frac{(978"k)(6.088")}{4661in^4} = \boxed{1.28ksi}$$