ARCH 324 - Structures 2, Winter 2009

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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 1\frac{1}{2}\) ) (x/2) = 24"^2 (15-x) \]

\[ 54x + 81 + 4x^2 = 360 - 24x \]

\[ 4x^2 + 78x - 279 = 0 \]

Solve using quadratic formula:

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

\[ x = 3.088" \]

2) Transformed Moment of Inertia:

\[ bd^3/12 = \frac{18(3)^3}{12} = 40.5 \text{in}^4 \]

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

\[ A_y^2 = \frac{24 \text{in}^2}{11.912 \text{in}^2} = 3405 \text{in}^4 \]

\[ I_{TR} = 4661.2 \text{in}^4 \]

3) Resisting Capacity of Concrete & Steel:

Concrete \( f' = 1.8 \text{ksi} \)

\[ M = \frac{F'I_{TR}}{C} = \frac{(1.8 \text{ksi})(4661 \text{in}^4)}{6.088"} = 1378"^k \]

Steel \( f' = 20 \text{ksi} \)

\[ M = \frac{F'I_{TR}}{CN} = \frac{(20 \text{ksi})(4661 \text{in}^4)}{(11.912") (8)} = 978"^k \]

Steel Governs.

4) Actual stress in concrete:

\[ f = \frac{M_c}{I_{TR}} = \frac{(978"^k)(6.088")}{4661 \text{in}^4} = 1.28 \text{ksi} \]