ARCH 324 - Structures 2, Winter 2009

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(1) Determine Neutral Axis of the Effective Section:

\[ Ac \bar{x}_c = \frac{A_t \bar{x}_t}{(18'' \times 3'')(x+1.5'') + (8'' \times x)(x/2)} = 24\text{ in}^2 (15-x) \]

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

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

Solve using quadratic formula:

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

\[ x = 3.088'' \]

(2) Transformed Moment of Inertia:

\[ bd^{3/2} = \frac{18(3)^3}{12} = 40.5\text{ in}^4 \]

\[ A_{y}^2 = (18)(5)(3.088+1.5)^2 = 1136.7\text{ in}^4 \]

\[ A_{y}^2 = (24\text{ in}^2)(11.912\text{ in}^2) = 3405\text{ in}^4 \]

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

(3) Resisting Capacity of Concrete & Steel:

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

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

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

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

Steel Governs.

(4) Actual Stress in concrete:

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