

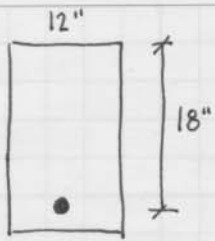
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13-1(A)

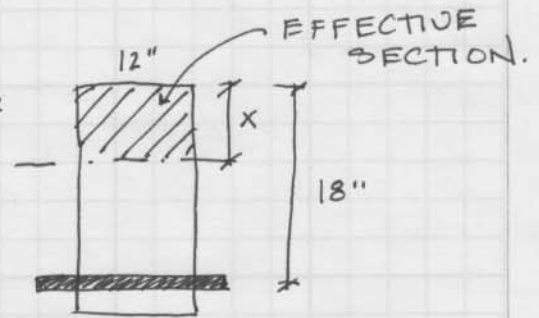


$$A_g = 3 \text{ in}^2$$

$$E_c = 3625 \text{ ksi} \rightarrow n = 8 \text{ (From Data Sheet D-23)}$$

$$E_s = 29000 \text{ ksi}$$

First transform section:  
(Convert steel into equivalent area of concrete.)



$$A_{tr} = 3 \text{ in}^2 \times 8 = 24 \text{ in}^2$$

(1) Determine Neutral Axis of the Effective Section:

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

$$(12'' \times x) \left(\frac{x}{2}\right) = 24 \text{ in}^2 (18 - x)$$

$$6x^2 = 432 - 24x$$

$$x^2 + 4x - 72 = 0$$

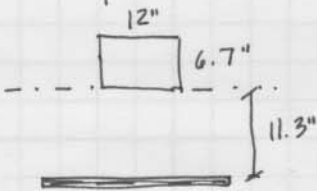
Use quadratic equation to solve:  $2a$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-4 \pm \sqrt{(4)^2 - (4)(1)(-72)}}{(2)(1)} = \boxed{6.7''}$$

(Note: ignore negative answer, because we are only interested in a positive value)

(2) Transformed Moment of Inertia



$$I = \frac{bd^3}{3} = \frac{(12'')(6.7'')^3}{3} = 1203 \text{ in}^4$$

$$I = Ax^2 = (24 \text{ in}^2)(11.3'')^2 = 3064.56 \text{ in}^4$$

$$I_{TR} = \boxed{4267.6 \text{ in}^4}$$

(3) Resisting Capacity of Concrete & Steel

Concrete:  $f = 1.8 \text{ ksi}$

$$M = \frac{f I_{TR}}{c} = \frac{(1.8 \text{ ksi})(4268 \text{ in}^4)}{6.7''} = 1146.6 \text{ ''k} = 95.5 \text{ ''k}$$

Steel:  $f = 20 \text{ ksi}$

$$M = \frac{f I_{TR}}{cn} = \frac{(20 \text{ ksi})(4268 \text{ in}^4)}{(11.3'')(8)} = 944.2 \text{ ''k} = \boxed{78.68 \text{ ''k}}$$

Lower Moment Governs

Steel governs.

Need Modular Ratio!

(4) Actual stress in concrete:

$$f = \frac{Mc}{I_{TR}} = \frac{(944.2 \text{ ''k})(6.7'')}{4268 \text{ in}^4} = \boxed{1.48 \text{ ksi}}$$