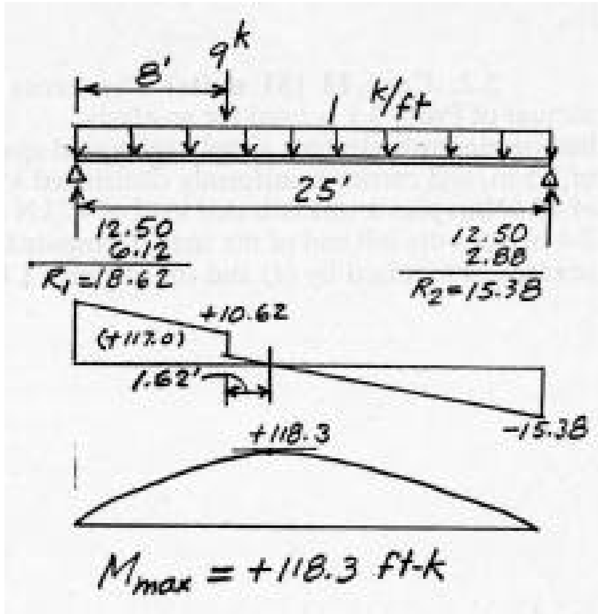
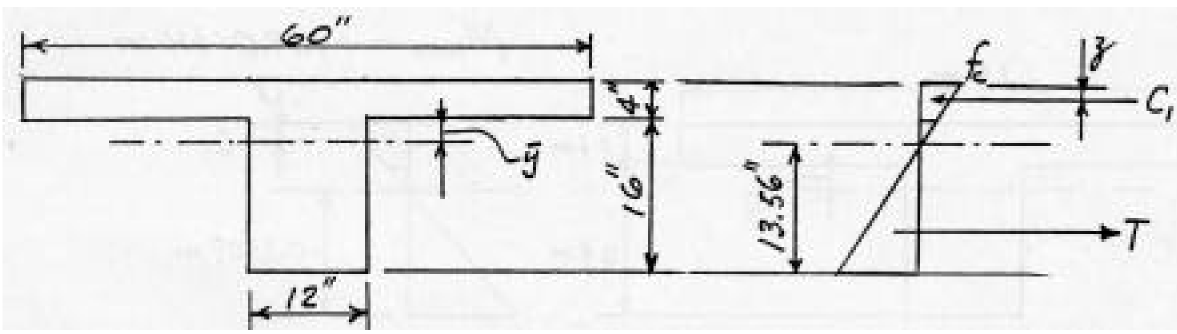
3.2, Case 4 The cross section of Prob. 3.1 is used for an elastic homogeneous beam on a simply supported span of 25 ft, and carries a uniformly distributed load of 1 kip/ft plus a concentrated load of 9 kips at 8 ft from the left end of the span. Compute the stresses as required by (a) and (b) of Prob. 3.1.





$$\bar{y} = \frac{192(8) - 240(2)}{192 + 240} = 2.44 \text{ in.} \qquad f_c(4 \text{ in. from top}) = \frac{2.44}{6.44} f_c = 0.379 f_c$$

$$C_1 \text{ on flange } = \frac{1}{2}(f_c + 0.379 f_c)240 = 165.5 f_c$$

$$\text{distance } z \text{ of } C_1 \text{ from top} = \frac{4}{3}\left[\frac{f_c + 2(0.379 f_c)}{f_c + 0.379 f_c}\right] = 1.70 \text{ in.}$$

$$C_2 \text{ on web } = \frac{1}{2}(0.379 f_c)(12)2.44 = 5.5 f_c$$

$$\text{Resisting Moment } = C_1 a_1 + C_2 a_2 = \left[165.5 f_c\left(20 - 1.70 - \frac{13.56}{3}\right) + 5.5 f_c\left(\frac{2}{3}\right)(16)\right]\frac{1}{12}$$

$$= 190.0\, f_c + 4.9\, f_c = 194.9\, f_c \text{ ft-kips}$$

Prob. 3.2, Case 4, p 2/2

Bending moment = Resisting moment; $118.3 = 194.9\,\boldsymbol{f_c}$; $\boldsymbol{f_c} = 0.607$ ksi

$$\boldsymbol{f_t} = \frac{13.56}{6.44}(0.607) = 1.278 \text{ ksi}$$

$$\boldsymbol{I} = \tfrac{1}{12}(60)(4)^3 + 240(4.44)^2 + \tfrac{1}{3}(12)(13.56)^3 + \tfrac{1}{3}(12)(2.44)^3 = 15{,}082 \text{ in.}^4$$

$$\text{Resisting moment } = \frac{15{,}082}{6.44}\,\boldsymbol{f_c}\left(\frac{1}{12}\right) = 195.2\,\boldsymbol{f_c} \approx 194.9\,\boldsymbol{f_c} \text{ above}$$