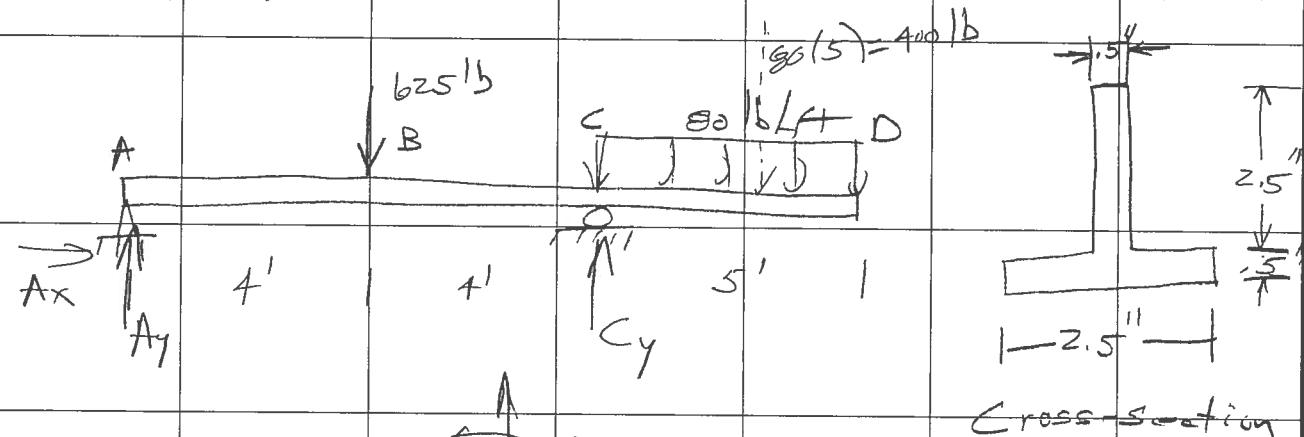


An inverted T-beam is loaded as shown. The cross-section of the beam is as shown. Determine the maximum tensile flexural stress in the beam and the maximum compressive flexural stress in the beam and indicate their respective locations.



Calculate Reactions

$$\sum M_A = 0$$

$$(1) -625(4) - 400(10.5) + C_y(8) = 0$$

$$(2) \quad C_y = 837.5 \text{ lb} \uparrow \text{ as shown}$$

$$\sum F_y = 0$$

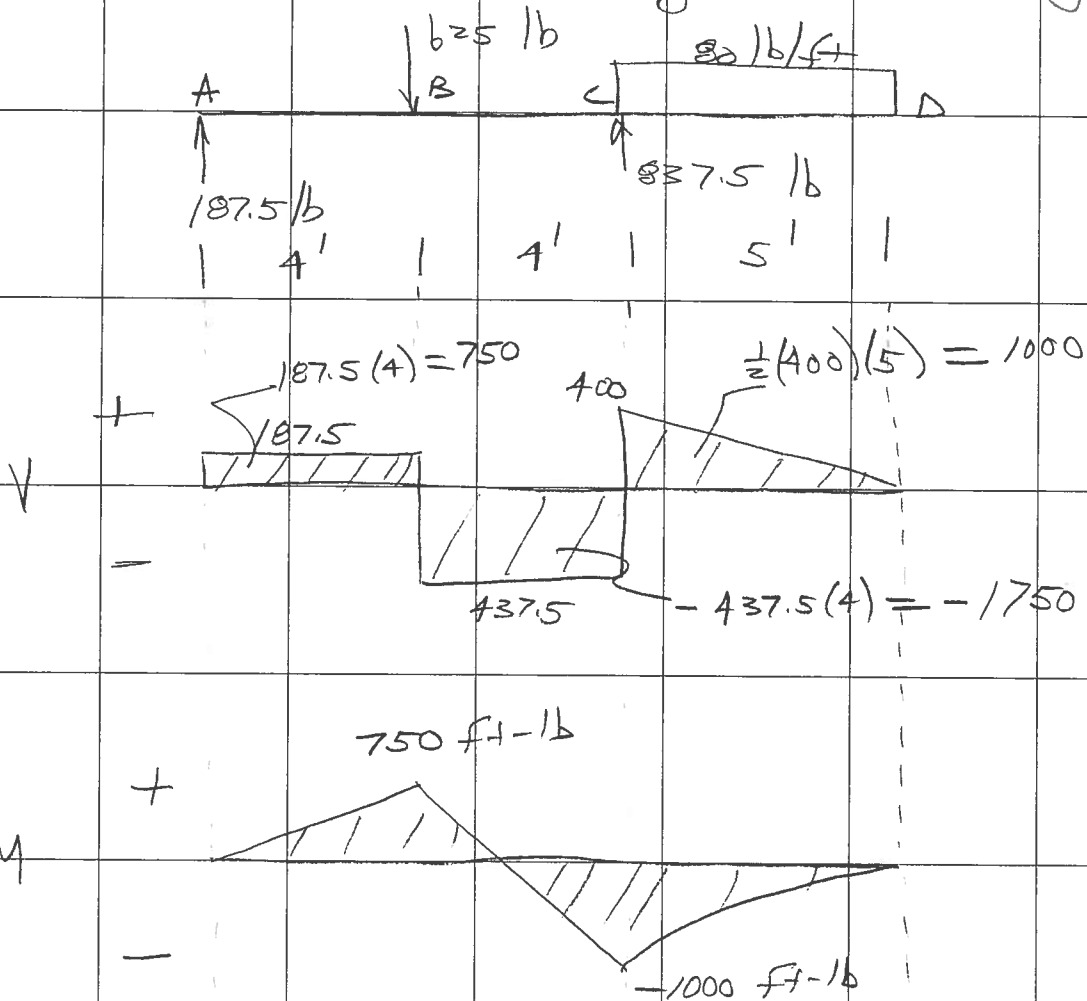
$$(3) \quad A_y - 625 - 400 + 837.5 = 0$$

$$(4) \quad A_y = 187.5 \text{ lb} \uparrow \text{ as shown}$$

$$\sum F_x = 0$$

$$(5) \quad A_x = 0$$

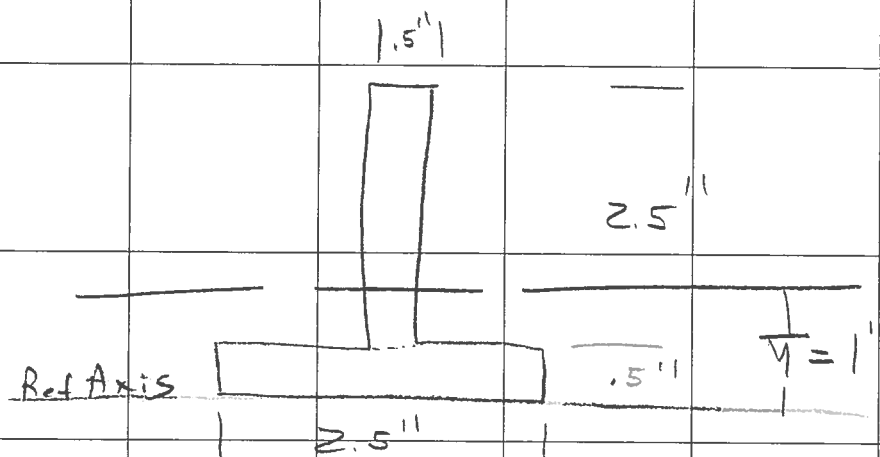
Draw shear and bending moment diagrams



$$\text{Max Positive Moment} = (750 \text{ ft-lb}) \left(\frac{1}{2} \frac{\text{in}}{\text{lb}} \right) = +9000 \text{ in-lb}$$

$$\text{Max Negative Moment} = (-1000 \text{ ft-lb}) \left(\frac{1}{2} \frac{\text{in}}{\text{lb}} \right) = -12000 \text{ in-lb}$$

Calculate Cross-Section Properties



$$(6) \quad \bar{y} = \frac{(1.5)(2.5)(\frac{2.5}{2} + .5) + (2.5)(1.5)(\frac{1.5}{2})}{(1.5)(2.5) + (2.5)(1.5)}$$

$$(7) \quad \bar{y} = 1 \text{ in}$$

$$(8) \quad I = \frac{1}{12} (1.5)(2.5)^3 + (1.5)(2.5) \left(\frac{2.5}{2} + .5 - 1 \right)^2 + \frac{1}{12} (2.5)(1.5)^3 + (2.5)(1.5) \left(1 - \frac{1.5}{2} \right)^2$$

$$(9) \quad I = .651 + .703 + .026 + .703$$

$$(10) \quad I = 2.083 \text{ in}^4$$

Calculate Maximum Stresses at B

$$(11) \quad \sigma = - \frac{My}{I}$$

$$(12) \quad \sigma_{B_{Top}} = - \frac{(9000 \text{ in-lb})(2 \text{ in})}{2.083 \text{ in}^4}$$

$$(13) \quad \sigma_{B_{Top}} = - 8,641 \text{ psi Compression}$$

$$(14) \quad \sigma_{B_{Bottom}} = - \frac{(9000)(-1 \text{ in})}{2.083 \text{ in}^4}$$

$$(15) \quad \sigma_{B_{Bottom}} = +4,321 \text{ psi Tension}$$

Calculate Maximum Stresses at C

$$(16) \quad \sigma_{C_{Top}} = - \frac{(-12000 \text{ in-lb})(2 \text{ in})}{2.083 \text{ in}^4}$$

$$(17) \quad \sigma_{C_{Top}} = 11,522 \text{ psi Tension}$$

$$(18) \quad \sigma_{C_{Bottom}} = - \frac{(-12000 \text{ in-lb})(1 \text{ in})}{2.083 \text{ in}^4}$$

$$(19) \quad \sigma_{C_{Bottom}} = - 5,761 \text{ psi Compression}$$

The maximum Tensile Stress occurs at point C on the top of the section

$$\sigma_{C_{Top}} = 11,522 \text{ psi Tension}$$

The maximum Compressive Stress occurs at point B on the top of the section

$$\sigma_{B_{Top}} = - 8,641 \text{ psi Compression}$$