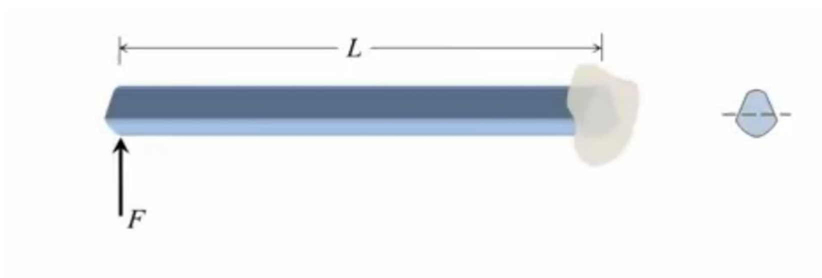
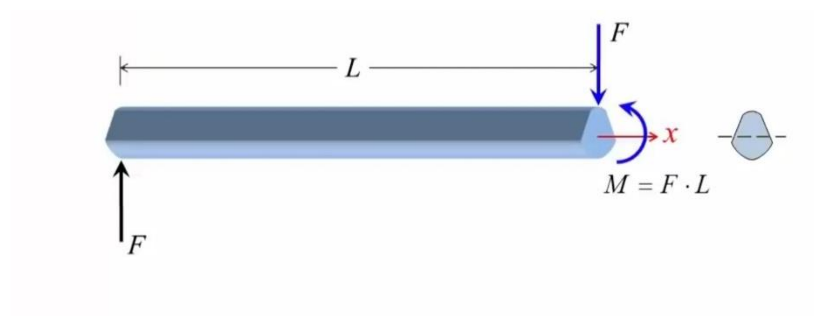
SHEAR STRESS EQUATION DERIVATION





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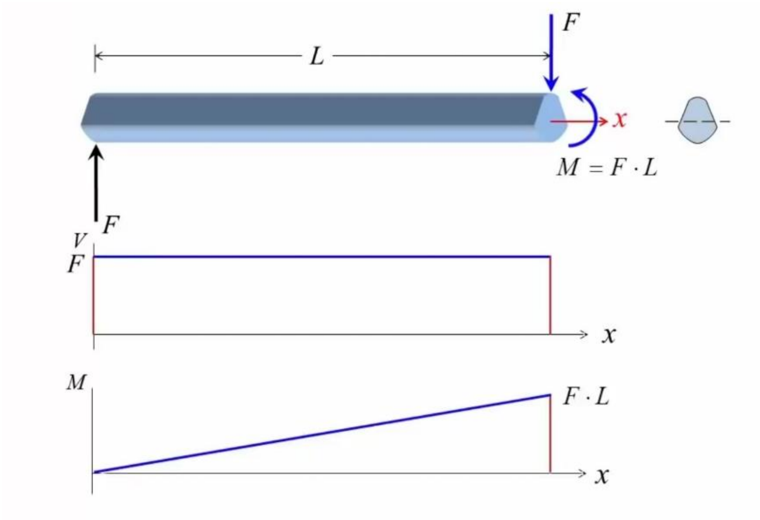
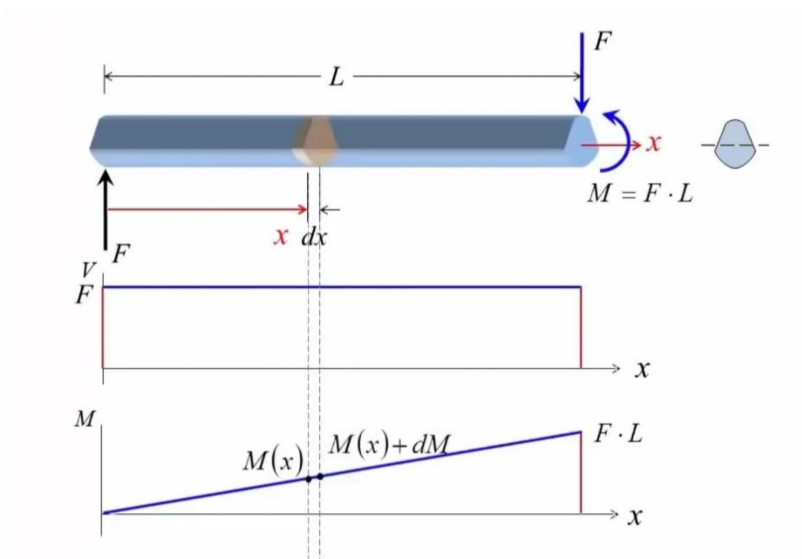
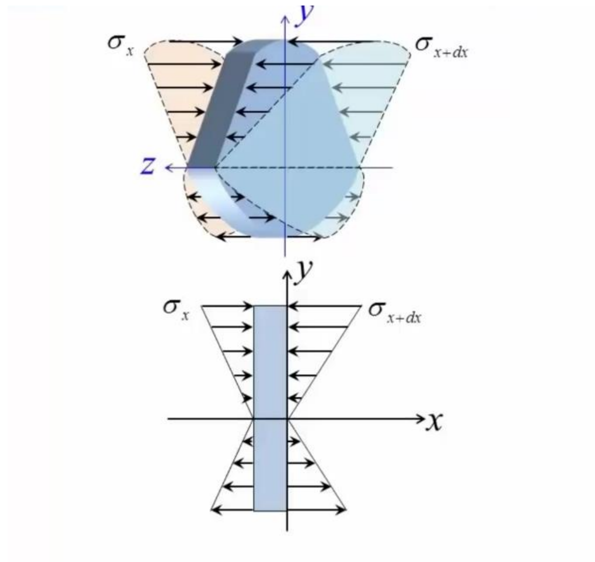
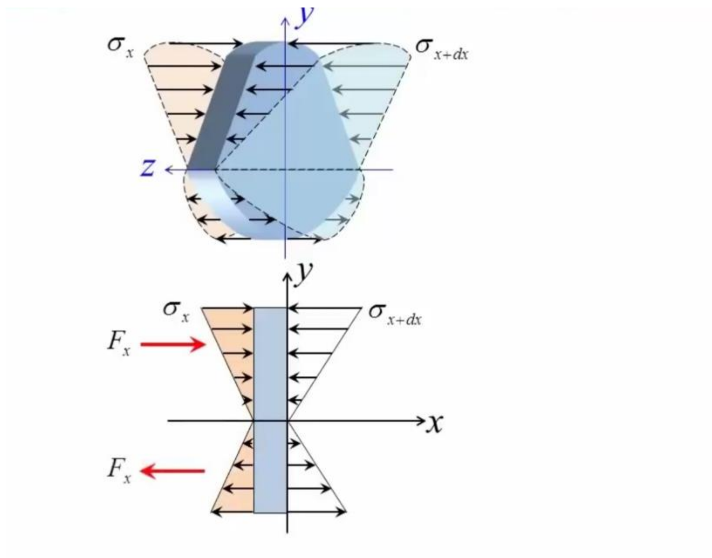




Flexural stress = MY/I

SHEAR STRESS EQUATION DERIVATION





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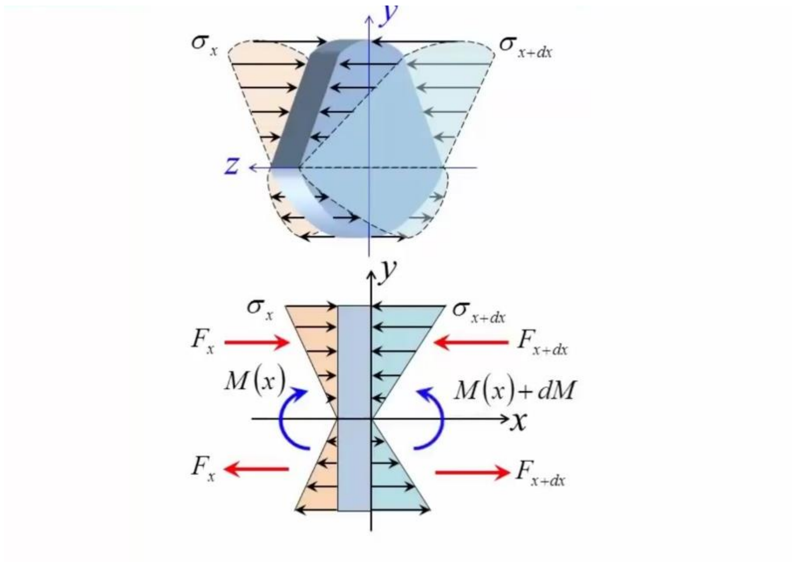

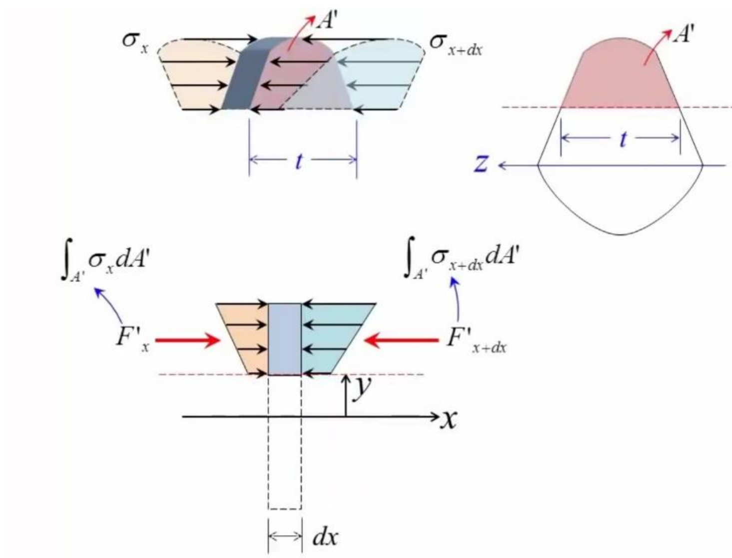

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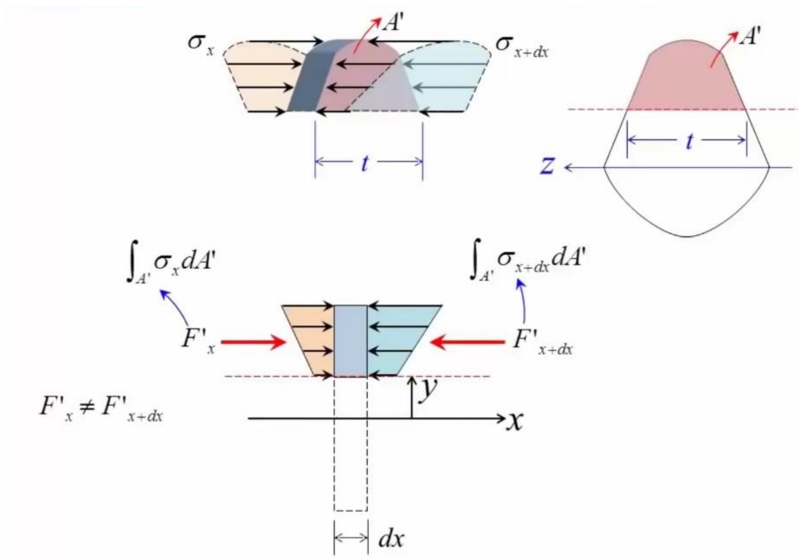

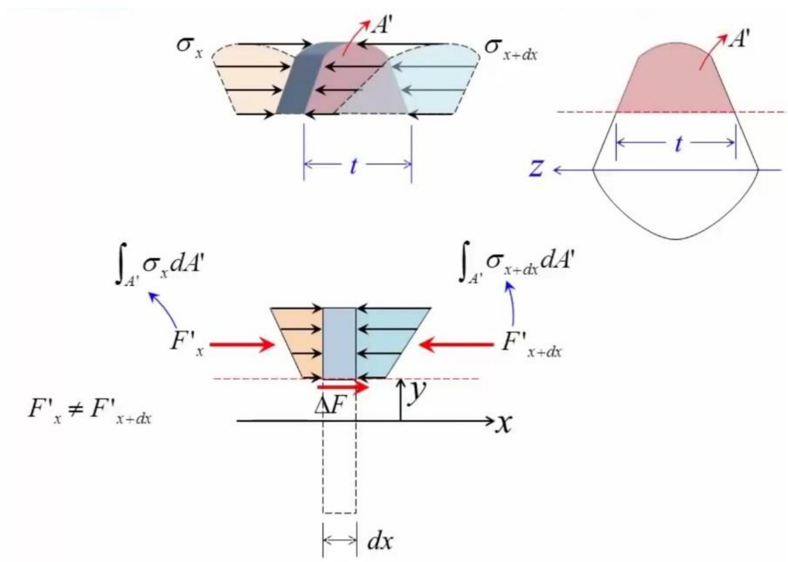

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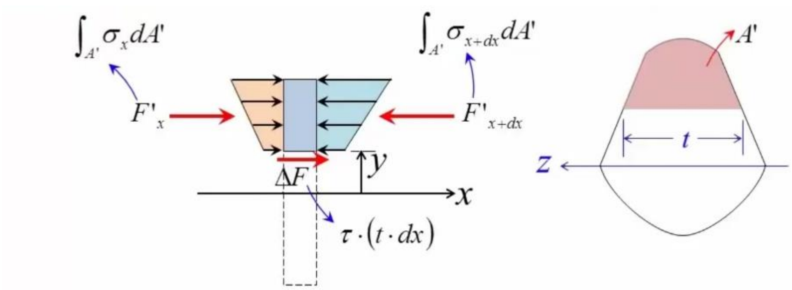
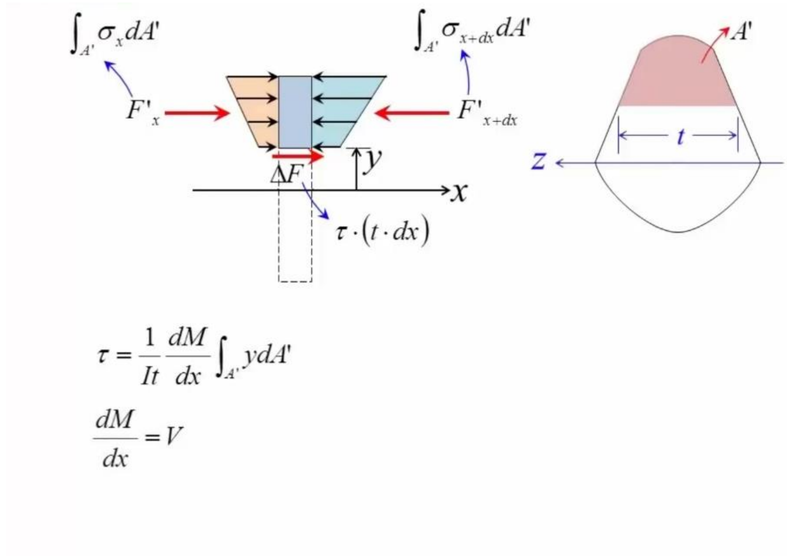


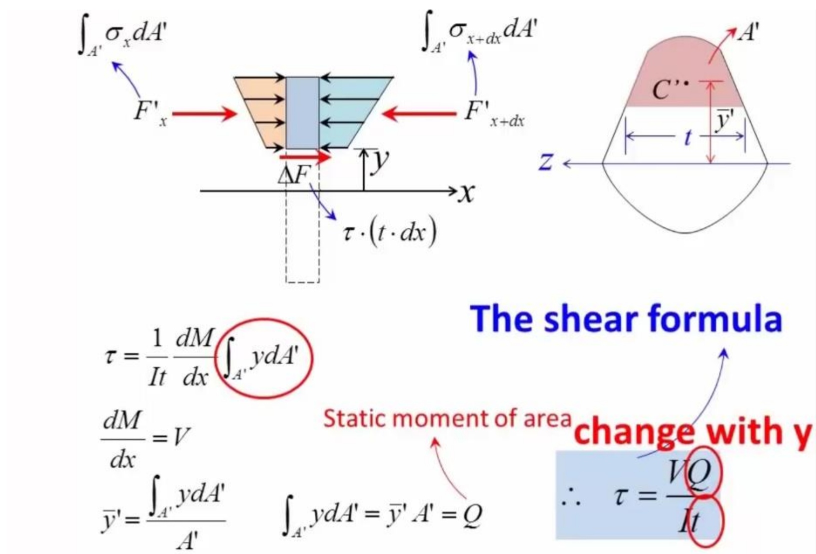
$$\sum F_x = 0 = \int_{A'} \sigma_x dA' + \tau \cdot tdx - \int_{A'} \sigma_{x+dx} dA' \qquad \sigma = \frac{My}{I}$$

$$\int_{A'} \frac{My}{I} dA' + \tau \cdot tdx - \int_{A'} \frac{(M + dM)y}{I} dA' = 0$$

$$\tau \cdot tdx - \frac{dM}{I} \int_{A'} y dA' = 0 \qquad \therefore \quad \tau = \frac{1}{It} \frac{dM}{dx} \int_{A'} y dA'$$

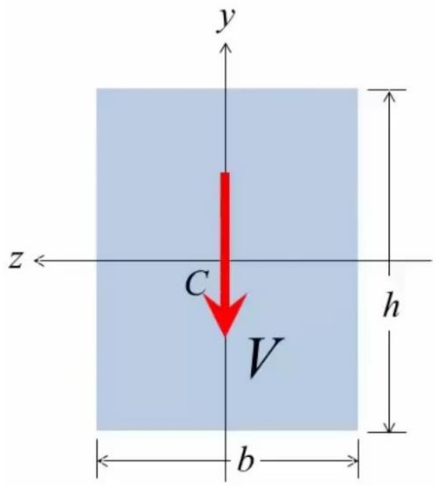
SHEAR STRESS EQUATION DERIVATION

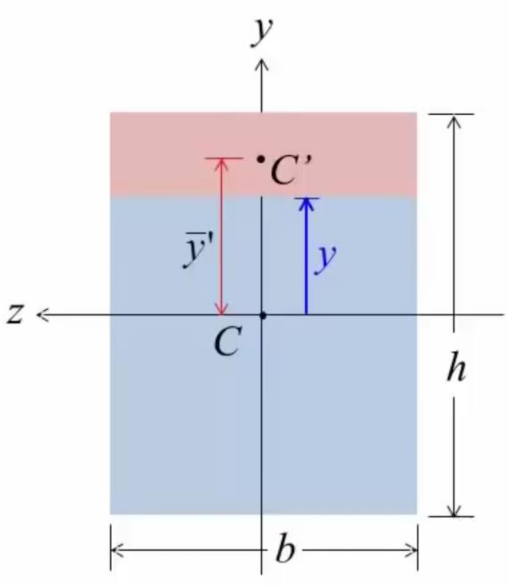




SHEAR STRESS EQUATION DERIVATION

Example 1: For the rectangular cross-sectional area subjected to internal shear force V, determine the shear stress distribution as a function of y.





$$\tau = \frac{VQ}{It} \qquad I = \frac{1}{12}bh^3$$

$$\bar{y}' = y + \frac{1}{2}\cdot\left(\frac{h}{2} - y\right) = \frac{1}{2}\left(\frac{h}{2} + y\right)$$

$$A' = b\cdot\left(\frac{h}{2} - y\right)$$

$$Q = \bar{y}'\,A' = \frac{b}{2}\left(\frac{h^2}{4} - y^2\right) \qquad t = b$$

$$\therefore \quad \tau = \frac{6V}{bh^3}\left(\frac{h^2}{4} - y^2\right)$$

SHEAR STRESS EQUATION DERIVATION

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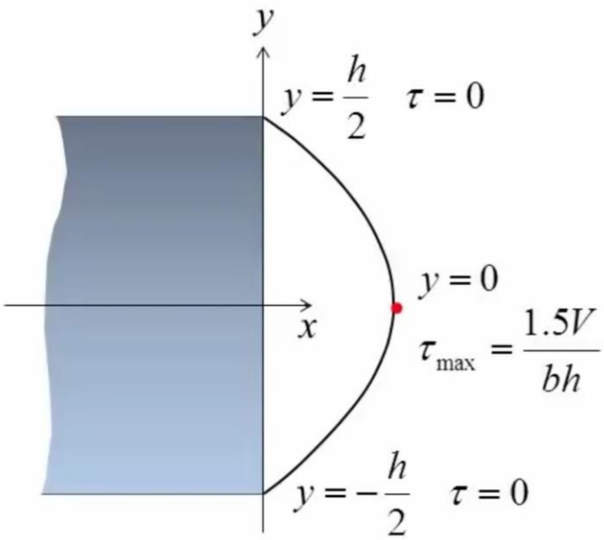
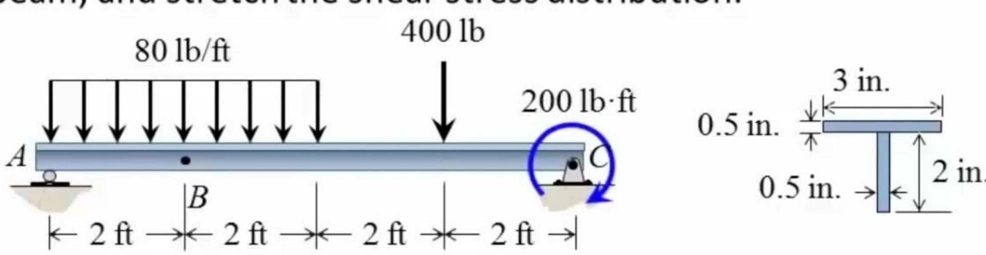


Example 2: For the over hanging beam with the shown loadings and cross section, determine the absolute maximum **shear** stress in the beam, and stretch the shear stress distribution.



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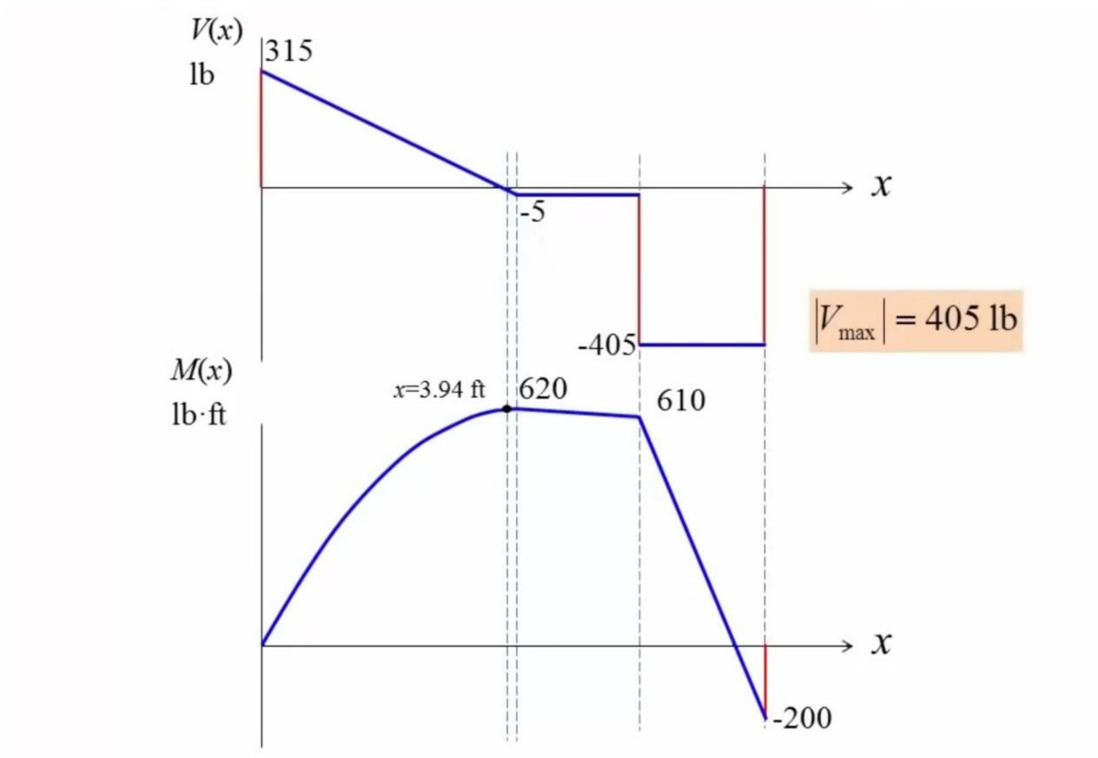
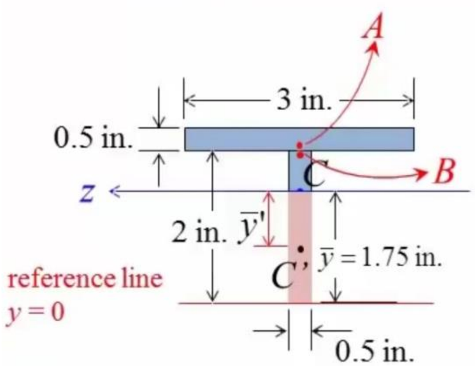




$$\tau = \frac{VQ}{It} \qquad |V_{max}| = 405 \text{ lb}$$

$$I_z = 1.30 \text{ in.}^4$$

$$Q = \bar{y}' A'$$

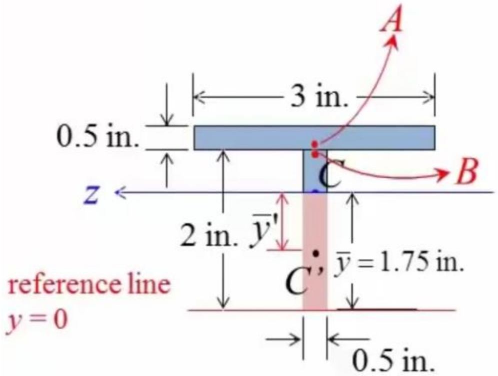
$$= \frac{1.75}{2} \cdot 1.75 \cdot 0.5 = 0.766 \left(\text{in.}^3\right)$$

$$\tau_{max} = \frac{405 \cdot 0.766}{1.30 \cdot 0.5} = 477 \left(\text{psi}\right)$$

$$\tau_A = 77.9 \text{ psi}$$

$$\tau_B = 467 \text{ psi}$$

SHEAR STRESS EQUATION DERIVATION



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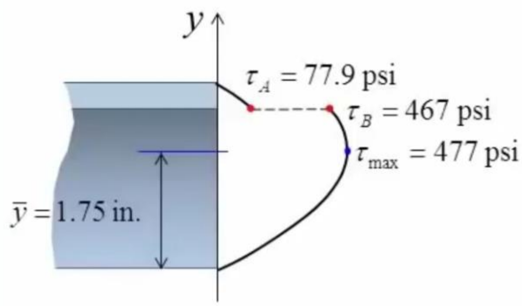

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