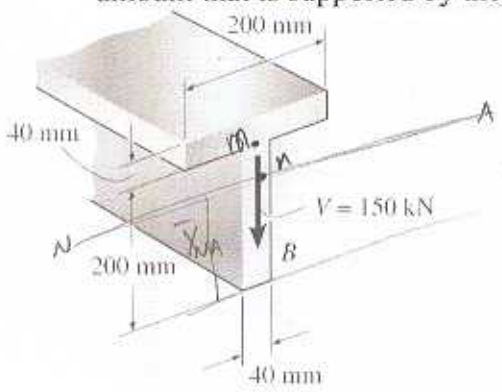
3. The T-beam is subjected to a shear of V= 150kN. a) Plot the shear stress distribution over the cross section. b) What's the absolute maximum shear stress over the cross section. c) Determine the amount of the force that is supported by the flange and the amount that is supported by the web.



$$\bar{Y}_{NA} = \frac{.10m(.20m)(.04m) + (.22m)(.2m)(.04m)}{(.04m)(.20m)+(.20m)(.04m)} = 0.16m$$

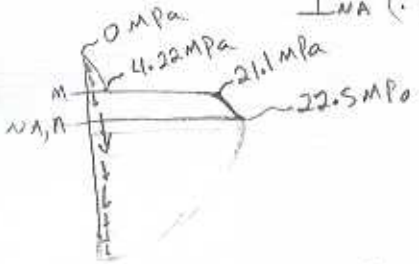
$$I_{NA} = \frac{1}{12}(.04)(.2)^3+(.04)(.2)(\bar{Y}_{NA}-.10m)^2 + \frac{1}{12}(.2)(.04)^3+(.2)(.04)(.22-\bar{Y}_{NA})^2 = 8.533\times10^{-5}\ m^4$$

(a) $\tau_{NA} = \frac{VQ}{I_{NA}t} = \frac{(150000N)(\bar{Y}_{NA}/2)(\bar{Y}_{NA})(.04)}{I_{NA}(.04)} = 22.5\ MPa$

(b) $\tau_{max} = \tau_{NA} = 22.5 MPa$

$$\tau_{m_1} = \frac{(150000N)(.22m-\bar{Y}_{NA})(.2m)(.04m)}{I_{NA}(.2m)} = 4.219\ MPa$$

$$\tau_{m_2} = \frac{(150000)(.22-\bar{Y}_{NA})(.2)(.04)}{I_{NA}(.04)} = 21.095\ MPa$$



(c) for flange $\tau = \frac{VQ}{It} = \frac{V}{It}\left((.2)(.08-y)\left(y+\frac{1}{2}(.08-y)\right)\right) = \frac{V}{It}\left(.2(.08-y)\left(\frac{y+.08}{2}\right)\right)$

$$= \frac{V}{It}\left(.1\left(.08y+.0064-y^2-.08y\right)\right) = \frac{V}{It}\left(-.1y^2+.00064\right)$$

$$V_{flange} = \int_{.04}^{.08}\tau\,dA = \frac{V}{It}\int_{.04}^{.08}(.00064-.1y^2)(t\,dy) = \frac{tV}{It}\left(.00064y-\frac{.1y^3}{3}\right)\Big|_{.04}^{.08}$$

$V_{flange} = 18750N = 18.75\ kN$

$\therefore$

$V_{web} = V - V_{flange} = 131249N = 131.25\ kN$