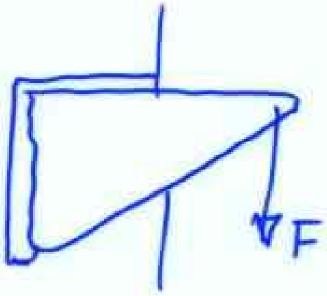
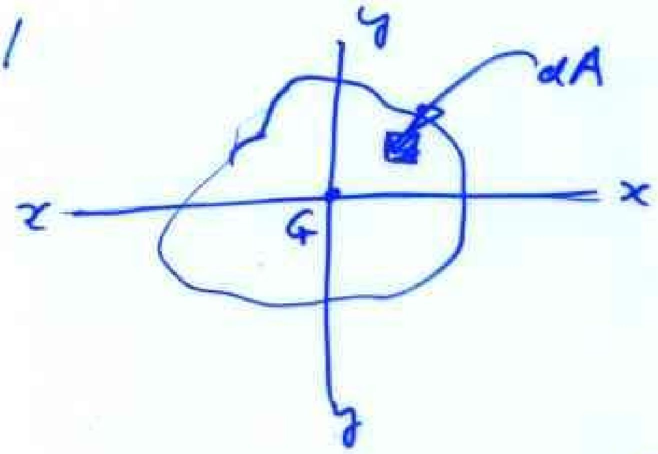
D&P MEEN 3004 1999-2001

3010 2002 2003

Materials MEEN-3011 2002-2003

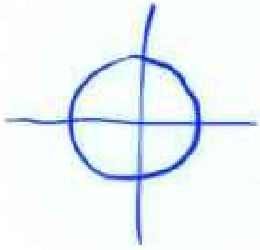
MEEN-3005 1999-2001

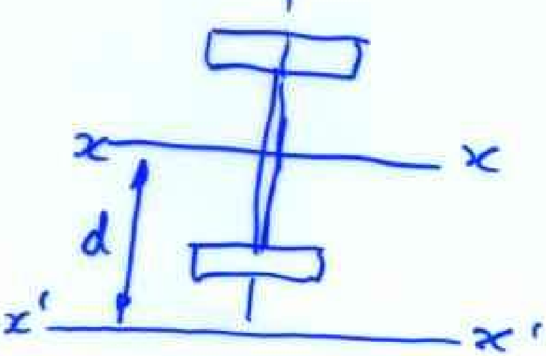




$I_x = \int y^2 dA$

$I_y = \int x^2 dA$





I_x Biggest

I_y less so

$I_{\text{another axis}} \parallel x$ $\quad I_{Gx} + Ad^2$

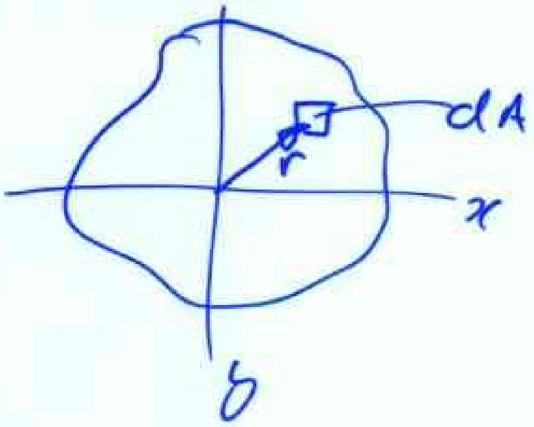
d is distance between new axis & x-axis

$J = \int r^2 \, dA$

$r^2 = x^2 + y^2$

$J = \int x^2 + y^2 \, dA$

$= I_x + I_y$



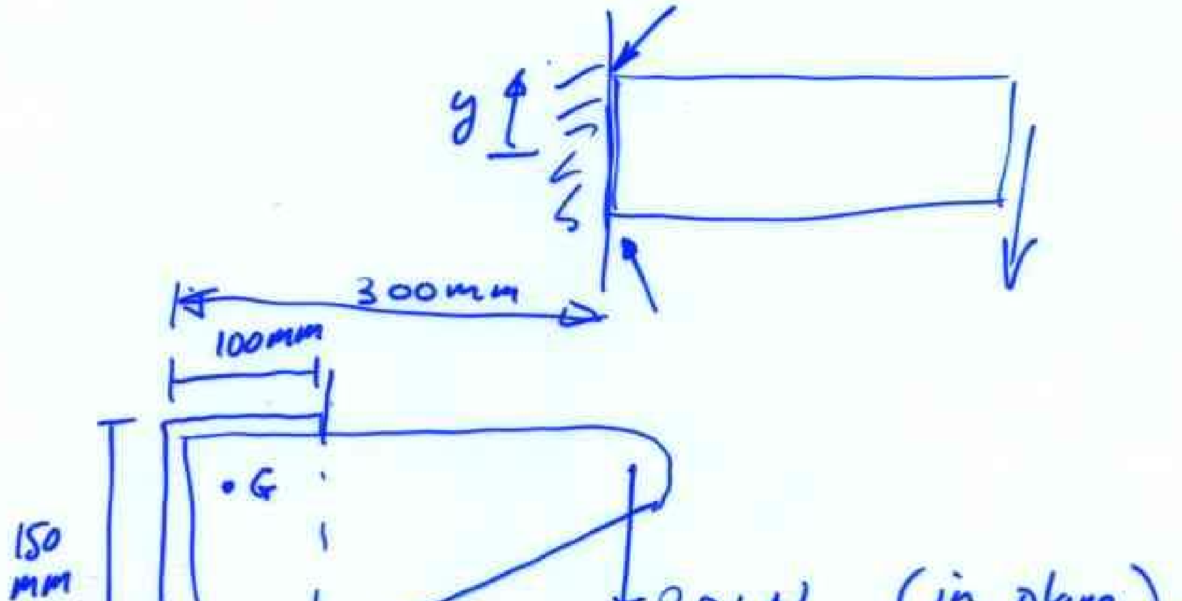
TORSION

Direct shear $\frac{P}{A}$ → same

Torsion induced shear $\frac{Tr}{J}$

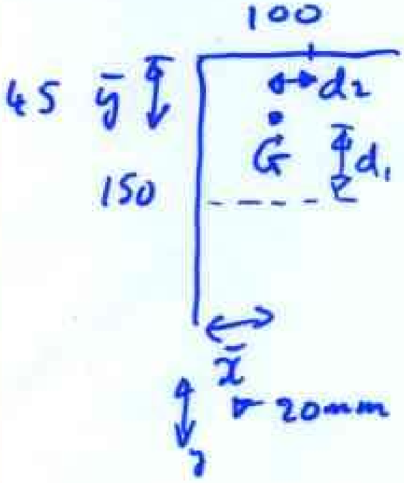
BENDING

Bending induced ~~shear~~ stress $= \frac{My}{I}$



find required size of weld for $S_y = 345$ MPa

F.S. = 2·5



$$\bar{x} = \frac{\Sigma x_i A}{\Sigma A_i} = \frac{(100t)(50) + (150t)(0)}{(250t)}$$

$$= 20\text{ mm}$$

$$\bar{y} = \frac{\Sigma y_i A_i}{\Sigma A_i} = \frac{(100t)(0) + (150t)(75)}{250t}$$

$$\bar{y} = 45\text{ mm}$$

Need to know J for weld group.

$$J = I_x + I_y$$

look @ each arm of weld separately.

<u>longer</u> $J_L = [I_x] + [I_y]$

$$\left[I_x = \frac{1}{12}AL^2\right] \qquad = \left[\frac{L^3 t}{12} + Lt\,\overbrace{(75-45)^2}^{d_1^2}\right] + \left[Lt\,(20)^2\right]$$

$$J = 476250\,t$$

<u>shorter</u> $J = I_x + I_y$

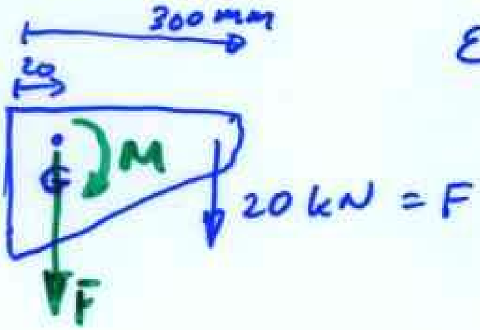
$$= \left[(100t)(45)^2\right] + \left(\frac{100^3 t}{12} + (100t)\overbrace{(50-20)^2}^{d_2^2}\right)$$

$$J_s = 375833t$$

$$J_{TOTAL} = (375833 + 476250)t$$

$$= \underline{852083\,t}$$

Express LOAD as a force plus a moment.



Effect @ G of F

is Force $\underline{20\,kN}$

+ moment of

$(20\,kN)(300-20\text{ mm})$

$$M = 5600\ Nm$$

$$\text{Direct Shear} = \frac{F}{A} = \frac{20\,000}{(250)(t)} = \underbrace{\frac{80}{\cancel{t}}\ MPa}_{\text{constant everywhere}}$$

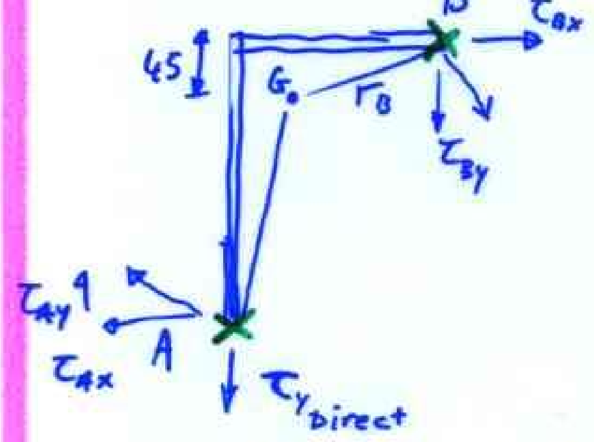
Shear Due to Torque

$$\tau = \frac{Tr}{J}$$

$$\tau_{Bx} = \frac{(45)(5600)}{852083t} = \frac{295.7}{t}\ MPa$$

$$\tau_{By} = \frac{(100-20)(5600)}{852083t} = \frac{525.8}{t}\ MPa$$

J



$$\tau_{Ax} = \frac{(150-45)(5600)}{J} = \frac{690}{t}\ MPa$$

$$\tau_{Ay} = \frac{(20)(5600)}{J} = \frac{131}{t}\ MPa$$

Max occurs @ $\underline{A}$ (check for yourself B smaller)

$$\frac{1}{t}\sqrt{690^2 + (131-80)^2} = \frac{692}{t}\ MPa$$

@B

$$\frac{1}{t}\sqrt{(525.8+80)^2+(295.7)^2} = \frac{674.1}{t} \text{ (smaller).}$$

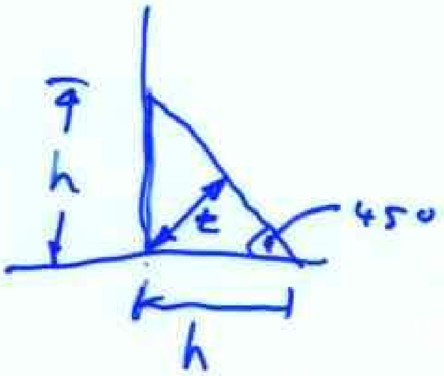
Look @ failure @ point A

BECAUSE SHEAR

$$\frac{692}{t} = \frac{(0.58)(345)}{2.5}$$

F.S.

$t = 8.65\,mm$

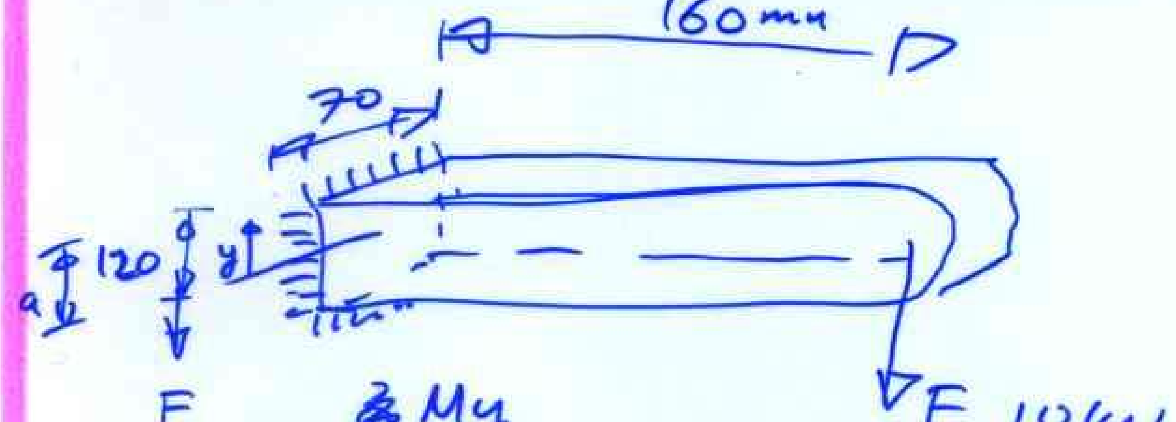


$$h = \frac{t}{0.707}$$

$$0.707 = \frac{\sqrt{2}}{2}$$

$$h = \frac{8.65}{0.707} = 12.23\ mm$$

$\boxed{h = 13\ mm}$ ← useful spec.



$$\frac{F}{A} + \frac{My}{I}$$

Bending moment

$$(160\times10^{-3})(10\times10^{3}) = 1600\,NM$$

I_x vert welds. $2\left(\frac{L^3 t}{12}\right) = 2\,(144\times10^{-9}t)\ m^4$

L = 120 mm

I_x Hz. welds. $2Lta^2 = (2)(70)(t)(60^2)$

$2(252\times10^{-9}t)\ m^4$

$$I_{x_{total}} = I_{x_{vert}} + I_{x_{Hz}}$$

then you have M, I, y

calc stresses.

Ans. $t = 1.86$ mm

$h = \sim 3$ mm.

if $\boxed{\sigma_y = 345\,MPa}$