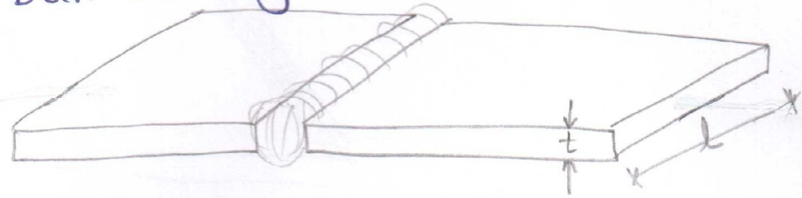
welding

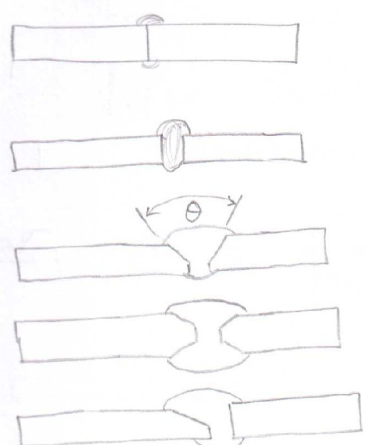
① Butt welding



square

l : width of welding

t : height of welding



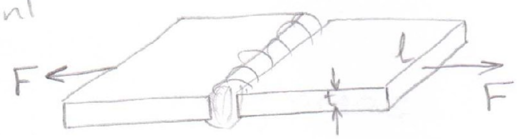
square

open square

V-joint

double V

Bevel joint

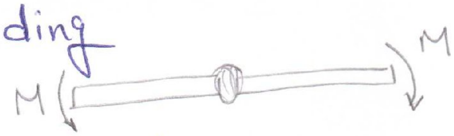


* strength in butt welding

tension

$$\sigma_t = \frac{F}{l t} \leq \frac{S_u}{F.S.}$$

as $A_w = l t$ Area of welding



bending

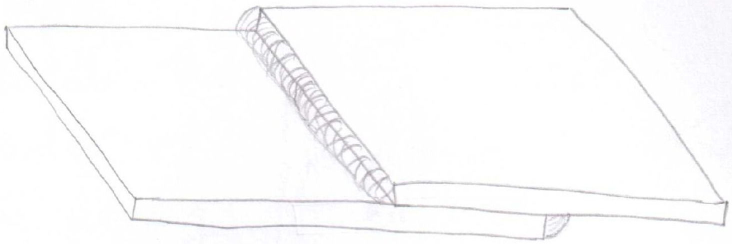
$$\sigma_b = \frac{M y}{I} \qquad \text{as } y = \frac{t}{2}$$

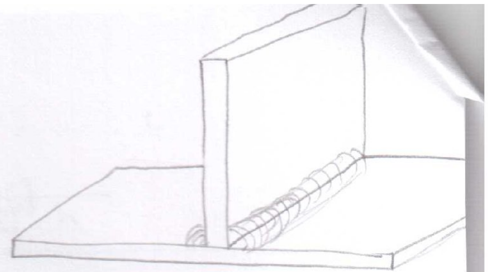
$$I = \frac{L t^3}{12}$$

* for Combined bending & tension

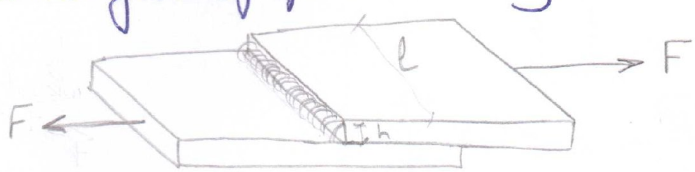
$$\sigma_t + \sigma_b \leq \frac{S_u}{F.S.}$$

② fillet welding

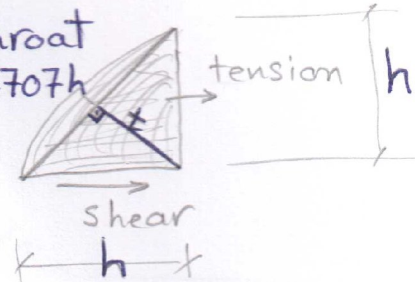




* strength of fillet welding

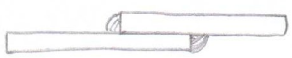


t = throat
= 0.707h



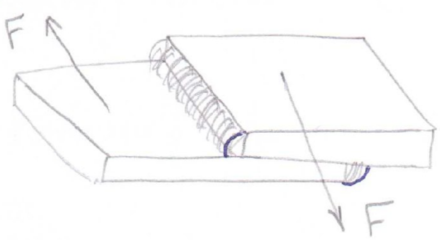
force could make tension or shear to welding material.

shear $\tau = \dfrac{F}{A_w} = \dfrac{F}{l * 0.707h}$

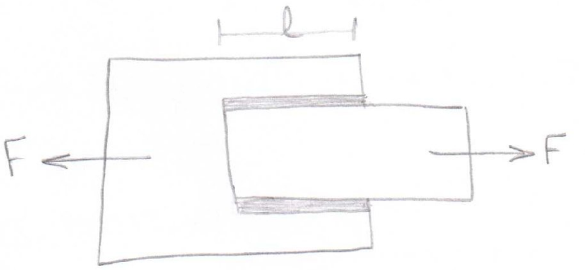


$\tau = \dfrac{F}{(l * 0.707h)\,2}$ ← no. of areas.

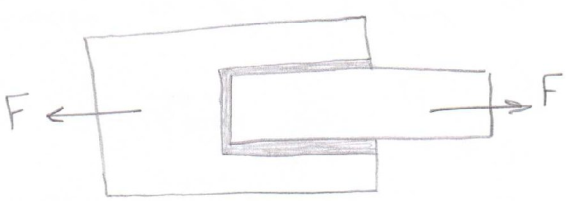
* Cases



$\tau = \dfrac{F}{0.707hl * 2}$



$\tau = \dfrac{F}{0.707hl * 2}$



$\tau = \dfrac{F}{0.707h * l_{weld}}$

مجموع الاطوال الثلاثة ←

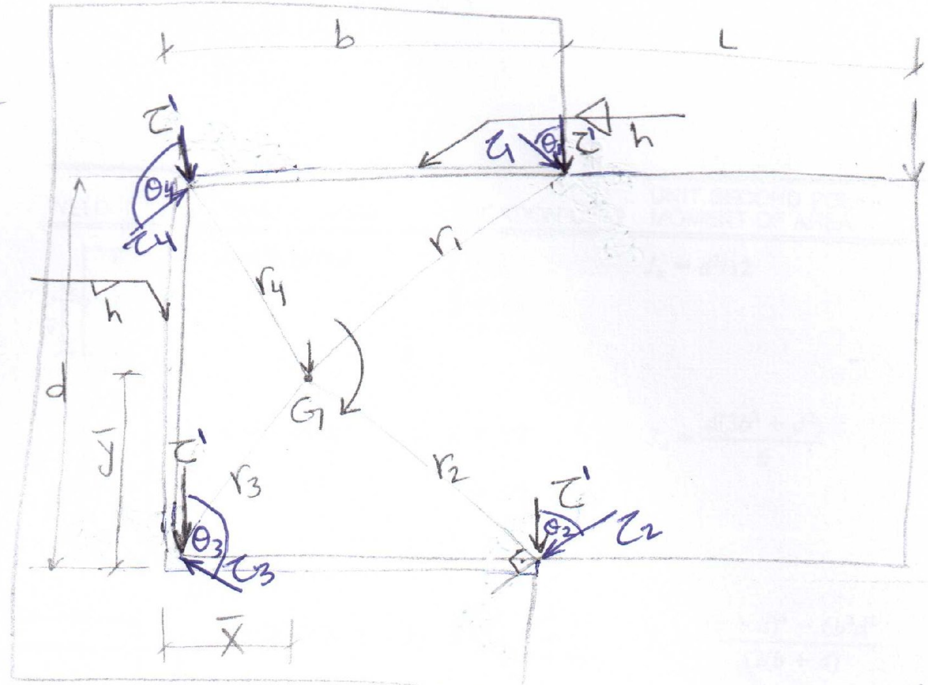
*) IF the load is eccentric

steps

① locate the center of the welding

من الجدول

$\bar{X}$, $\bar{Y}$



② Transfer the force to the welding center with a force and turning moment $T = F * (L + b - \bar{X})$

③ Calculate the stresses as follows:

ⓘ primary shear $\tau' = \dfrac{F}{A} = \dfrac{F}{(2b+d) * 0.707\,h}$

ⓘⓘ secondary shear $\tau_s = \dfrac{T\,r}{J}$

as $J = J_u * 0.707\,h$ يتم حساب J_u من معادلة بالجدول

④ For the point at which the max. shear is expected

⊛ max. r

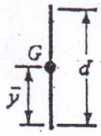
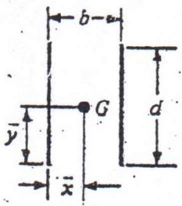
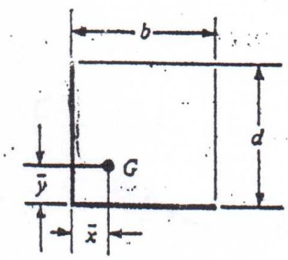
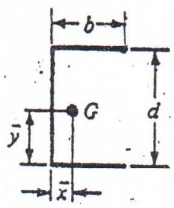
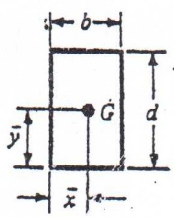
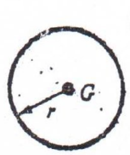
⊛ min. θ

⑤ $\tau_{max} = \sqrt{\tau'^2 + \tau_s^2 + 2\,\tau'\,\tau_s \cos\theta} \leq \tau_{all}$

$\tau_{max} \leq \dfrac{0.5\,S_y}{f.s.}$

TABLE 9-2

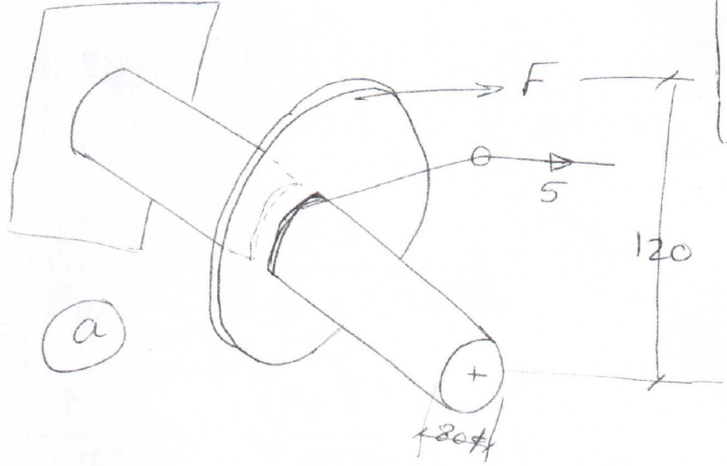
Torsional Properties of Fillet Welds*

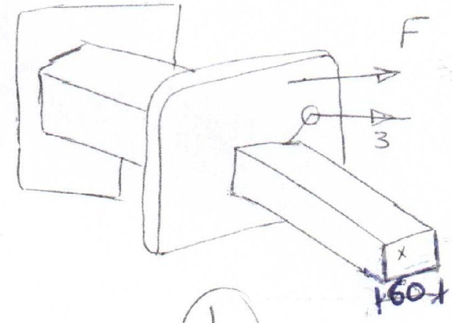
WELD	THROAT AREA	LOCATION OF G	UNIT SECOND POLAR MOMENT OF AREA
	$A = 0.707hd$	$\bar{x} = 0$ $\bar{y} = d/2$	$J_u = d^3/12$
	$A = 1.414hd$	$\bar{x} = b/2$ $\bar{y} = d/2$	$J_u = \dfrac{d(3b^2 + d^2)}{6}$
	$A = 0.707h(b + d)$	$\bar{x} = \dfrac{b^2}{2(b + d)}$ $\bar{y} = \dfrac{d^2}{2(b + d)}$	$J_u = \dfrac{(b + d)^4 - 6b^2d^2}{12(b + d)}$
	$A = 0.707h(2b + d)$	$\bar{x} = \dfrac{b^2}{2b + d}$ $\bar{y} = d/2$	$J_u = \dfrac{8b^3 + 6bd^2 + d^3}{12} - \dfrac{b^4}{2b + d}$
	$A = 1.414h(b + d)$	$\bar{x} = b/2$ $\bar{y} = d/2$	$J_u = \dfrac{(b + d)^3}{6}$
	$A = 1.414\pi hr$		$J_u = 2\pi r^3$

*G is centroid of weld group; h is weld size; plane of torque couple is in the plane of the paper; all welds are of unit width.

ex.

Find the max. safe value of F if $\tau_{all} = 140\ MPa$





(a) $T = F * 120$

$\tau' = 0$ (No possibility of linear motion in the direction of force F)

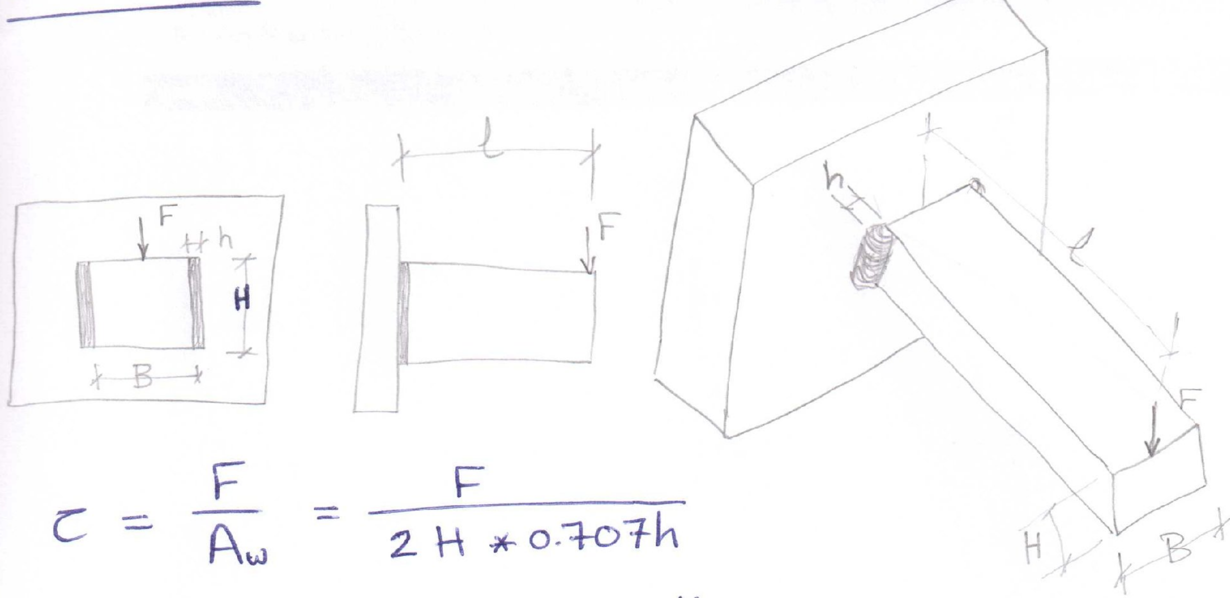
$$\tau_{max} = \tau_s = \frac{Tr}{J} \leq \tau_{all}$$

$$= \frac{(F * 120) * \frac{80}{2}}{2\, J_u * 0.707 * 5} \leq 140$$

$$F \leq \text{——}\ N$$

(b) F is not a function of welding size because of the shape (there is no possibility of linear motion or rotation)

* Bending



$$\tau = \frac{F}{A_w} = \frac{F}{2H * 0.707h}$$

$$\sigma_b = \frac{M y_{max}}{I} = \frac{(F * l) * H/2}{\left(\frac{0.707h\, H^3}{12}\right) * 2} \leftarrow \text{no. of welds}$$

$$\sigma_{max} = \frac{\sigma_b}{2} + \sqrt{\left(\frac{\sigma_b}{2}\right)^2 + \tau^2} \le \frac{S_u}{f.s.} = \sigma_{all}$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma_b}{2}\right)^2 + \tau^2} \le \frac{S_{ush.}}{f.s.} = \tau_{all}$$

$$\left.\begin{aligned} \sigma_{all} &= \frac{}{h_1} \\ \tau_{all} &= \frac{}{h_2} \end{aligned}\right\}$$

نختار ال h الأكبر
ونقرب لأكبر رقم صحيح

<u>from table</u> match the welding type

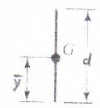
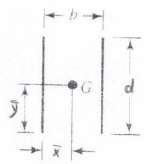
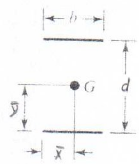
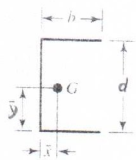
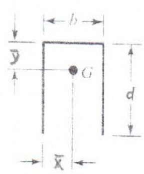
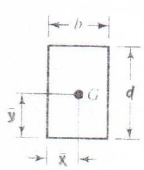
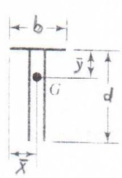
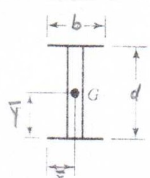
$$\tau = \frac{F}{A}$$

$$\sigma_b = \frac{M y_{max}}{0.707h\, I_u} \leftarrow$$

Calculate $\bar{y}$ & $d - \bar{y}$
if $\bar{y} > d - \bar{y}$ $\therefore y_{max} = \bar{y}$
if not $\therefore y_{max} = d - \bar{y}$

ثم نكمل كما سبق .

Bending Properties of Fillet Welds*

Weld	Throat Area	Location of G	Unit Second Moment of Area
	$A = 0.707hd$	$\bar{x} = 0$ $\bar{y} = d/2$	$I_u = \dfrac{d^3}{12}$
	$A = 1.414hd$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \dfrac{d^3}{6}$
	$A = 1.414hd$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \dfrac{bd^2}{2}$
	$A = 0.707h(2b + d)$	$\bar{x} = \dfrac{b^2}{2b + d}$ $\bar{y} = d/2$	$I_u = \dfrac{d^2}{12}(6b + d)$
	$A = 0.707h(b + 2d)$	$\bar{x} = b/2$ $\bar{y} = \dfrac{d^2}{b + 2d}$	$I_u = \dfrac{2d^3}{3} - 2d^2\bar{y} + (b + 2d)\bar{y}^2$
	$A = 1.414h(b + d)$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \dfrac{d^2}{6}(3b + d)$
	$A = 0.707h(b + 2d)$	$\bar{x} = b/2$ $\bar{y} = \dfrac{d^2}{b + 2d}$	$I_u = \dfrac{2d^3}{3} - 2d^2\bar{y} + (b + 2d)\bar{y}^2$
	$A = 1.414h(b + d)$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \dfrac{d^2}{6}(3b + d)$
	$A = 1.414\pi hr$		$I_u = \pi r^3$