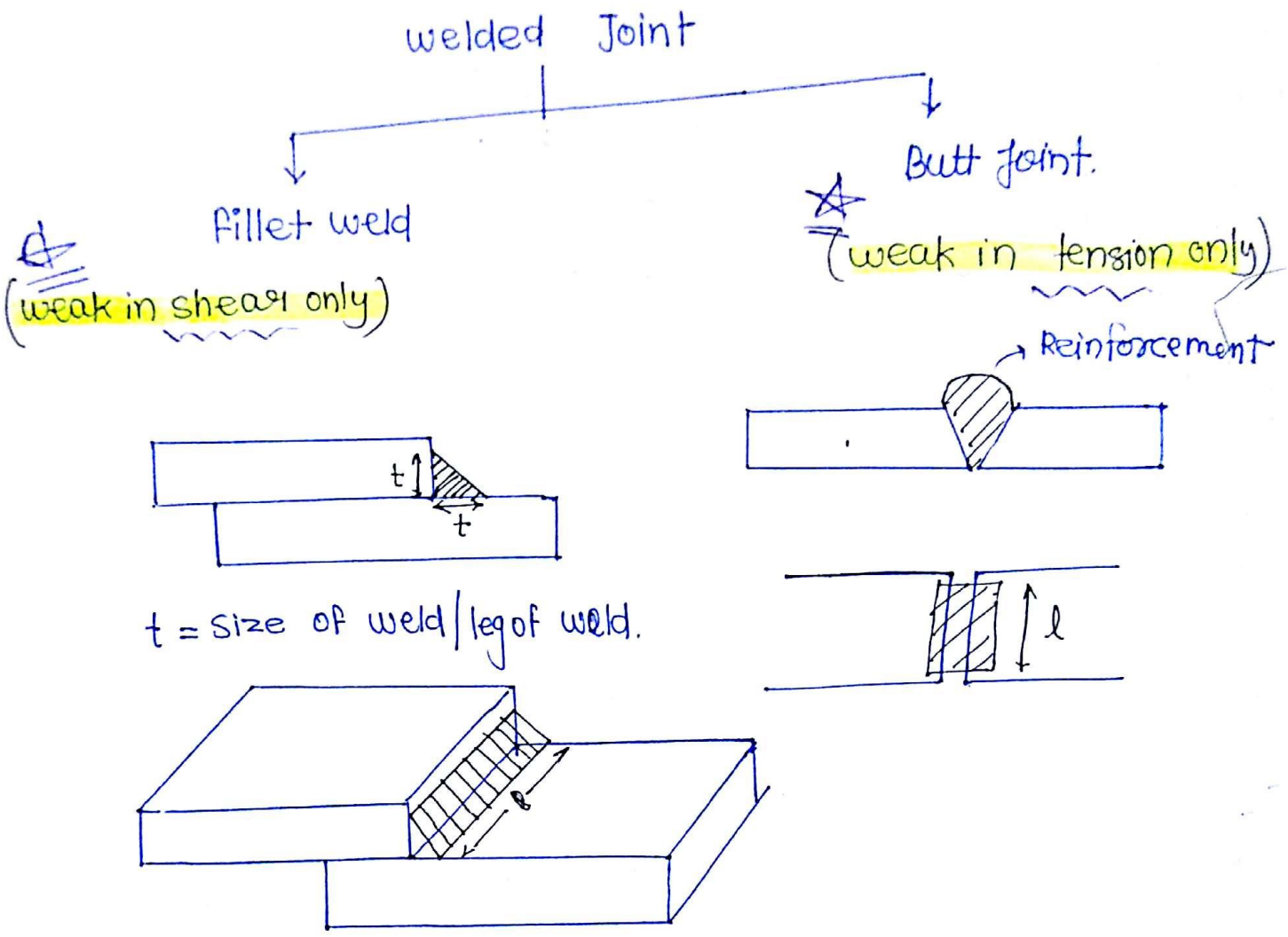
Welded Joint



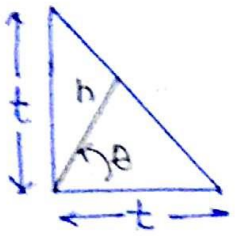
Fillet weld :- ① Parallel fillet weld
② transverse fillet weld.

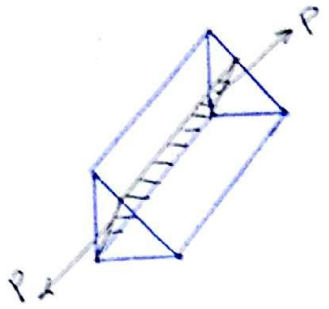
Design of parallel filled weld.: when line of action is parallel to length of weld

- The aim of design is to determine size/leg of weld

shear stress = ?

$$\text{shear stress} = \frac{\text{shear load}}{\text{sheared area.}} \leftarrow \min$$





h = Throat of weld

$$h = \frac{t}{\sin\theta + \cos\theta}$$

$$\tau_{ind} = \frac{P}{ht}$$

$$\tau_{ind} = \frac{P(\sin\theta + \cos\theta)}{t \cdot l}$$

$\tau \rightarrow$ max.

$\tau_{ind} \rightarrow f(\theta)$

$$\frac{d\tau_{ind}}{d\theta} = 0$$

$\theta = 45°$, $h = 0.707\,t = \frac{t}{\sqrt{2}}$

$$\tau_{max} = \frac{P}{\frac{t}{\sqrt{2}} l} = \frac{P}{0.707\,t\,l}$$

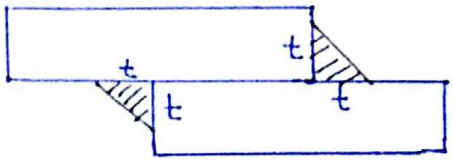
Safe cond^n $\tau_{max} \leq \tau_{per.}$

$$\frac{P}{0.707\,t\,l} \leq \tau_{per.}$$

Shear Strength of fillet weld

$$P_{max} \leq 0.707\,t\,l\,\tau_{per.}$$

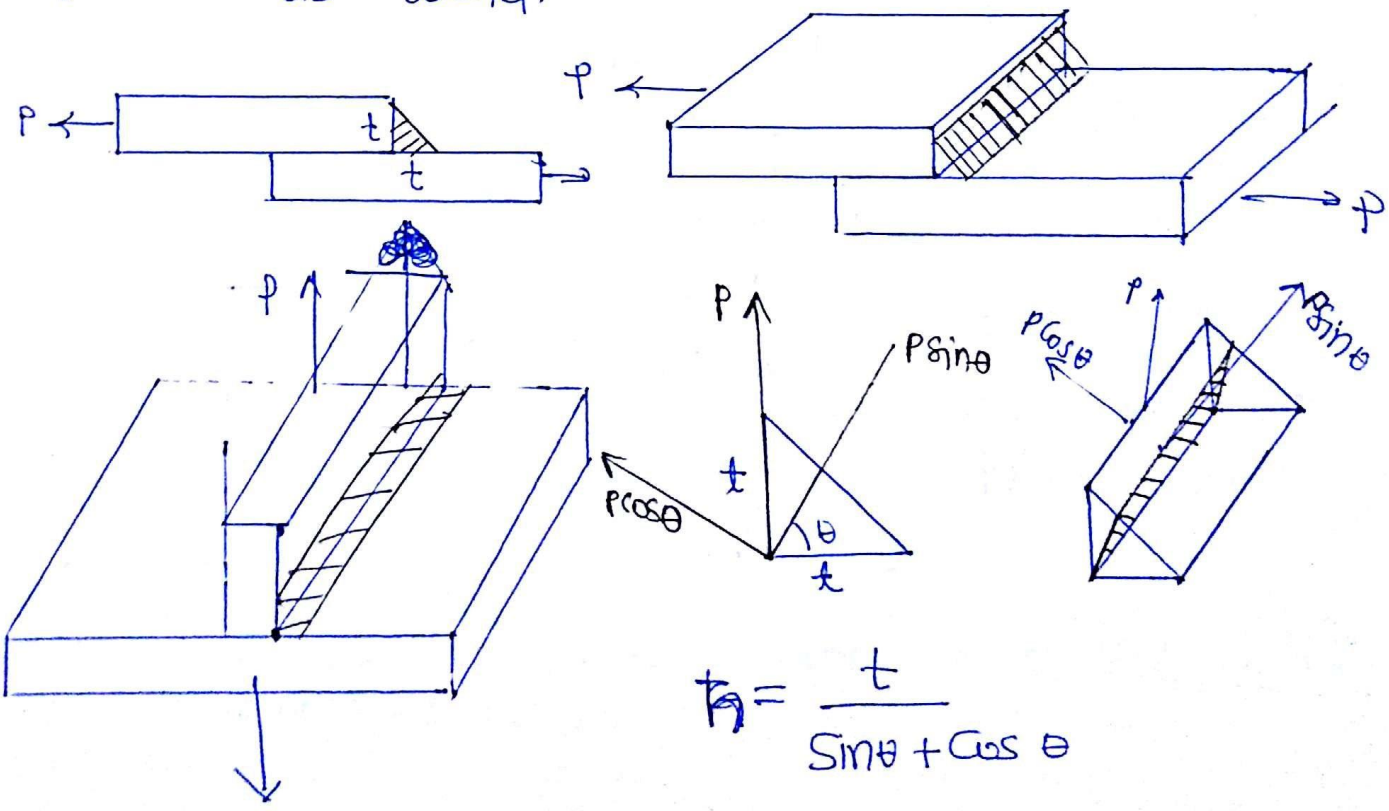
If Double parallel Fillet :-



$$\tau_{max} = \frac{P}{2 \times 0.707\, t.l}$$

$$P_{max} = (2 \times 0.707\, t.l)\, \tau_{max.}$$

Transverse plate weld :- when line of action of load is $\perp^{er}$ to the length of weld is reffered as weld.



$$t_h = \frac{t}{\sin\theta + \cos\theta}$$

$$\tau_{ind} = \frac{P \sin\theta}{ht}$$

$$\tau_{ind} = \frac{P \sin\theta (\sin\theta + \cos\theta)}{t l}$$

$\tau_{ind} \rightarrow \tau_{max}$

$\hookrightarrow f(\theta)$

$$\frac{d\tau_{ind}}{d\theta} = 0$$

$\theta = 67\frac{1}{2}^{\circ}$

$h = 0.765t$

Condition for τ_{max}

$$\tau_{max} = \frac{P}{0.828\, t l}$$

Safe Cond^{n} $\tau_{max} \leq \tau_{per.}$

$$\frac{P}{0.828\, t l} \leq \tau_{per.}$$

Shear Strength of transverse fillet weld

$$P_{max} = 0.828\, t l\, \tau_{per}$$

IF Double

$$\tau_{max} = \frac{P}{2 \times 0.828\, t l}$$

$$P_{max} = 2 \times 0.828\, t l \cdot \tau_{per.}$$

$$(P_{max})_{parallel} = 0.707\ t\ l\ \tau_{per.}$$

$$(P_{max})_{transverse} = 0.828\ t\ l\ \tau_{per.}$$

Note. Hence parallel is weaker than transverse so always design any fillet weld by assuming ~~parallel~~ parallel fillet weld only.

min thickness = Throat (h) = $0.707\ t$

min Area = $0.707\ t.l$

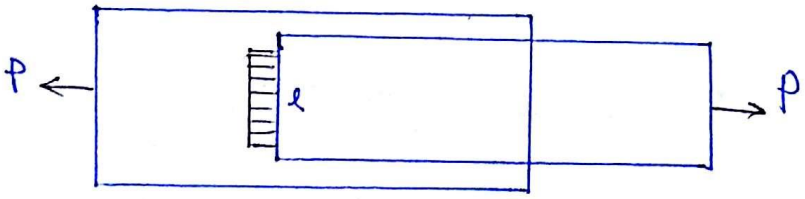
for any fillet weld.

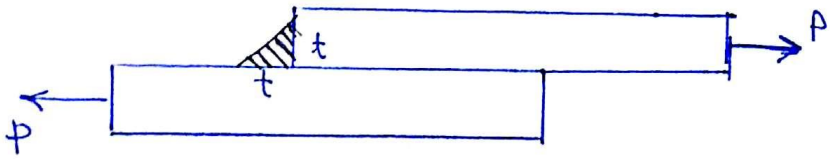
~~Flat~~

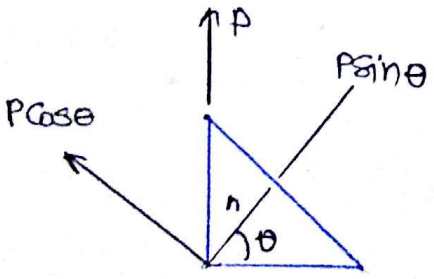
Fillet weld under tension:-

τ_{per} = not Given

σ_{per} = Given







$$\sigma_{ind} = \frac{P\cos\theta(\sin\theta + \cos\theta)}{t\,l}$$

$$\frac{d\sigma_{ind}}{d\theta} = 0 \Rightarrow \theta = 22\tfrac{1}{2}^{\circ}$$

$$\sigma_{ind} = \frac{P}{0.828\,t\,l} < \frac{P}{0.707\,t\,l}$$

used $\sigma_{ind} = \frac{P}{0.707\,t.l}$ better safe

$$\sigma_{ind} = \frac{P}{0.707\, t.l}$$

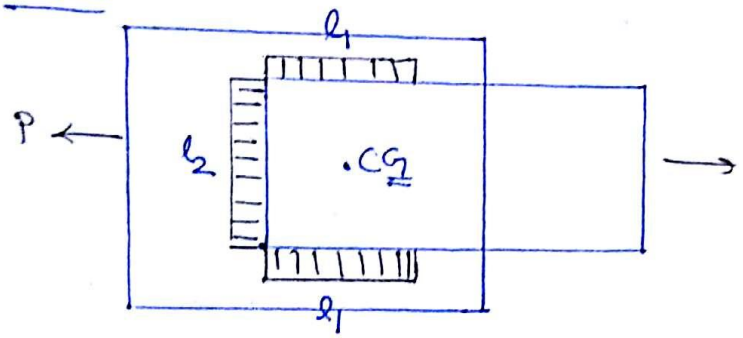
$$\sigma_{max} \leq \sigma_{ind\ per}$$

$$\frac{P}{0.707\, t.l} \leq \sigma_{per}$$

Tension strength of Fillet weld

$$\boxed{P_{max} = 0.707\, t.l\, \sigma_{per}.}$$

* Que



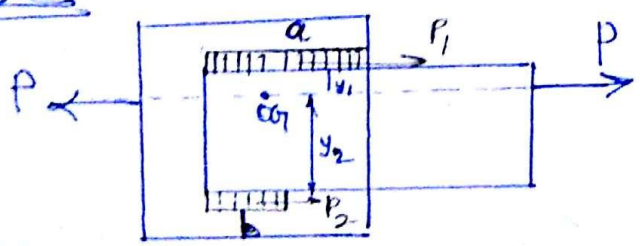
τ_{per} = Given

σ_{per} = Given.

$$P_{max} = 2 \times 0.707 \times t \times l_1 \times \tau_{per} + 0.707\, t\, l_2\, \sigma_{per}$$

$$P_{max} = 2 \times 0.707\, t\, l_1 \tau_{per} + 0.707\, t\, l_2\, \sigma_{per}$$

Ques



$$P = P_1 + P_2$$

$$P = 0.707\, t\, a\, \tau_{per} + 0.707\, t\, b\, \tau_{per}$$

$$P = \frac{t}{\sqrt{2}} \tau_{per} (a+b) \quad \text{--- (1)}$$

Moment about CG

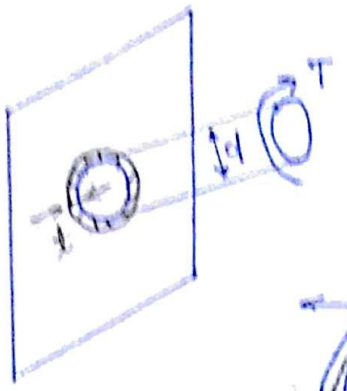
$$P_1 y_1 = P_2 y_2$$

$$\Rightarrow a y_1 = b y_2 \quad \text{--- (2)}$$

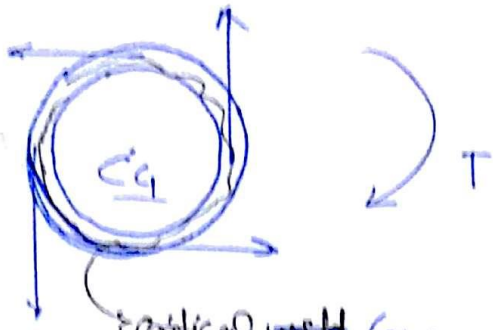
a = ?

b = ?

Fillet weld under twisting :-



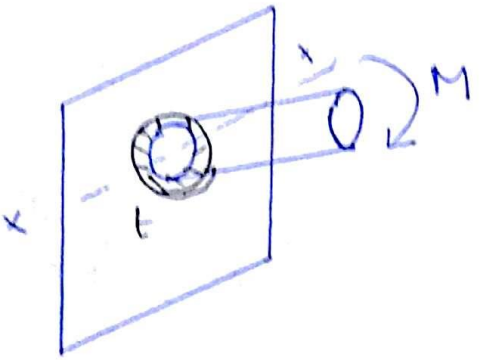
$$\tau_{max} = \frac{2.83\,T}{\pi d^2 t}$$



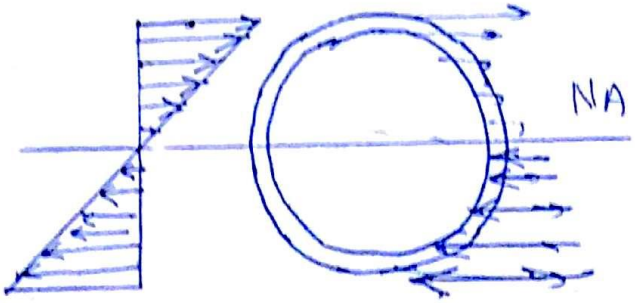
$\tau_{max} \propto \gamma$

Critical ~~weld~~ point (every point Critical)

Fillet weld under bending :-



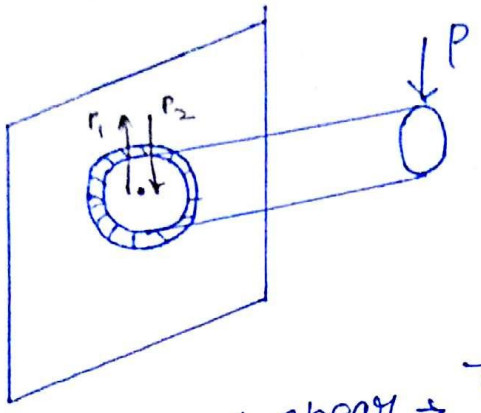
$$(\sigma_b)_{max} = \frac{5.66\,M}{\pi d^2 t}$$



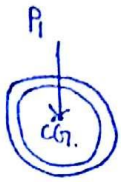
if both twisting & bending

$$\text{MSST} \quad \sqrt{\left(\frac{5.66\,M}{\pi d^2 t}\right)^2 + 4\left(\frac{2.83\,T}{\pi d^2 t}\right)^2} \leq \frac{S_{yt}}{N}$$

point load :-

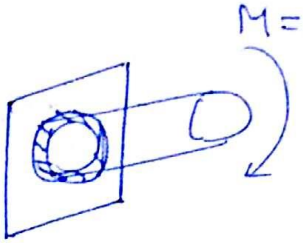


effect of P_1



direct shear stress $\Rightarrow \tau_{dir} = \dfrac{P}{0.707 t(\pi d)}$

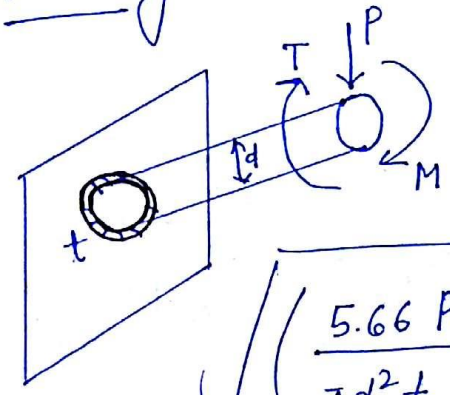
effect of P_2



$(\sigma_b)_{max} = \dfrac{5.66\,Pe}{\pi d^2 . t}$

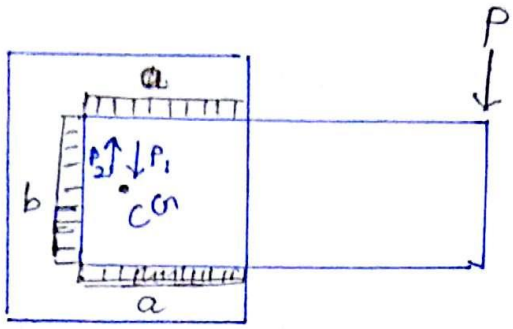
$$\sqrt{\sigma^2 + 4\tau^2} \leq \sigma_{per.}$$

if bending, twisting, point

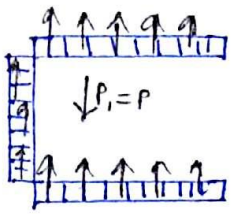


$$\sqrt{\left(\frac{5.66\,Pe}{\pi d^2 t} + \frac{5.66\,M}{\pi d^2 t}\right)^2 + 4\left(\frac{9.83T}{\pi d^2 t} + \frac{P}{0.707 t \pi d}\right)^2} \leq \frac{S_{yt}}{N}$$

Ques



effect of P_1

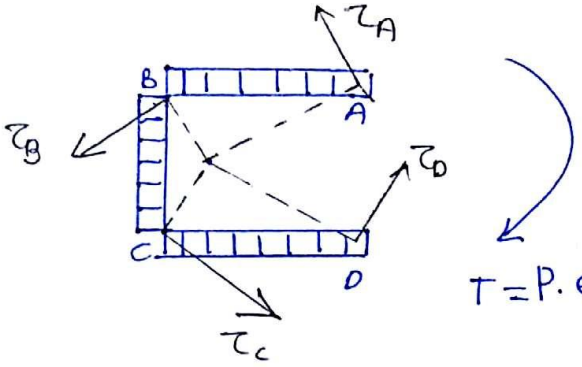


$$\tau_{max} = \frac{P}{0.707\, t\,(2a+b)}$$

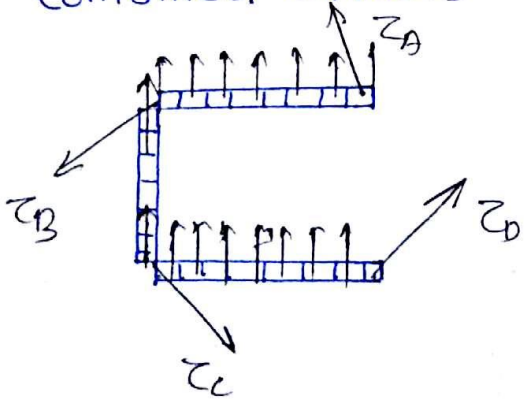
{ Direct shear stress.

effect of P_2

$\tau_{max} \propto \gamma$

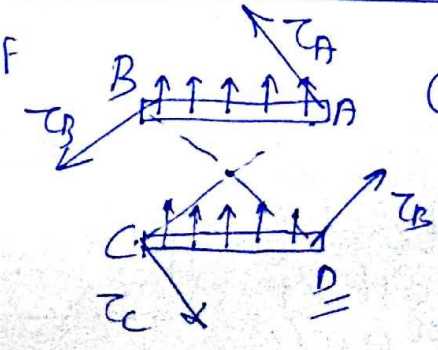


Combined effect:



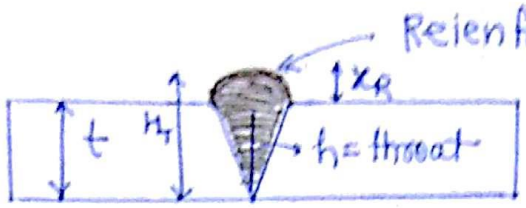
critical point A, D

if



Critical point A, D

Butt weld :- (weak in tension)



$h = H_t - x_R$

$t < 6$ mm → || → Square butt weld

$6\text{mm} \le t \le 20\text{mm}$ → V → Vee butt weld

$20\text{mm} < t$ → X → double butt weld

The height of Reinforement will not be Considered in the design because reinforment will be grind of after Complition of welding

$$\boxed{h_t = H - x_R}$$ Use this.

$h_t = t$ in this Case.

$$\sigma_{ind} = \frac{P}{h \cdot l}$$

Safe Cond^n

$(\sigma_{ind}) \le \sigma_{per}$

$P/h \cdot l \le \sigma_{per}$

$$\boxed{P_{max} = h \cdot l \cdot \sigma_{per}}$$

tensile Strength of butt weld

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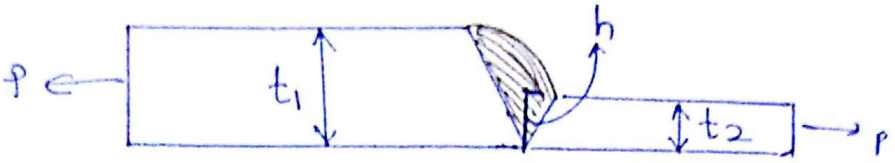

$$\sigma_{ind} = \frac{P}{t_2 l}$$

$$h = t_2$$

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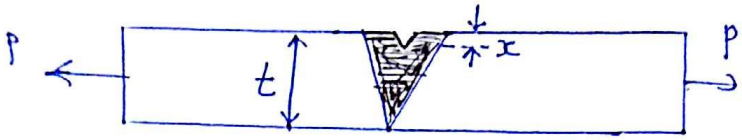

$$h = t - x$$

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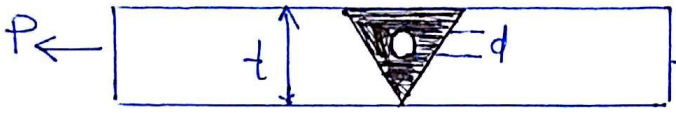

$$h = t - d$$

weld strength & skilling of labour