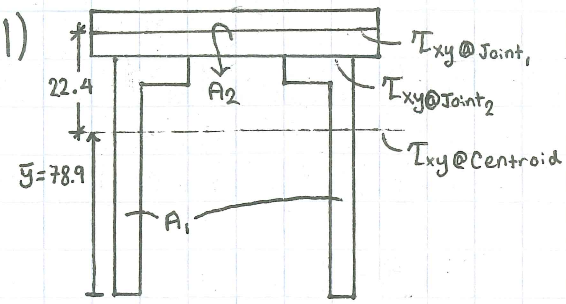
CIV102 - STRUCTURES and MATERIALS

Topic: Example Bridge Design Part II

1)



Shear at Glue Joint$_2$

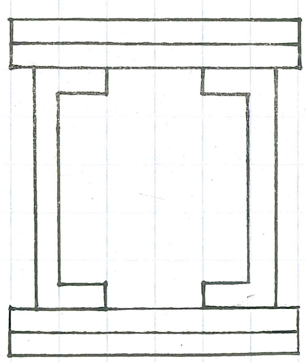
$$V = \frac{\tau_{xy} I \cdot b}{Q}$$

$$Q_2 = A_2 \cdot dist = 1.27 \times 2 \times 120 \times (22.4)$$
$$Q_2 = 6806\,mm^3$$

$$\frac{P_6}{2} = \frac{\tau_{xy} \cdot I \cdot b}{Q_2} \Rightarrow \frac{P_6}{2} = \frac{2 \times 587 \times 10^3 \times (2 \times 10)}{6806}$$

$$P_6 = 6899N$$

Shear at $\boxed{B}$



I = Bigger
Q = Bigger

$$\tau_{xy} = \frac{VQ}{Ib}$$

Shear

$\boxed{A}$ Max $\tau_{xy} = 4MPa$

$$\tau_{xy} = \frac{VQ}{Ib} \Rightarrow V = \frac{\tau_{xy} I \cdot b}{Q}$$

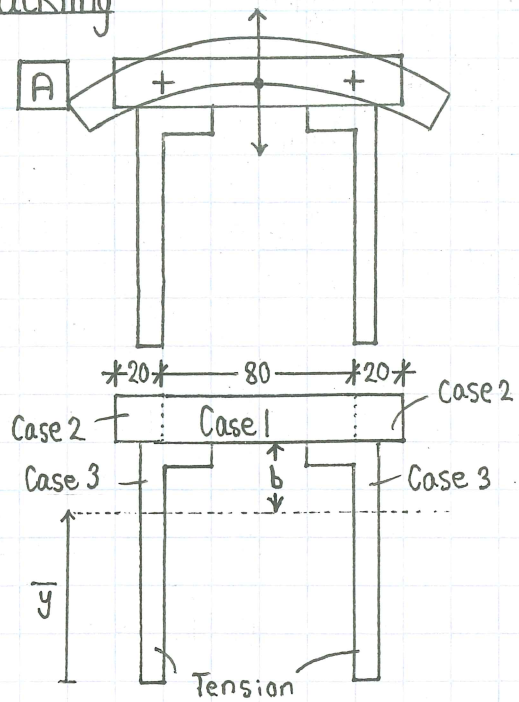
$$Q_1 = A_1 \cdot dist = 78.9 \times 1.27 \times 2 \times \frac{78.9}{2}$$
$$Q_1 = 7906\,mm^3$$

$$\frac{P_5}{2} = \frac{\tau_{xy} \cdot I \cdot b}{Q_1} \Rightarrow \frac{P_5}{2} = \frac{4 \cdot 587 \times 10^3 (1.27 \cdot 2)}{7906}$$

$$P_5 = 1509N$$

Shear at Glue Joint$_1$

Buckling



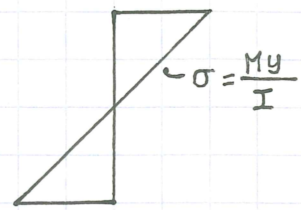
Case 1 – Restrained on 2 sides, Constant σ

Case 2 – Restrained on 1 side, Constant σ

Case 3 – Restrained on 2 sides, variable σ

Case 4 – Shear Stress

Axial Stress $\rightarrow$ Moments



Case 1 Buckling Top Centre

$$\sigma_{cr} = \frac{K\pi^2 E}{12(1-\mu^2)}\left(\frac{t}{b}\right)^2$$

$$= \frac{4\pi^2 4000}{12(1-0.2^2)}\left(\frac{1.27\cdot 2}{80}\right)^2$$

$$= 13.8\ \text{MPa}$$

Since > 6 MPa ignore this buckling

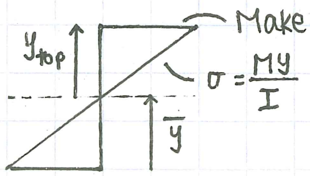
Case 2

$$\sigma_{cr} = \frac{0.425\pi^2 E}{12(1-\mu^2)}\left(\frac{t}{b}\right)^2$$

$t = 1.27 \times 2 \quad b = 20$

$\sigma_{cr} = 23.5$ MPa

How to Respond if $\sigma_{cr} < 6$ MPa ?



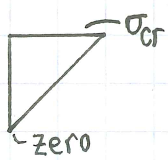
Make this $\sigma = \sigma_{cr}$ Solve for M, Solve for P

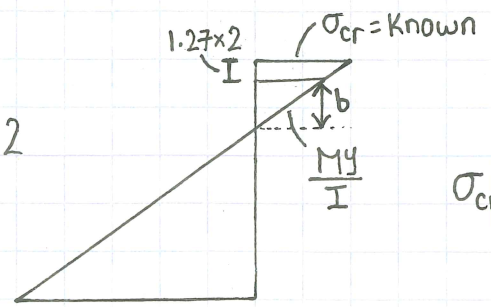
Case 3

$b = 23.6 - 1.27 \times 2$

$t = 1.27$ mm

$K = 6$





$$\sigma_{cr} = \frac{M(236 - 1.27\times 2)}{I}$$