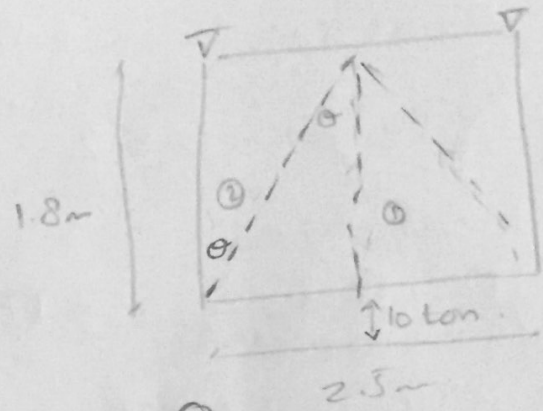
Qu4 Stringer Bracing

case①

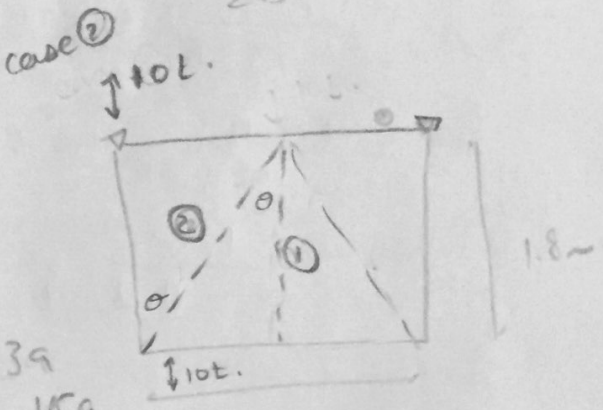
$\tan\theta = \frac{1.25}{1.8} \rightarrow \theta = 34.78°$

$F_1 = \pm 10$ ton



case②

$F_2 \cos\theta = \pm 10 \rightarrow F_2 = \pm 12.2$ t



* member ①

use 2 angles BTB $L_{in} = 1.8$m $r_{in} = 0.39$

$L_{out} = 1.8 \times 1.2$ $r_{out} = 0.459$

$\frac{180}{0.39} \leq 140 \rightarrow a \geq 4.3$cm

$\frac{180 \times 1.2}{0.459} \leq 140 \rightarrow a \geq 3.43$cm

& $a-t \geq 3.6$cm

$A_{req} = \frac{10}{2 \times 0.75 \times 0.85} = 7.84\text{cm}^2$ → Choose 2 ∠ 65×7 BTB

$\left(\frac{L}{r}\right)_{in} = \frac{180}{0.3 \times 6.5} = 92.3 < 100$

$\left(\frac{L}{r}\right)_{out} = \frac{180 \times 1.2}{0.45 \times 6.5} = 73.85$

$f_{all} = 1.4 - 0.000065\lambda^2 = 0.85$ t/cm²

$f_{act} = \frac{10}{2 \times 8.7} = 0.57$ t/cm² < $0.85 * 0.85$ (0.72 t/cm²) ∴ safe

* check tension: assume $\phi_{bolt} = 16$mm.

$A_{net} = 2\left[8.7 - (1.6+0.2) * 0.7\right] = 14.88\text{cm}^2$.

$f_{act} = \frac{10}{14.88} = 0.67$ t/cm² < $1.4 * 0.85$ (1.19 t/cm²) ∴ safe

* member ② :

$L = \sqrt{1.8^2 + 1.25^2} = 2.19$ m. $\quad L_{out} = 1.2 \times 2.19 = 2.63$ m

$\frac{219}{0.3a} \leq 140 \rightarrow a \geq 5.2$ cm $\quad \frac{263}{0.45a} \leq 140 \rightarrow a \geq 4.17$ cm

$a - t \geq 3.6$ cm

$A_{req} = \frac{12.2}{2 \times 0.8 \times 0.85} = 8.97$ cm^2 $\rightarrow$ choose 2 ∠ 75 × 8 BTB

$\left(\frac{L}{i}\right)_{in} = \frac{219}{0.3 \times 7.5} = 97.3 < 100$ $\quad \left(\frac{L}{i}\right)_{out} = \frac{263}{0.45 \times 7.5} = 77.9$

$P_{all} = 1.4 - 0.000065 (97.3)^2 = 0.78$ t/cm^2

$f_{act} = \frac{12.2}{2 \times 11.5} = 0.53$ t/cm^2 $< 0.78 * 0.85$ ∴ safe
$(0.66$ t/cm$^2)$

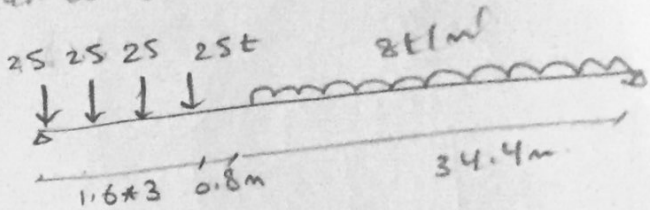
check tension

$f_{act} = \frac{12.2}{2[11.5 - (1.6+0.2) * 0.8]} = 0.6$ t/cm^2 $< 1.4 * 0.85$

Braking Bracing:

BF: 0.25 total loads without impact = 0.25(4*25+8*34.4) = 93.8t.
DF: 0.3 total loads without impact = 0.3 (4x 25+8*34.4) = 112.56t > 75t XX

∴use 93.8t.

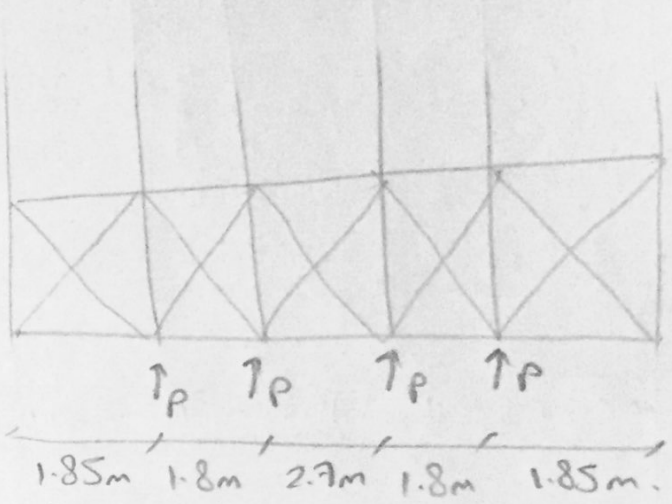


* assume using 2 bracing systems.
one at end & one at start of bridge

Force/bracing system = $\frac{93.8}{2}$ = 46.9t.

P = $\frac{46.9}{2}$ = 23.45t.

R = $\frac{23.45*4}{2}$ = 46.9t.

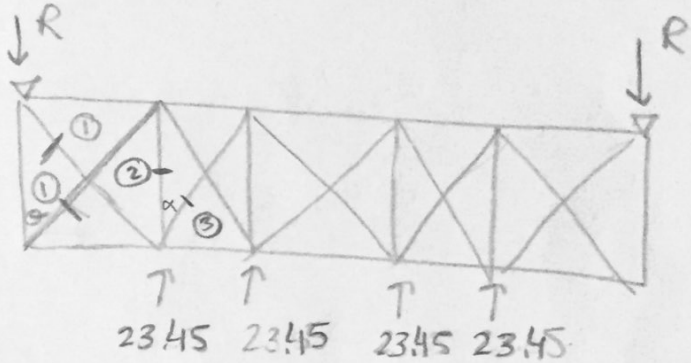


* design of section ①

$L_g = \frac{\sqrt{2.5^2+1.85^2}}{2}$ = 1.56m

$\left(\frac{L}{i}\right)_{in} = \frac{156}{0.3a} \leq 140 \rightarrow a \geq 3.71 cm$

$\left(\frac{L}{i}\right)_{out} = \frac{156*1.5}{0.45a} \leq 140 \rightarrow a \geq 3.71 cm$



$F_1 = \pm\frac{R}{2\cos\theta} = \frac{46.9}{2\cos\theta} = \pm 29.16t$

$A_{req} = \frac{29.16}{2*0.95*0.8*0.85} = 22.6 cm^2$.

construction condition: a-t ≥ 3.6 cm

⟹ try 2∠ 100x100x10 → A = 19.2 cm²

$\left(\frac{L}{i}\right)_{in} = \frac{156}{0.3x10} = 52 < 100$ $\left(\frac{L}{i}\right)_{out} = 52$

$f_{all} = 1.4 - 0.000065(52)^2 = 1.22 t/cm^2$

$f_{act} = \frac{29.16}{2x19.2} = 0.76 t/cm^2 < 1.22x0.85*0.8$ (0.83 t/cm²) ∴safe

* check tension

$f_{act} = \frac{29.16}{2[19.2 - (1.6+0.2)*1]} = 0.84 t/cm^2 < 1.4*0.8x0.85$ (0.95 t/cm²)

∴safe.

cont. Braking Bracing :

* member ② :

$$F_3 = \pm \frac{46.9 - 23.45}{2\cos\alpha} = \pm 14.44t$$

$$F_3\cos\alpha + 23.45 - F_1\cos\theta + F_2 = 0 \rightarrow F_2 = \pm 11.73\,t.$$

$$\left(\frac{L}{i}\right)_{in} = \frac{250}{0.39} \leq 140 \rightarrow a \geq 5.95c \qquad \left(\frac{L}{i}\right)_{out} = \frac{250}{0.45a} \leq 140 \rightarrow a \geq 3.97c$$

$$A_{req} = \frac{11.73}{2*0.8*0.8*0.85} = 10.8cm^2 \Rightarrow \text{choose } 2*80*10 \text{ BTB}.$$

$$\left(\frac{L}{i}\right)_{in} = \frac{250}{0.3*8} = 104.2 < 140 \text{ & } > 100$$

$$f_{all} = \frac{F_{500}}{(104.2)^2} = 0.69\,t/c^2$$

$$f_{act} = \frac{11.73}{2\times15.1} = 0.39\,t/c^2 < 0.69\times0.8*0.85 \quad (0.47\,t/c^2)$$

∴ safe

* check Tasoi :

$$f_{act} = \frac{11.73}{2[15.1-(1.6+0.2)\times1]} = 0.44\,t/c^2 < 1.4\times0.8\times0.85$$

∴ safe.