

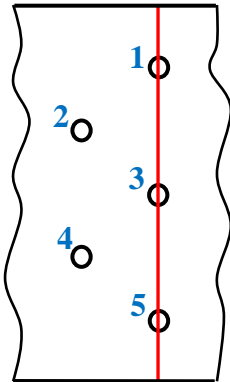
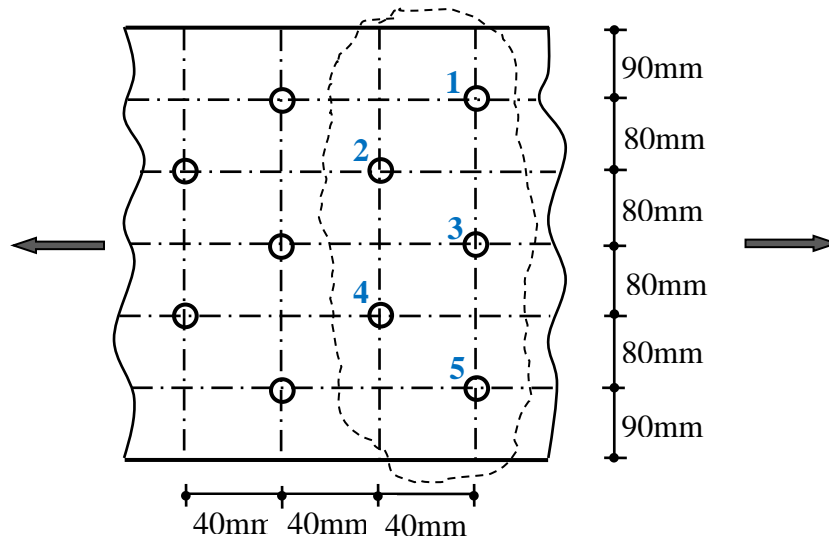
CALCUL DES PIÈCES SOUMISES À LA TRACTION SIMPLE

CORRECTION DE L'EXERCICE N°1

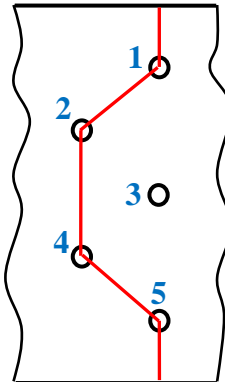
$$N_{t.Rd} = \min \left\{ \begin{array}{l} \frac{A f_y}{\gamma_{M0}} \\ 0,9 \frac{A_{net} f_u}{\gamma_{M2}} \end{array} \right\} \quad \gamma_{M0} = 1,10 ; \quad \gamma_{M2} = 1,25 ; \quad f_y = 235 \text{ N/mm}^2 ; \quad f_u = 360 \text{ N/mm}^2$$

Calcul de A : $A = 500 \times 10 = 5000 \text{ mm}^2$

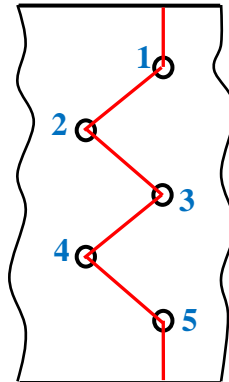
Calcul de A_{net} : $A_{net} = \min \{A_1 ; A_2 ; A_3\}$



$$A_1 = \Sigma(1,3,5)$$



$$A_2 = \Sigma(1,2,4,5) \text{ ou } \Sigma(1,2,3,5) \text{ ou } \Sigma(1,3,4,5)$$



$$A_3 = \Sigma(1,2,3,4,5)$$

$$A_1 = 5000 - (3 \times 24 \times 10) = 4280 \text{ mm}^2$$

$$A_2 = 5000 - (4 \times 24 \times 10) + \{2(40^2 \times 10) / (4 \times 80)\} = 4140 \text{ mm}^2$$

$$A_3 = 5000 - (5 \times 24 \times 10) + \{4(40^2 \times 10) / (4 \times 80)\} = 4000 \text{ mm}^2$$

$$A_{net} = \min \{4280 ; 4140 ; 4000\} = A_3 = 4000 \text{ mm}^2$$

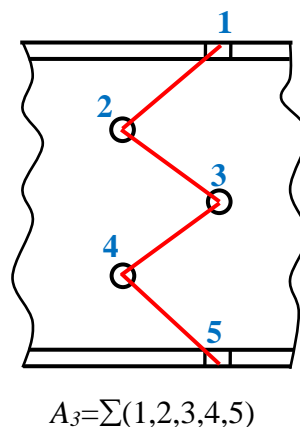
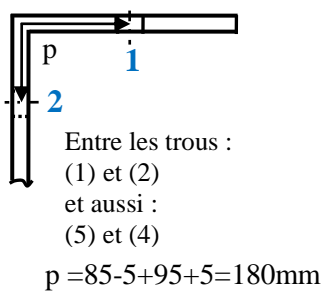
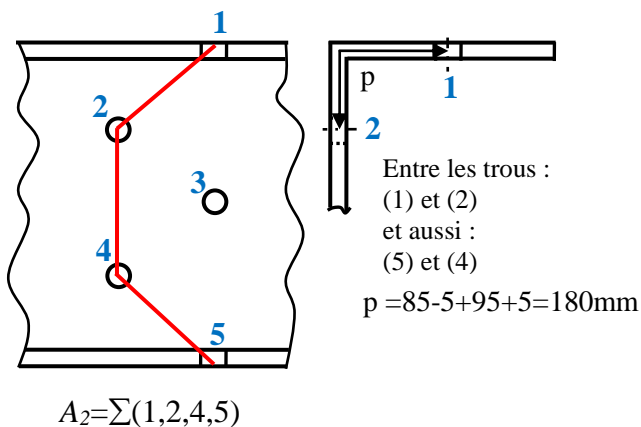
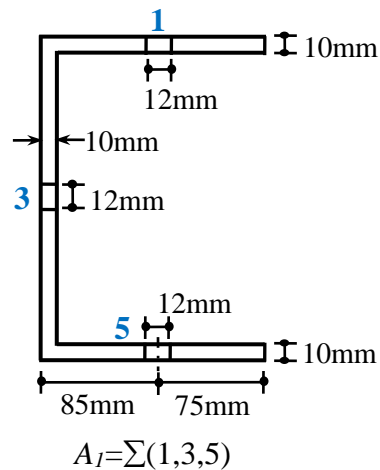
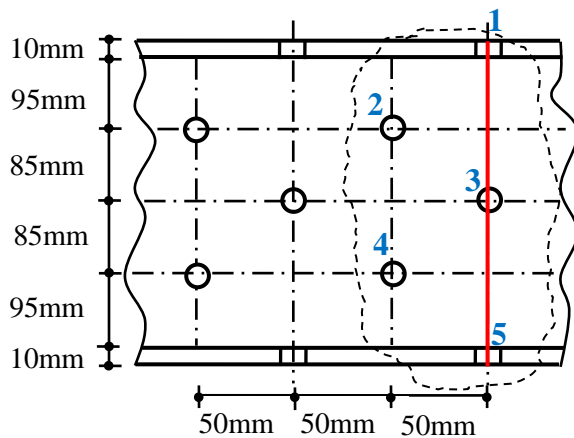
$$N_{t.Rd} = \min \left\{ \begin{array}{l} \frac{A f_y}{\gamma_{M0}} = \frac{5000 \times 0,235}{1,10} = 1068,18 \text{ kN} \\ \frac{0,9 A_{net} f_u}{\gamma_{M2}} = \frac{0,9 \times 4000 \times 0,36}{1,25} = 1036,8 \text{ kN} \end{array} \right\} = \underline{\underline{1036,8 \text{ kN}}}$$

CORRECTION DE L'EXERCICE N 2

$$N_{t.Rd} = \min \left\{ \begin{array}{l} \frac{A f_y}{\gamma_{M0}} \\ \frac{0,9 A_{net} f_u}{\gamma_{M2}} \end{array} \right\} \quad \gamma_{M0} = 1,10 ; \quad \gamma_{M2} = 1,25 ; \quad f_y = 235 \text{ N/mm}^2 ; \quad f_u = 360 \text{ N/mm}^2$$

Calcul de A : $A = 360 \times 10 + 2 \times 160 \times 10 = 6800 \text{ mm}^2$

Calcul de A_{net} : $A_{net} = \min \{A_1 ; A_2 ; A_3\}$



$$A_1 = 6800 - (3 \times 12 \times 10) = 6440 \text{ mm}^2$$

$$A_2 = 6800 - (4 \times 12 \times 10) + 2 \{ (50^2 \times 10) / (4 \times 180) \} = 6389,4 \text{ mm}^2$$

$$A_3 = 6800 - (5 \times 12 \times 10) + 2 \{ [(50^2 \times 10) / (4 \times 180)] + [(50^2 \times 10) / (4 \times 85)] \} = 6416,5 \text{ mm}^2$$

$$A_{net} = \min \{6440 ; 6389,4 ; 6416,5\} = A_2 = 6389,4 \text{ mm}^2$$

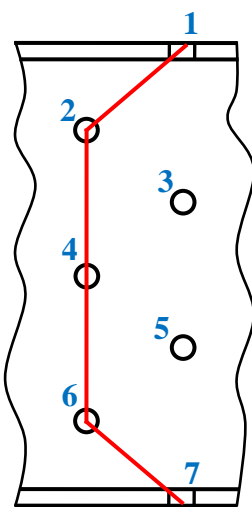
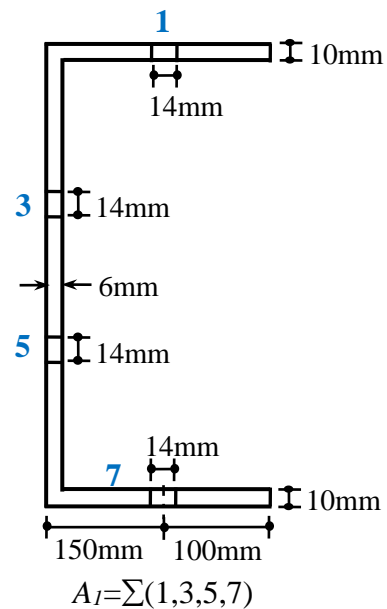
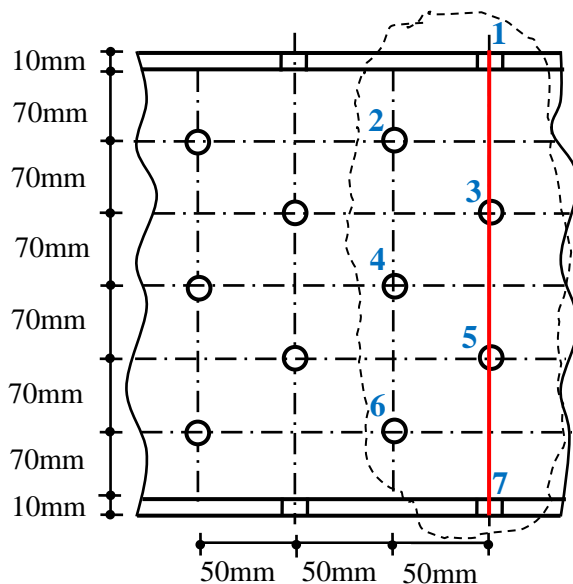
$$N_{t.Rd} = \min \left\{ \begin{array}{l} \frac{A f_y}{\gamma_{M0}} = \frac{6800 \times 0,235}{1,10} = 1452,7 \text{ kN} \\ \frac{0,9 A_{net} f_u}{\gamma_{M2}} = \frac{0,9 \times 6389,4 \times 0,36}{1,25} = 1656,13 \text{ kN} \end{array} \right\} = \underline{\underline{1452,7 \text{ kN}}}$$

CORRECTION DE L'EXERCICE N°3

$$N_{t.Rd} = \min \left\{ \begin{array}{l} \frac{A f_y}{\gamma_{M0}} \\ \frac{0,9 A_{net} f_u}{\gamma_{M2}} \end{array} \right\} \quad \gamma_{M0} = 1,10 ; \quad \gamma_{M2} = 1,25 ; \quad f_y = 235 \text{ N/mm}^2 ; \quad f_u = 360 \text{ N/mm}^2$$

Calcul de A : $A = 420 \times 6 + 2 \times 250 \times 10 = 7520 \text{ mm}^2$

Calcul de A_{net} : $A_{net} = \min \{A_1 ; A_2 ; A_3 ; A_4\}$

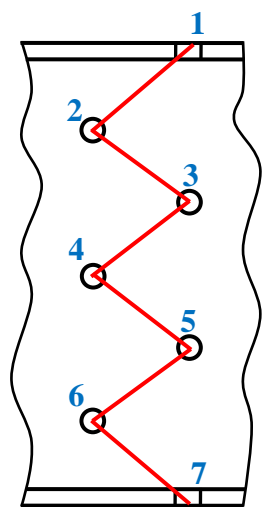
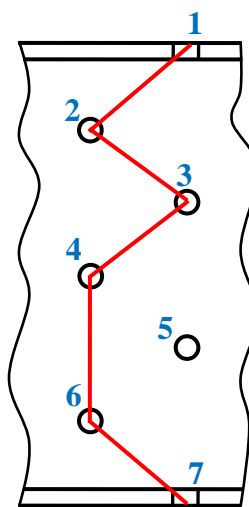


Entre les trous :
(1) et (2)
et aussi :
(5) et (4)

$p_1 = 150 - 3 = 147 \text{ mm}$
 $p_2 = 70 + 5 = 75 \text{ mm}$
 $p = 147 + 75 = 222 \text{ mm}$

$s_1 = \frac{s}{p} \times p_1 = \frac{50}{222} \times 147 = 33 \text{ mm}$
 $s_2 = \frac{s}{p} \times p_2 = \frac{50}{222} \times 75 = 17 \text{ mm}$

$\frac{s^2 \times t}{4 \times p} = \frac{s_1^2 \times t_1}{4 \times p_1} + \frac{s_2^2 \times t_2}{4 \times p_2}$



$$A_1 = 7520 - 14 \times (2 \times 10 + 2 \times 6) = 7072 \text{ mm}^2$$

$$A_2 = 7520 - 14 \times (2 \times 10 + 3 \times 6) + 2 \times \left\{ \frac{33^2 \times 10}{4 \times 147} + \frac{17^2 \times 6}{4 \times 75} \right\} = 7036,6 \text{ mm}^2$$

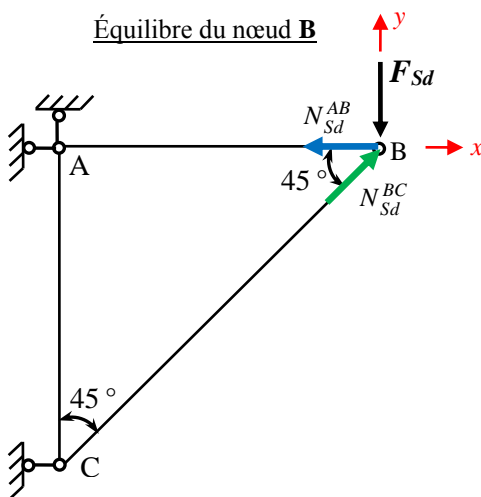
$$A_3 = 7520 - 14 \times (2 \times 10 + 4 \times 6) + 2 \times \left\{ \frac{33^2 \times 10}{4 \times 147} + \frac{17^2 \times 6}{4 \times 75} + \frac{50^2 \times 6}{4 \times 70} \right\} = 7059,7 \text{ mm}^2$$

$$A_4 = 7520 - 14 \times (2 \times 10 + 4 \times 6) + 2 \times \left\{ \frac{33^2 \times 10}{4 \times 147} + \frac{17^2 \times 6}{4 \times 75} \right\} + 4 \times \left\{ \frac{50^2 \times 6}{4 \times 70} \right\} = 7082,9 \text{ mm}^2$$

$$A_{net} = \min \{7072 ; 7036,6 ; 7059,7 ; 7082,9\} = A_2 = 7036,6 \text{ mm}^2$$

$$N_{t.Rd} = \min \left\{ \begin{array}{l} \frac{A f_y}{\gamma_{M0}} = \frac{7520 \times 0,235}{1,10} = 1606,5 \text{ kN} \\ \frac{0,9 A_{net} f_u}{\gamma_{M2}} = \frac{0,9 \times 7036,6 \times 0,36}{1,25} = 1823,9 \text{ kN} \end{array} \right\} = \underline{\underline{1606,5 \text{ kN}}}$$

CORRECTION DE L'EXERCICE N°4



$$F_{Sd} = 1,35 \times F_G + 1,5 \times F_{wl} = 1,35 \times 20 + 1,5 \times 20 = 57 \text{ kN}$$

$$\sum F/y = 0 \Rightarrow \frac{N_{Sd}^{BC}}{\sqrt{2}} - F_{Sd} = 0 \Rightarrow N_{Sd}^{BC} = \sqrt{2} \times F_{Sd}$$

$$\sum F/x = 0 \Rightarrow \frac{N_{Sd}^{BC}}{\sqrt{2}} - N_{Sd}^{AB} = 0 \Rightarrow N_{Sd}^{AB} = \frac{N_{Sd}^{BC}}{\sqrt{2}} = F_{Sd} = 57 \text{ kN}$$

On vérifie que :

$$N_{Sd}^{AB} = N_{tSd} \stackrel{?}{\leq} N_{tRd} = N_{uRd} = \frac{\beta_2 \times A_{net} \times f_u}{\gamma_{M2}}$$

Boulons : $d = 16 \text{ mm} \Rightarrow d_0 = 16 + 2 = 18 \text{ mm}$

$$p_1 = 40 \text{ mm} < 2,5 \times d_0 = 2,5 \times 18 = 45 \text{ mm} \Rightarrow \beta_2 = 0,4$$

$$A_{net} \rightarrow \text{ } \text{ } 60 \times 60 \times 6 \rightarrow A = 6,91 \text{ cm}^2 = 691 \text{ mm}^2$$

$$A_{net} = A - t \times d_0 = 691 - 6 \times 18 = 583 \text{ mm}^2$$

Vérification :

$$N_{tRd} = N_{uRd} = \frac{0,4 \times 583 \times 0,36}{1,25} = 67,16 \text{ kN} > N_{tSd} = 57 \text{ kN}$$

La barre «AB »est donc vérifiée à la traction.