

ETC 3

TE

8.06.20

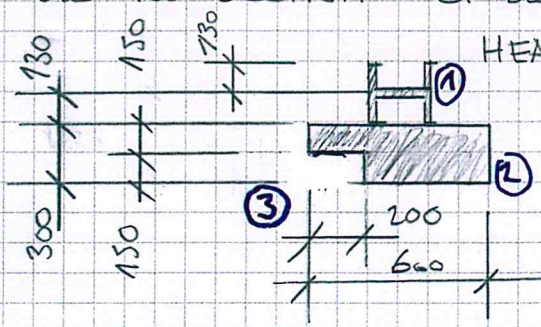
8H¹⁵ - 9H⁵⁰

Nom : _____

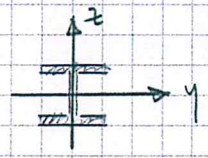
Cours de RDM

Note

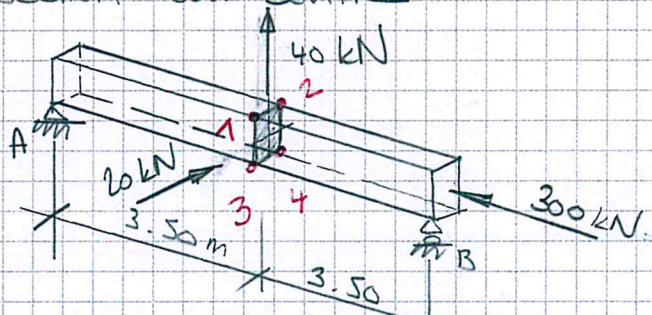
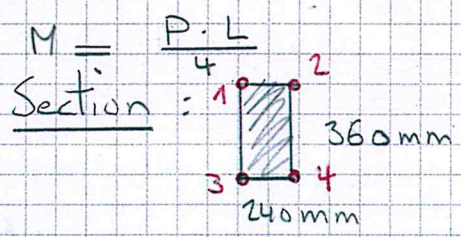
1 - Déterminez les caractéristiques I_y, W_y, i_y de la section ci-dessous (calcul selon axe $y-y$!)



- HEA 260
- $A = 8680 \text{ mm}^2$
- $I_y = 104,5 \text{ E}6 \text{ mm}^4$
- $I_z = 36,7 \text{ E}6 \text{ mm}^4$
- $i_y = 110 \text{ mm}$
- $i_z = 65 \text{ mm}$

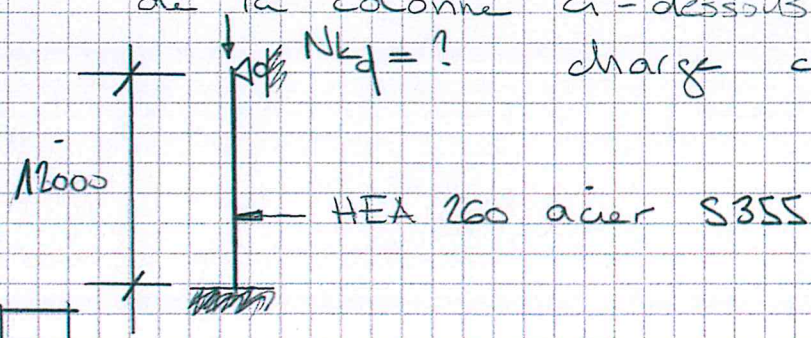


2a - Déterminez les contraintes aux 4 coins de la poutre ci-dessous dans la section au centre



2b - Quel sera le raccourcissement de la poutre sous l'effet de N ($E_{bois} = 11000 \text{ N/mm}^2$)

3 - Calculez la charge minimale de flambage de la colonne ci-dessous et comparez-la avec la charge critique d'Euler.



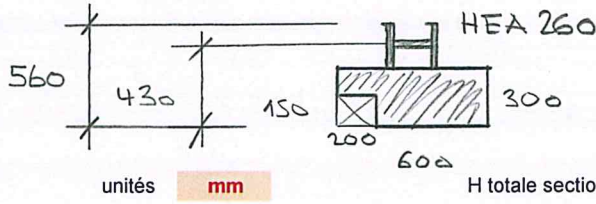
15pts

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CARACTERISTIQUES DES SECTIONS SELON Y



| Demi cercle | |
|-------------|----------------|
| r | ly (0.11*r^4) |
| 0.0 | 0.0 |
| A | z cg (0.424*r) |
| 0.00 | 0.00 |
| | 0.00 |

unités **mm** H totale section = **560**

| n° | base ou D | hauteur | A | Z ref | Sy réf | I propre | Zref - Zcg | (Zref - Zcg)^2 | A*(Zref - Zcg)^2 | Inertie totale |
|--------------|-----------|---------------|-------------------|--------|----------------------|-------------------|------------|----------------|-------------------|-------------------|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 2 | 600.00 | 300.00 | 180'000.00 | 150.00 | 27'000'000.00 | 1.3500E+09 | -29.50 | 870.00 | 1.5660E+08 | 1.5066E+09 |
| 3 TROU | 200.00 | 150.00 | -30'000.00 | 75.00 | -2'250'000.00 | -5.6250E+07 | -104.50 | 10'919.38 | -3.2758E+08 | -3.8383E+08 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 5 TRI | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 6 ROND | 0.00 | ROND | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 7 ACIER | HEA | PROFILE | 8'680.00 | 430.00 | 3'732'400.00 | -3.6700E+07 | 250.50 | 62'752.33 | 5.4469E+08 | 5.8139E+08 |
| Total | | 450.00 | 158'680.00 | | 28'482'400.00 | 1.3305E+09 | | | 3.7371E+08 | 1.7042E+09 |

$$Z_{cg} = \frac{28'482'400.00}{158'680.00} = 179.496$$

$$i_y = \sqrt{\frac{1'704'159'667.25}{158'680.00}} = 103.63$$

$$W_{y\ sup} = \frac{1'704'159'667.3}{380.504} = 4.479E+06$$

$$W_{y\ inf} = \frac{1'704'159'667.25}{179.496} = 9.494E+06$$

CARACTERISTIQUES DES SECTIONS SELON Z

unités **mm** H totale section =

| n° | base ou D | hauteur | A | Y ref | Sz réf | I propre | Yref - Ycg | (Yref - Ycg)^2 | A*(Yref - Ycg)^2 | Inertie totale |
|--------------|-----------|-------------|-------------|-------|-------------|-------------------|------------|----------------|-------------------|-------------------|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 3 TROU | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 5 TRI | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 6 ROND | 0.00 | ROND | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| 7 ACIER | HEA 200 | PROFILE | 0.00 | 0.00 | 0.00 | 0.0000E+00 | -179.50 | 32'218.76 | 0.0000E+00 | 0.0000E+00 |
| Total | | 0.00 | 0.00 | | 0.00 | 0.0000E+00 | | | 0.0000E+00 | 0.0000E+00 |

$$Y_{cg} = \frac{0.00}{0.00} = \#DIV/0!$$

$$i_z = \sqrt{\frac{0.00}{0.00}} = \#DIV/0!$$

$$W_{z\ gauche} = \frac{0.0}{\#DIV/0!} = \#DIV/0!$$

$$W_{z\ droit} = \frac{0.00}{\#DIV/0!} = \#DIV/0!$$

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2a -

$$N = -300 \text{ kN}$$

$$M_y = -\frac{40 \cdot 7}{4} = -70 \text{ kNm}$$

$$M_z = \frac{20 \cdot 7}{4} = 35 \text{ kNm}$$



$$W_y = \frac{240 \cdot 360^2}{6} = 5.184 \text{ E6 mm}^3 \checkmark$$

$$W_z = \frac{360 \cdot 240^2}{6} = 3.456 \text{ E6 mm}^3 \checkmark$$

$$A = 240 \cdot 360 = 86400 \text{ mm}^2 \checkmark$$

| | $\frac{N}{A}$ | $\frac{M_y}{W_y}$ | $\frac{M_z}{W_z}$ | Σ |
|---|--------------------------------|--|--|----------|
| 1 | -3.47 | +13.50 | -10.13 | -0,10 |
| 2 | -3.47 | +13.50 | +10.13 | +20,16 |
| 3 | -3.47 | -13.50 | -10.13 | -27,10 |
| 4 | -3.47 | -13.50 | +10.13 | -6,84 |
| - | $\frac{300 \text{ E3}}{86400}$ | $\pm \frac{70 \text{ E6}}{5.184 \text{ E6}}$ | $\pm \frac{35 \text{ E6}}{3.456 \text{ E6}}$ | |

} N/mm²

$$2b \quad \Delta L = \frac{N \cdot L}{E \cdot A} = \frac{300 \text{ E3} \cdot 7000}{11000 \cdot 86400} = 2.21 \text{ mm}$$

$$3 - \quad L_k = 0,7 L = 12000 \cdot 0,7 = 8400 \text{ mm}$$

$$\lambda_{ky} = \frac{8400}{110} = 76.4 \rightarrow 77$$

$$f_{kyd} = 181 \text{ N/mm}^2$$

$$N_{kyd} = \frac{181 \cdot 8680}{\text{E3}} = 1571 \text{ kN} \quad (N_{cr,y} = 3066 \text{ kN} / 195\%)$$

$$\lambda_{kz} = \frac{8400}{65} = 129.2 \rightarrow 130$$

$$f_{kzd} = 187,0 \text{ N/mm}^2$$

$$N_{kzd} = \frac{187,0 \cdot 8680}{\text{E3}} = 1755 \text{ kN} = \text{charge min.}$$

Charge critique Euler selon z-z

$$\frac{\pi^2 E \cdot 36,7 \text{ E6}}{8400^2}$$

$$= 1077 \text{ kN}$$

$$142 \%$$