TALAT Lecture 2301

Design of Members

Axial Force

Example 5.2 : Axial force resistance of symmetric hollow extrusion

4 pages

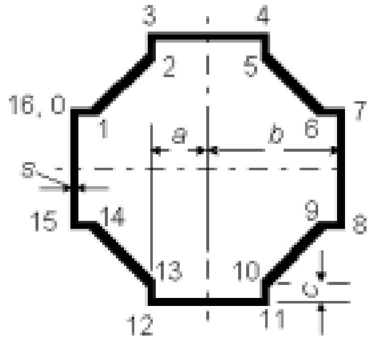
Advanced Level

prepared by Torsten Höglund, Royal Institute of Technology, Stockholm

Date of Issue: 1999

Example 5.2 Axial force resistance of symmetric hollow extrusion

Half width	$b := 50 \cdot mm$	$f_o := 300 \cdot MPa$
Indent	$c := 10 \cdot mm$	$E := 70000 \cdot MPa$
Half width of flat parts	$a := 18 \cdot mm$	$\gamma_{M1} := 1.0$
Thickness	$s := 1.2 \cdot mm$	
Length	$L := 1200 \cdot mm$	

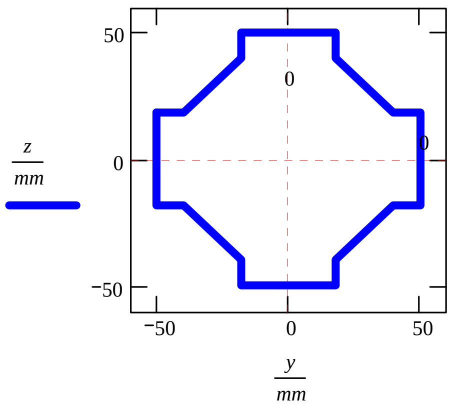


$MPa \equiv 10^6 \cdot Pa$

$kN \equiv 1000 \cdot newton$

Nodes no., co-ordinates, thickness

$$i := \begin{bmatrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \\ 10 \\ 11 \\ 12 \\ 13 \\ 14 \\ 15 \\ 16 \end{bmatrix} \quad y := \begin{bmatrix} -b \\ -b+c \\ -a \\ -a \\ a \\ a \\ b-c \\ b \\ b \\ b-c \\ a \\ a \\ -a \\ -a \\ -b+c \\ -b \\ -b \end{bmatrix} \quad z := \begin{bmatrix} a \\ a \\ b-c \\ b \\ b \\ b-c \\ a \\ a \\ -a \\ -a \\ -b+c \\ -b \\ -b \\ -b+c \\ -a \\ -a \\ a \end{bmatrix} \quad t := \begin{bmatrix} s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \\ s \end{bmatrix}$$



Nodes $i := 1 .. rows(y) - 1$

5.4.5 **Local buckling**

$$\varepsilon := \sqrt{\frac{250 \cdot MPa}{f_o}}$$

5.4.3 (1) c) $$\beta_i := if\left[t_i > 0, \frac{\sqrt{\left(y_i - y_{i-1}\right)^2 + \left(z_i - z_{i-1}\right)^2}}{t_i}, 1\right]$$

5.4.5 (3) c) heat-treated, unwelded $$\rho_{c_i} := if\left[\frac{\beta_i}{\varepsilon} > 22, 32 \cdot \frac{\varepsilon}{\beta_i} - 220 \cdot \left(\frac{\varepsilon}{\beta_i}\right)^2, 1.0\right]$$

Effective thickness $\quad t_{eff} := \overrightarrow{(\rho \cdot t)}$

Effective area of elements $\quad dA_i := \overrightarrow{\left[t_{eff_i} \cdot \sqrt{(y_i - y_{i-1})^2 + (z_i - z_{i-1})^2}\right]}$

$i =$	$\beta_i =$	$\frac{\beta_i}{\varepsilon} =$	$\rho_i =$	$\frac{t_{eff_i}}{mm} =$
1	8.333	9.129	1	1.2
2	25.927	28.402	0.854	1.025
3	8.333	9.129	1	1.2
4	30	32.863	0.77	0.924
5	8.333	9.129	1	1.2
6	25.927	28.402	0.854	1.025
7	8.333	9.129	1	1.2
8	30	32.863	0.77	0.924
9	8.333	9.129	1	1.2
10	25.927	28.402	0.854	1.025
11	8.333	9.129	1	1.2
12	30	32.863	0.77	0.924
13	8.333	9.129	1	1.2
14	25.927	28.402	0.854	1.025
15	8.333	9.129	1	1.2
16	30	32.863	0.77	0.924

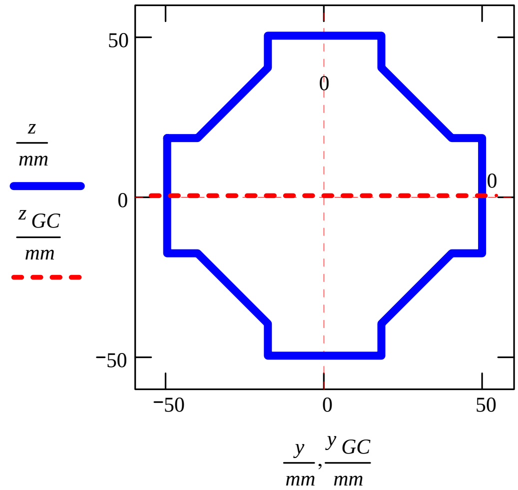
Area of effective cross section $\quad A_{eff} := \sum_{i=1}^{rows(y)-1} dA_i \qquad A_{eff} = 356.591 \cdot mm^2$

First moment of area. Gravity centre $\quad S_y := \sum_{i=1}^{rows(y)-1} (z_i + z_{i-1}) \cdot \frac{dA_i}{2} \qquad z_{gc} := \frac{S_y}{A_{eff}}$

$z_{gc} = 0 \cdot m$

Axial force resistance, no flexural buckling

$N_{Rd} := A_{eff} \cdot \frac{f_o}{\gamma_{M1}} \qquad N_{Rd} = 107 \cdot kN$



5.8.4 Flexural buckling

Second moment of area of effective cross section $\quad I := \sum_{i=1}^{rows(y)-1} \left[(z_i)^2 + (z_{i-1})^2 + z_i \cdot z_{i-1}\right] \cdot \frac{t_i \cdot \sqrt{(y_i - y_{i-1})^2 + (z_i - z_{i-1})^2}}{3}$

$I = 4.701 \cdot 10^5 \cdot mm^4$

Radius of gyration $\quad r := \sqrt{\frac{I}{A_{eff}}}$

Table 5.7 $\quad K := 1 \qquad l := K \cdot L \qquad l = 1.2 \cdot 10^3 \cdot mm$

Table 5.5 and 5.6 $\quad \alpha := 0.2 \qquad \lambda_o := 0.1 \qquad k_1 := 1 \qquad k_2 := 1$

See to the right $\quad \lambda := \frac{l}{r} \cdot \frac{1}{\pi} \cdot \sqrt{\frac{f_o}{E}} \qquad \lambda = 0.689$

(5.33) $\phi := 0.5 \cdot \left[1 + \alpha \cdot (\lambda - \lambda_o) + \lambda^2 \right]$ $\chi := \dfrac{1}{\phi + \sqrt{\phi^2 - \lambda^2}}$ $\phi = 0.796$ $\chi = 0.837$

5.8.3 (1) $N_{b.Rd} := \chi \cdot k_1 \cdot k_2 \cdot \dfrac{f_o}{\gamma_{M1}} \cdot A_{eff}$ $N_{b.Rd} = 89.5 \cdot kN$