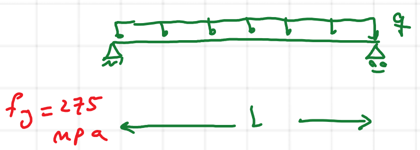
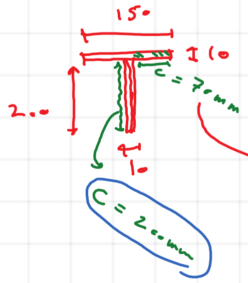
In the previous video, we learned how to use the tables provided in Eurocode 1993-1-1 to choose appropriate tables based on loading and other conditions. This video will teach the classification of asymmetric sections subjected to partial bending or partial compression with helpful examples.





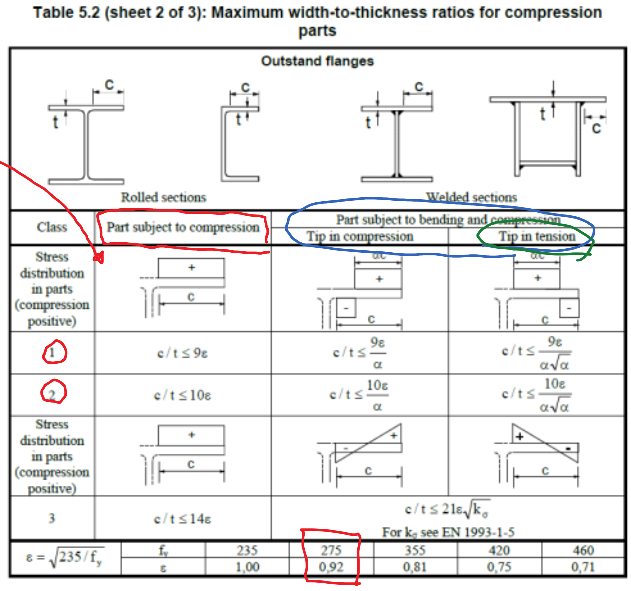
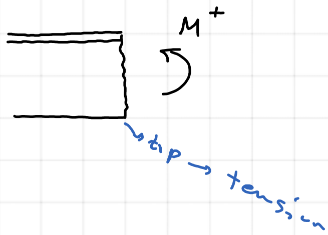
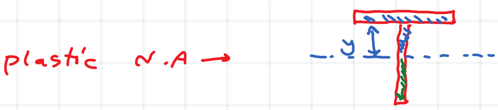


Table 5.2 (sheet 2 of 3): Maximum width-to-thickness ratios for compression parts

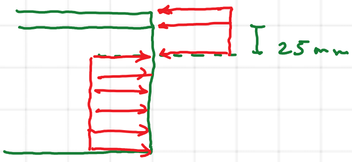
Outstanding flanges			
	Rolled sections	Welded sections	
Class	Part subject to compression	Part subject to bending and compression: Tip in compression	Part subject to bending and compression: Tip in tension
Stress distribution in parts (compression positive)			
1	$c/t \le 9\varepsilon$	$c/t \le \frac{9\varepsilon}{\alpha}$	$c/t \le \frac{9\varepsilon}{\alpha\sqrt{\alpha}}$
2	$c/t \le 10\varepsilon$	$c/t \le \frac{10\varepsilon}{\alpha}$	$c/t \le \frac{10\varepsilon}{\alpha\sqrt{\alpha}}$
Stress distribution in parts (compression positive)			
3	$c/t \le 14\varepsilon$	$c/t \le 21\varepsilon\sqrt{k_\sigma}$ For k_σ see EN 1993-1-5	

$\varepsilon = \sqrt{235/f_y}$						
	f_y	235	275	355	420	460
	ε	1,00	0,92	0,81	0,75	0,71





$\Sigma A_{top} = \Sigma A_{Bot} \rightarrow 150 \times 10 + y \times 10 = (200 - y) \times 10 \rightarrow y = 25\,mm$



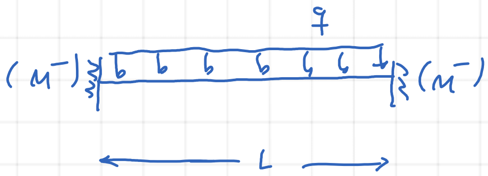
$\alpha = \frac{25}{200} = 0.125$

$f_y = 275\,MPa \rightarrow \varepsilon = 0.92$

Limits
$$\begin{cases} ① \ \frac{9\varepsilon}{\alpha\sqrt{\alpha}} = 187 \\ ② \ \frac{10\varepsilon}{\alpha\sqrt{\alpha}} = 208 \end{cases}$$

$\frac{c}{t} = \frac{200}{10} = 20 \le 187$ web class 1

flange $\frac{c}{t} = \frac{70}{10} = 7 \le \begin{cases} 9\varepsilon = 8.3 \ ✓ \\ 10\varepsilon = 9.2 \end{cases}$ flange class 1



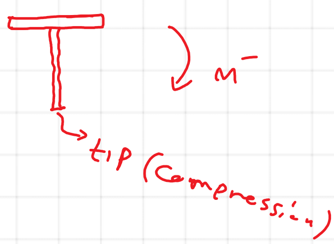
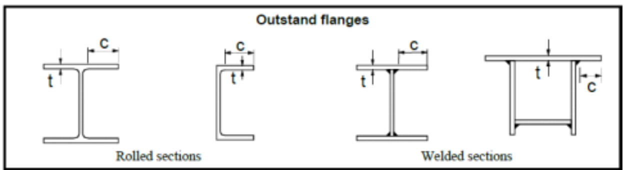
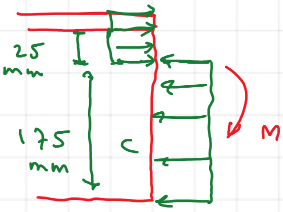


Table 5.2 (sheet 2 of 3): Maximum width-to-thickness ratios for compression parts



Class	Part subject to compression	Part subject to bending and compression: Tip in compression	Part subject to bending and compression: Tip in tension
Stress distribution in parts (compression positive)	+ c	αc + c −	αc + c −
1	$c/t \le 9\varepsilon$	$c/t \le \frac{9\varepsilon}{\alpha}$	$c/t \le \frac{9\varepsilon}{\alpha\sqrt{\alpha}}$
2	$c/t \le 10\varepsilon$	$c/t \le \frac{10\varepsilon}{\alpha}$	$c/t \le \frac{10\varepsilon}{\alpha\sqrt{\alpha}}$
Stress distribution in parts (compression positive)	+ c	− + c	+ − c
3	$c/t \le 14\varepsilon$	$c/t \le 21\varepsilon\sqrt{k_\sigma}$ For k_σ see EN 1993-1-5	

$\varepsilon = \sqrt{235/f_y}$						
	f_y	235	275	355	420	460
	ε	1,00	0,92	0,81	0,75	0,71



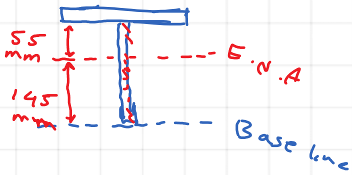
$\alpha = \frac{175}{200} = 0.875$

$\varepsilon = 0.92$

limits
① $9\varepsilon/\alpha = 9.46$
② $10\varepsilon/\alpha = 10.5$

$\frac{c}{t} = \frac{200}{10} = 20 \not< \begin{cases} 9.46 \\ 10.5 \end{cases}$ Not → Class 1 or Class 2

Elastic N.A → $\bar{y} = \frac{\sum A_i \bar{y}_i}{\sum A} = \frac{200 \times 10 \times 100 + 150 \times 10 \times 2.5}{200 \times 10 + 150 \times 10}$ (mm^3) / (mm^2)



$\bar{y} = 145mm$

$\sigma = \frac{M.y}{I}$

$\frac{\sigma_2}{\sigma_1} = \frac{y_2}{y_1} = \frac{55mm}{-145mm} \rightarrow \frac{\sigma_2}{\sigma_1} = -0.38 = \psi$

$k_\sigma = 0.57 - 0.21\psi + 0.07\psi^2 = 0.66$

Table 4.2: Outstand compression elements

Stress distribution (compression positive)	Effective[p] width b_{eff}
* b_{eff}, σ_2, σ_1, c → tip	$1 > \psi \ge 0$: $b_{eff} = \rho c$
b_t, b_c, σ_1, σ_2, b_{eff}	$\psi < 0$: $b_{eff} = \rho b_c = \rho c / (1-\psi)$

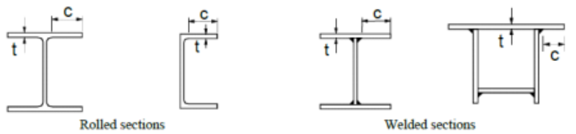
→ $\psi = \sigma_2/\sigma_1$	1	0	-1	$1 \ge \psi \ge -3$
Buckling factor k_σ	0,43	0,57	0,85	$0{,}57 - 0{,}21\psi + 0{,}07\psi^2$

Stress distribution (compression positive)	Effective[p] width b_{eff}
b_{eff}, σ_1, σ_2, c	$1 > \psi \ge 0$: $b_{eff} = \rho c$
b_{eff}, σ_1, σ_2, b_c, b_t	$\psi < 0$: $b_{eff} = \rho b_c = \rho c / (1-\psi)$

$\psi = \sigma_2/\sigma_1$	1	$1 > \psi > 0$	0	$0 > \psi > -1$	-1
Buckling factor k_σ	0,43	$0{,}578 / (\psi + 0{,}34)$	1,70	$1{,}7 - 5\psi + 17{,}1\psi^2$	23,8

Table 5.2 (sheet 2 of 3): Maximum width-to-thickness ratios for compression parts

Outstand flanges



Class	Part subject to compression	Part subject to bending and compression: Tip in compression	Part subject to bending and compression: Tip in tension
Stress distribution in parts (compression positive)	+ c	αc + - c	αc + - c
1	$c/t \le 9\varepsilon$	$c/t \le \frac{9\varepsilon}{\alpha}$	$c/t \le \frac{9\varepsilon}{\alpha\sqrt{\alpha}}$
2	$c/t \le 10\varepsilon$	$c/t \le \frac{10\varepsilon}{\alpha}$	$c/t \le \frac{10\varepsilon}{\alpha\sqrt{\alpha}}$
Stress distribution in parts (compression positive)	+ c	+ - c	+ - c
3	$c/t \le 14\varepsilon$	$c/t \le 21\varepsilon\sqrt{k_\sigma}$ For k_σ see EN 1993-1-5	

$\varepsilon = \sqrt{235/f_y}$	f_y	235	275	355	420	460
	ε	1,00	0,92	0,81	0,75	0,71

$$\frac{c}{t} = \frac{200}{10} = 20 \nless 21\varepsilon\sqrt{k_\sigma} = 15.7$$

$\varepsilon \rightarrow 0.92$, $k_\sigma \rightarrow 0.55$

Not class 3

→ cross-section class → **4**