In the previous video, we learned about cross-section classification. In this video, we will explore how to use the tables provided in Eurocode 1993-1-1 to choose appropriate tables based on loading and other conditions, with helpful examples.

5.5 Classification of cross sections

5.5.1 Basis

(1) The role of cross section classification is to identify the extent to which the resistance and rotation capacity of cross sections is limited by its local buckling resistance.

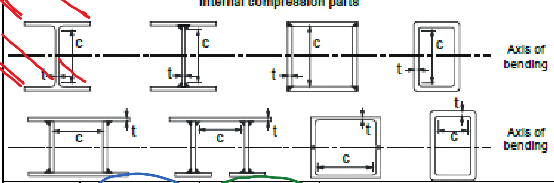
5.5.2 Classification

(1) Four classes of cross-sections are defined, as follows:

- Class 1 cross-sections are those which can form a plastic hinge with the rotation capacity required from plastic analysis without reduction of the resistance.
- Class 2 cross-sections are those which can develop their plastic moment resistance, but have limited rotation capacity because of local buckling.
- Class 3 cross-sections are those in which the stress in the extreme compression fibre of the steel member assuming an elastic distribution of stresses can reach the yield strength, but local buckling is liable to prevent development of the plastic moment resistance.
- Class 4 cross-sections are those in which local buckling will occur before the attainment of yield stress in one or more parts of the cross-section.

Table 5.2 (sheet 1 of 3): Maximum width-to-thickness ratios for compression parts

Internal compression parts



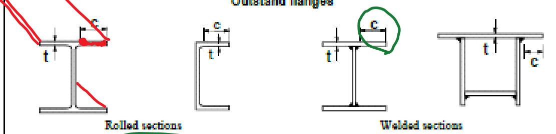
Class	Part subject to bending	Part subject to compression	Part subject to bending and compression
Stress distribution in parts (compression positive)			
1	$c/t \leq 72\varepsilon$	$c/t \leq 33\varepsilon$	when $\alpha > 0{,}5$: $c/t \leq \frac{396\varepsilon}{13\alpha - 1}$ when $\alpha \leq 0{,}5$: $c/t \leq \frac{36\varepsilon}{\alpha}$
2	$c/t \leq 83\varepsilon$	$c/t \leq 38\varepsilon$	when $\alpha > 0{,}5$: $c/t \leq \frac{456\varepsilon}{13\alpha - 1}$ when $\alpha \leq 0{,}5$: $c/t \leq \frac{41{,}5\varepsilon}{\alpha}$
Stress distribution in parts (compression positive)			
3	$c/t \leq 124\varepsilon$	$c/t \leq 42\varepsilon$	when $\psi > -1$: $c/t \leq \frac{42\varepsilon}{0{,}67 + 0{,}33\psi}$ when $\psi \leq -1$*): $c/t \leq 62\varepsilon(1-\psi)\sqrt{(-\psi)}$

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

*) $\psi \leq -1$ applies where either the compression stress $\sigma \leq f_y$ or the tensile strain $\varepsilon_y > f_y/E$

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

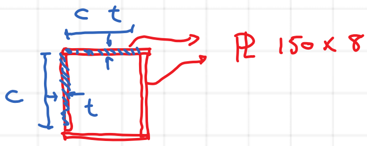
Outstand flanges



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)			
1	$c/t \leq 9\varepsilon$	$c/t \leq \frac{9\varepsilon}{\alpha}$	$c/t \leq \frac{9\varepsilon}{\alpha\sqrt{\alpha}}$
2	$c/t \leq 10\varepsilon$	$c/t \leq \frac{10\varepsilon}{\alpha}$	$c/t \leq \frac{10\varepsilon}{\alpha\sqrt{\alpha}}$
Stress distribution in parts (compression positive)			
3	$c/t \leq 14\varepsilon$	$c/t \leq 21\varepsilon\sqrt{k_\sigma}$ 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

$\varepsilon = \sqrt{\frac{235}{f_y}}$



$\begin{cases} c = 150\,mm \\ t = 8\,mm \end{cases}$

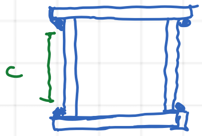
subjected to compression

$f_y = 235$

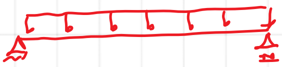
$\varepsilon = 1$

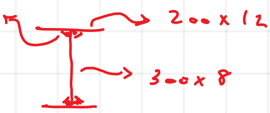
class 1 → limit: $33\varepsilon = 33$
class 2 → limit: $38\varepsilon = 38$
class 3 → limit: $42\varepsilon = 42$

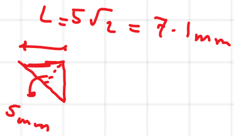
$\frac{c}{t} = \frac{150}{8} = 18.75 \leqslant 33 \rightarrow$ **class 1**

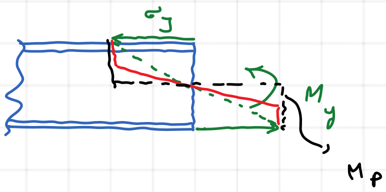


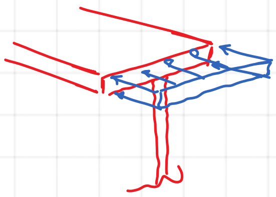
$a_w = 5\,mm$

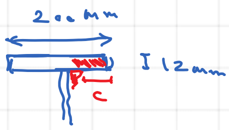












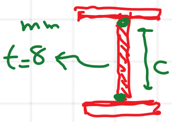
$\begin{cases} c = \frac{200\,mm - 8\,mm}{2} - 7.1\,mm = 88.9\,mm \\ t = 12\,mm \end{cases}$

Part subject to compression

limits $\begin{cases} Cl_1 . \ 9\varepsilon = 9 \\ Cl_2 , \ 10\varepsilon = 10 \\ Cl_3 . \ 14\varepsilon = 14 \end{cases}$

$f_y = 235 \rightarrow \varepsilon = 1$

$\frac{c}{t} = \frac{88.9}{12} = 7.4 \leqslant 9 \rightarrow$ **class 1**



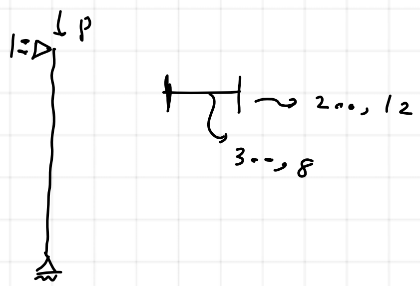
$c = 300 - 2 \times 7.1 \cong 286\,mm$

Pure bending moment

limits $\begin{cases} Cl_1 \cdot \ 72\varepsilon = 72 \\ Cl_2 . \ 83\varepsilon = 83 \\ Cl_3 : \ 124\varepsilon = 124 \end{cases}$

$\frac{c}{t} = \frac{286}{8} = 35.7 \leqslant 72 \rightarrow$ **web class 1**

cross-section class → **1**



flange → part subject to compression → **class 1**

web → $\frac{c}{t} = 35.7$ limits: { 33, 38, 42 }

$\frac{c}{t} \not\leq 33$ class 1 ✗

$\frac{c}{t} \leq 38$ class 2 → **web class 2**

→ **class 2**