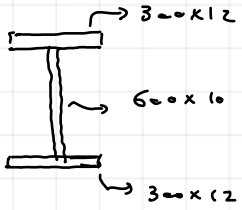
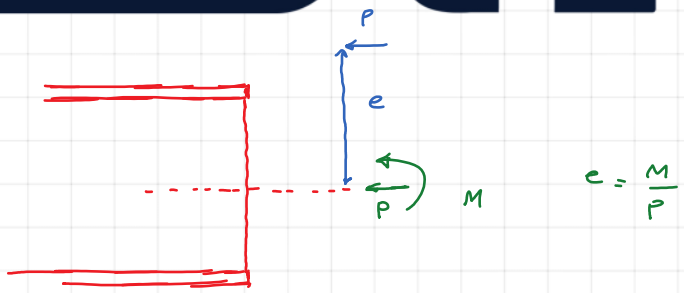
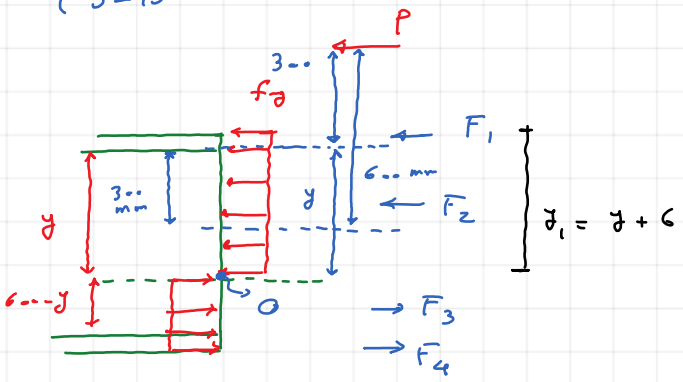
In the previous video, we learned how to classify asymmetric sections subjected to partial bending or partial compression according to Eurocode 1993-1-1. This video explains the classification of sections used as beams with axial compression and without pure bending.

(mm)




{ Assume S275 $e = 600$ mm




$F = \sigma A$

$F_1 = 300 \times 12 \times f_y$

$F_2 = y \times 10 \times f_y$

$F_3 = (600 - y) \times 10 \times f_y$

$F_4 = 300 \times 12 \times f_y$

$\Sigma F = P$

$F_1 + F_2 - F_3 - F_4 = P$

$(10y - (600 - y) \times 10) f_y = P$ (I)

$\Sigma M_O = P\,(300 + y)$

$y_1 = y + 6$, $y_2 = y/2$, $y_3 = \frac{600 - y}{2}$, $y_4 = \frac{600 - y}{2} + 6$

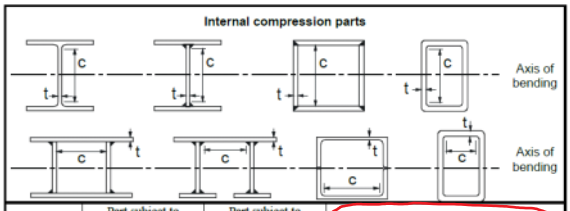
$F_1 y_1 + F_2 y_2 + F_3 y_3 + F_4 y_4 = P(300 + y)$

$$f_y\left[300 \times 12 \times (y + 6) + 10y\left(\tfrac{y}{2}\right) + (600 - y) \times 10 \times \frac{600 - y}{2} + 300 \times 12 \times \left(\frac{600 - y}{2} + 6\right)\right] = (10y - (600 - y) \times 10) f_y \cdot (300 + y)$$

$\rightarrow y = 508$ mm $\quad \alpha = \frac{508}{600} = 0.85$

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

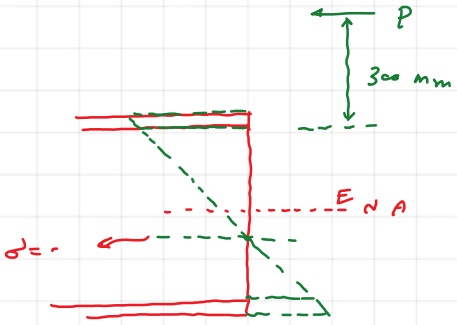
| $\varepsilon = \sqrt{235/f_y}$ | $f_y$ | 235 | 275 | 355 | 420 | 460 |
|---|---|---|---|---|---|---|
| | $\varepsilon$ | 1,00 | 0,92 | 0,81 | 0,75 | 0,71 |

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

limits: { cl1 $\rightarrow \frac{396\varepsilon}{13\alpha - 1} = 36.25$ ; cl2 $\rightarrow \frac{456\varepsilon}{13\alpha - 1} = 41.74$ } $\varepsilon = 0.92$

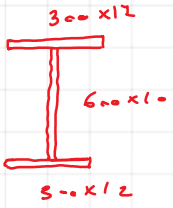
$\frac{c}{t} = \frac{600}{10} = 60 \not\le 36.25, 41.74$

part is not class 1 or 2




$$\sigma = \frac{P}{A} \pm \frac{My}{I}$$

$$0 = \frac{P}{A} \pm \frac{My}{I} \rightarrow y = \pm \frac{P \cdot I}{A \, M} = \pm \frac{I}{A \cdot M/P}$$



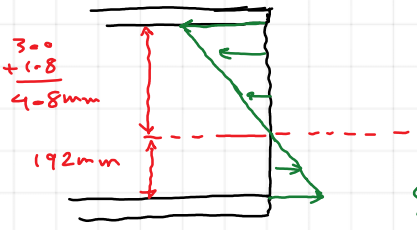

$$y_{\substack{N-A \\ (\sigma=0)}} = \pm \frac{I}{A\,e}$$

$$I = \frac{300 \times 624^3}{12} - \frac{290 \times 600^3}{12} = 8.54 \times 10^8 \ mm^4$$

$$A = 300 \times 12 \times 2 + 600 \times 10 = 13200 \ mm^2$$

$$e = 600 \ mm$$

$$y_{(\sigma=0)} = \pm \frac{8.54 \times 10^8 \ mm^4}{13200 \ mm^2 \times 600 \ mm} = \pm 108 \ mm$$

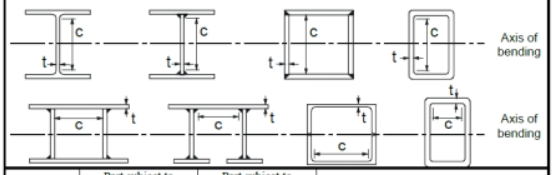


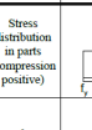
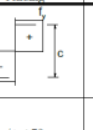

$$\psi = \frac{\sigma_t}{\sigma_c} = \frac{y_t}{y_c} = \frac{-192}{408}$$

$$\psi = -0.47$$

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 | $c/t \le 72\varepsilon$ | $c/t \le 33\varepsilon$ | when $\alpha > 0,5$: $c/t \le \frac{396\varepsilon}{13\alpha - 1}$<br>when $\alpha \le 0,5$: $c/t \le \frac{36\varepsilon}{\alpha}$ |
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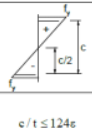
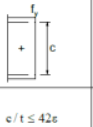
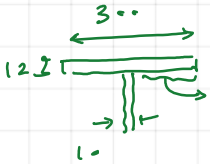
| Stress distribution in parts (compression positive) |  |  |  |
| 3 | $c/t \le 124\varepsilon$ | $c/t \le 42\varepsilon$ | when $\psi > -1$: $c/t \le \frac{42\varepsilon}{0,67 + 0,33\psi}$<br>when $\psi \le -1$*): $c/t \le 62\varepsilon(1-\psi)\sqrt{(-\psi)}$ |
| $\varepsilon = \sqrt{235/f_y}$ | $f_y$ | 235 | 275 | 355 | 420 | 460 |
| | $\varepsilon$ | 1,00 | 0,92 | 0,81 | 0,75 | 0,71 |

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

$$\psi > -1 \rightarrow \frac{c}{t} \le \frac{42\varepsilon}{0,67 + 0,33\psi} = 75$$

($\varepsilon \rightarrow 0.92$, $\psi \rightarrow -0.47$)

$$\frac{c}{t} = \frac{600}{10} = 60 \le 75$$ Class 3 web




$c = 145 \ mm$

$t = 12$

$$\frac{c}{t} = 12.1 \le \begin{cases} 9\varepsilon = \\ 10\varepsilon = 9.2 \\ 14\varepsilon = 12.88 \end{cases}$$

Class 3 flange

$\varepsilon = 0.92$

Cross_section → Class 3