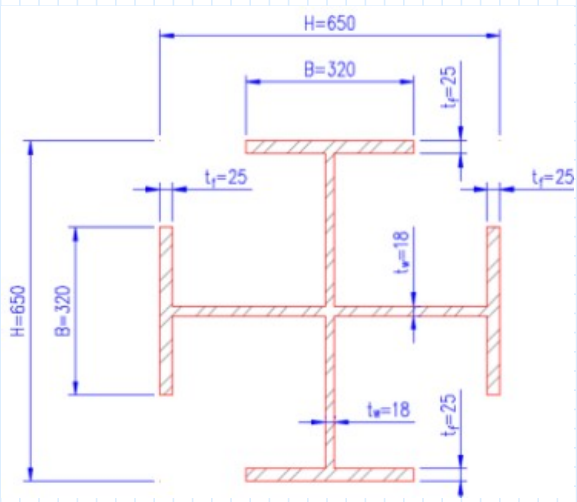
# Width-to-Thickness Ratios Check
# For Built-up Section H650x320

## 1. Section Properities:




$F_y := 355 \cdot MPa$ *(Yield strength of column)*

$F_u := 470 \cdot MPa$ *(Ultimate tensile strength of column)*

$E := 206000 \cdot MPa$ *(Elastic modulus)*

$H := 650\ mm$

$B := 320\ mm$

$t_w := 18\ mm$

$t_f := 25\ mm$

Flange: $b := \frac{B - t_w}{2} = 151\ mm$ $\qquad R_{Flange} := \frac{b}{t_f} = 6.04$

Web $h := \frac{H - 2 \cdot t_f - t_w}{2} = 291\ mm$ $\qquad R_{web} := \frac{h}{t_w} = 16.167$

<u>Elastic section properties:</u>

$$I_x := \frac{1}{12} \cdot t_w \cdot (H - 2 \cdot t_f)^3 + 2 \cdot B \cdot t_f \cdot \left(\frac{H}{2} - 0.5 \cdot t_f\right)^2 + \frac{1}{12} \cdot t_w^3 \cdot (H - 2 \cdot t_f) + 2 \cdot \frac{1}{12} \cdot t_f \cdot B^3$$

$I_y := I_x$

$S_{xt} := \frac{I_x}{0.5\ H}$

$S_{xc} := S_{xt}$ $\qquad A := 2 \cdot t_w \cdot (H - t_f) - t_w \cdot t_f + 4 \cdot t_f \cdot B$

$I_x = (2.023 \cdot 10^5)\ cm^4$ $\qquad I_y = (2.023 \cdot 10^5)\ cm^4$

$S_{xt} = (6.226 \cdot 10^3)\ cm^3$ $\qquad S_{xc} = (6.226 \cdot 10^3)\ cm^3$

## 2. Width-to-Thickness Ratios :

2.1 Allowable Width-to-Thickness Ratio_ compression

$$k_c := min\left(\max\left(0.35, \frac{4}{\sqrt{\frac{h}{t_w}}}\right), 0.76\right) = 0.76$$ *( Table B4.1a note [a] )*

$$\lambda_{r_F_c} := 0.64 \cdot \sqrt{\frac{k_c \cdot E}{F_y}} = 13.44$$ *( Table B4.1a case 2 )*

$$\lambda_{r_W_c} := 1.49 \cdot \sqrt{\frac{E}{F_y}} = 35.893$$ *( Table B4.1a case 5 )*

2.2 Allowable Width-to-Thickness Ratio_ Flexture

$$F_L := \left\| \begin{array}{l} \text{if } \frac{S_{xt}}{S_{xc}} \geq 0.7 \\ \quad \| \ 0.7 \cdot F_y \\ \text{else} \\ \quad \| \ \max\left(F_y \cdot \frac{S_{xt}}{S_{xc}}, 0.5\ F_y\right) \end{array} \right\| = 248.5\ \frac{N}{mm^2}$$ *( Table B4.1a note [b] )*

$$\lambda_{\rho_F_F} := 0.38 \cdot \sqrt{\frac{E}{F_y}} = 9.154$$

*( Table B4.1b case 11 )*

$$\lambda_{r_F_F} := 0.95 \cdot \sqrt{\frac{k_c \cdot E}{F_L}} = 23.845$$

$$\lambda_{p_W_F} := 3.76 \cdot \sqrt{\frac{E}{F_y}} = 90.575$$

*( Table B4.1b case 15 )*

$$\lambda_{r_W_F} := 5.7 \cdot \sqrt{\frac{E}{F_y}} = 137.308$$

## 3. Check Results:

| case | Actual Ratio | Allowable Ratio | |
|---|---|---|---|
| | | $\lambda_p$ | $\lambda_r$ |
| Compression- Flange | 6.04 | | 13.44 |
| Compression- web | 16.17 | | 35.89 |
| Flexure- Flange | 6.04 | 9.15 | 23.85 |
| Flexure- Web | 16.17 | 90.57 | 137.31 |

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|-----------------------------------------------------------------------|
| SECTION CLASS  UNSTIFFENED /    λ        λp       λr        CASE      |
|                STIFFENED                                               |
| Compression :  Non-Slender     7.93     N/A      13.44    T.B4.1(a)-2  |
|                Non-Slender    13.86     N/A      35.89    T.B4.1(a)-5  |
| Flexure     :  Compact         7.93     9.15     23.85    T.B4.1(b)-11 |
|                Compact        13.86    90.57    137.31    T.B4.1(b)-15 |
    STAAD SPACE                                          -- PAGE NO.  384
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