

# STEEL BEAM – Stiffener & Double Plate Requirements

Check  $R_u$  against

- $\phi R_n$  for Web Local Yielding
- $\phi R_n$  Web Crippling

If  $\phi R_n < R_u$  Use a stiffener!

How much strength does the stiffener need to handle?  
(It's the difference between the applied load and what the unstiffened beam can handle)

$$R_{st} = R_u - \phi R_n$$

Determine min/max stiffener widths

$$b_{st,max} = \frac{b_f - t_w}{2} \quad b_{st,min} = \frac{b_f - t_w}{6}$$

Choose width closer to the max

Determine min stiffener thickness

$$h_{st,min} = d - 2k_{des}$$

Check Coeff. of slender unstiffened elements in compression ( $k_c$ ):

AISC Table B4.1A (Note a)

$$k_c = \frac{4}{\sqrt{h_{st}}} \quad [0.35 \leq k_c \leq 0.76]$$

Calculate limiting width/thickness ratio for stiffener:

$$\frac{b_{st}}{t_{st}} \leq 0.64 \sqrt{\frac{k_c E}{F_y}} \rightarrow t_{st,min} \geq \frac{b_{st}}{0.64 \sqrt{\frac{k_c E}{F_y}}}$$

Verify Stiffeners Meet Required Strength:

- Determine Gross Area of Cross Shaped Column

$$A_{g,cross} = A_{st} + 12t_w^2 \text{ if end stiffener}$$

$$A_{st} + 25t_w^2 \text{ if interior stiffener}$$

$$\text{when: } A_{st} = n_{st} b_{st} t_{st}$$

- Effective web length =  $L_{w,eff} = 12t_w$  if end stiffener  
 $= 25t_w$  if interior stiffener

- Calculate Moment of Inertia of the Cross-shaped Column ( $I_{cross}$ )

$$I_{cross} = I_{st} + I_w = \frac{(bd^3)_{st}}{12} + \frac{(bd^3)_w}{12} = \frac{t_{st}(t_w + 2b_{st})^3}{12} + \frac{(L_{w,eff} - t_{st})t_w^3}{12}$$

- Calculate Effective Slenderness Ratio (Eff. Length Factor = 0.75)

$$\frac{KL}{r} = \frac{Kh_{cross}}{r_{cross}} \quad \text{when: } r_{cross} = \sqrt{\frac{I_{cross}}{A_{g,cross}}}$$

Nominal Axial Compression Load Capacity  $P_n = F_{cr} A_{g,cross}$

When Effective slenderness ratio

$$\frac{KL}{r} \leq 4.71 \sqrt{\frac{E}{F_y}}$$

$$F_{cr} = 0.658 \left( \frac{F_y}{F_e} \right) F_y$$

When Effective slenderness ratio

$$\frac{KL}{r} > 4.71 \sqrt{\frac{E}{F_y}}$$

$$F_{cr} = 0.877 F_e$$

$$F_e = \frac{\pi^2 E}{\left( \frac{KL}{r} \right)^2}$$

Calculate the Design Strength:  $P_{u,st} = \phi_c P_n$

$$P_{u,st} > R_{st} ?$$

