B1T5MA0417A

Dados:

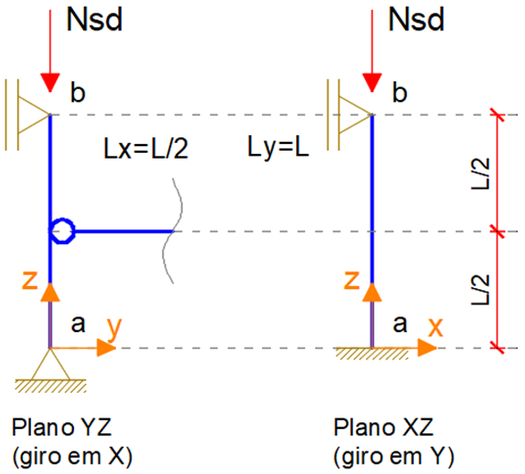
$L := 8000\ mm$

$bf := 300\ mm$

$hw := 290\ mm$

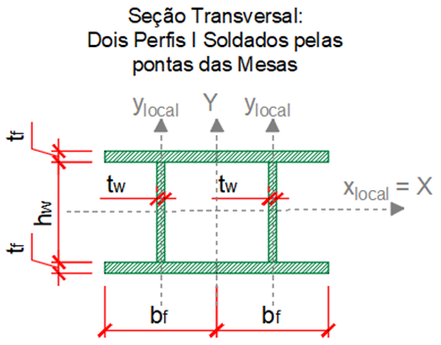
$tw := 5\ mm$

$tf := 6,3\ mm$



Plano YZ
(giro em X)

Plano XZ
(giro em Y)



Determinar qual a máxima carga de compressão centrada Nsd (em valor de cálculo), possível de se aplicada na barra "ab" de modo que a mesma ainda atenda as verificações pertinentes.

- Aço MR 250;
- Seção Transversal Peris Soldados solidarizados pelas Pontas das Mesas;
- Utilizar valores recomendados para Kx e Ky;

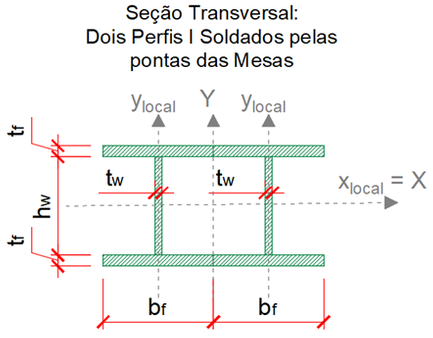
Dados Iniciais:

$E := 20000\ \frac{kN}{cm^2}$ $fy := 25\ \frac{kN}{cm^2}$ $Kx := 1,0$ $Lx := \frac{L}{2} = 400\ cm$ $\gamma a1 := 1,1$

$Ky := 0,8$ $Ly := L = 800\ cm$

Propriedades Geométricas:

$Ag := 2 \cdot (hw \cdot tw + 2 \cdot bf \cdot tf) = 104,6\ cm^2$



$Ix := 2 \cdot \left(\frac{bf \cdot (hw + 2 \cdot tf)^3}{12} - \frac{(bf - tw) \cdot hw^3}{12} \right) = 18627,9245\ cm^4$

$Iy\_local := \frac{hw \cdot tw^3}{12} + \frac{2 \cdot tf \cdot bf^3}{12} = 2835,3021\ cm^4$

$A1 := hw \cdot tw + 2 \cdot bf \cdot tf = 52,3\ cm^2$

$d := \frac{bf}{2} = 15\ cm$

Teorema dos eixos paralelos: Y = 2.(ylocal + A1.d^2)

$Iy := 2 \cdot \left(Iy\_local + A1 \cdot d^2 \right) = 29205,6042\ cm^4$

$rx := \sqrt{\frac{Ix}{Ag}} = 13,3449\ cm$

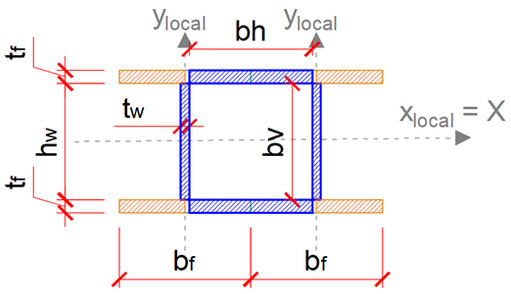
$ry := \sqrt{\frac{Iy}{Ag}} = 16,7096\ cm$

$\lambda x := \frac{Kx \cdot Lx}{rx} = 29,9739$

$\lambda y := \frac{Ky \cdot Ly}{ry} = 38,3012$

Cálculo do Fator Q:

Cálculo do Qa (elementos AA - em azul):



$$Q_a = \frac{A_{ef}}{A_g}$$

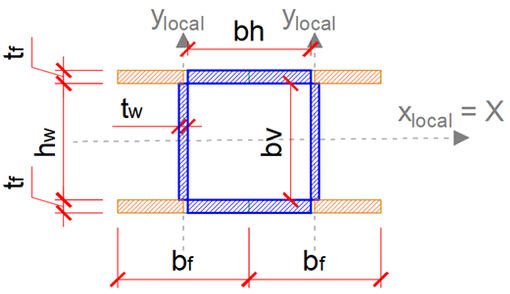
$$A_{ef} = A_g - \sum (b - b_{ef})\, t$$

$$b_{ef} = 1{,}92t\sqrt{\frac{E}{\sigma}}\left[1 - \frac{c_a}{b/t}\sqrt{\frac{E}{\sigma}}\right] \leq b$$

c_a – é um coeficiente, igual a **0,38** para mesas ou almas de seções tubulares retangulares e **0,34** para todos os demais casos

σ - é a tensão que pode atuar no elemento analisado tomada igual **σ = χ . fy** ou conservadoramente **σ = fy**

Chapas verticais:



$bv := hw = 29\ \text{cm}$

$\lambda v := \frac{bv}{tw} = 58$ $\quad \lambda lim := 1{,}49 \cdot \sqrt{\frac{E}{fy}} = 42{,}1436$

como λv > λlim : ocorre flambagem
local do tipo AA nas chapas verticais

$bef\_v\_calc := 1{,}92 \cdot tw \cdot \sqrt{\frac{E}{fy}} \cdot \left(1 - \frac{0{,}38}{\lambda v} \cdot \sqrt{\frac{E}{fy}}\right) = 22{,}1212\ \text{cm}$

$bef\_v := \text{if } bef\_v\_calc > bv = 22{,}1212\ \text{cm}$
$\quad bv$
$\quad \text{else}$
$\quad bef\_v\_calc$

Chapas horizontais:

$bh := bf - tw = 29{,}5\ \text{cm}$

$\lambda h := \frac{bh}{tf} = 46{,}8254$ $\quad \lambda lim := 1{,}49 \cdot \sqrt{\frac{E}{fy}} = 42{,}1436$

como λh > λlim : ocorre flambagem
local do tipo AA nas chapas horizontais

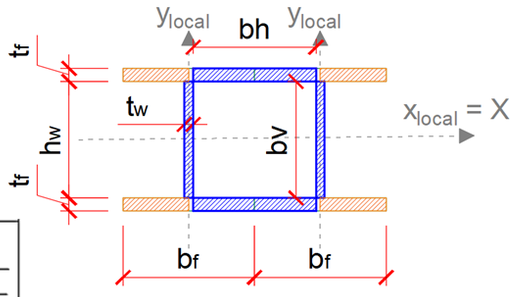
$bef\_h\_calc := 1{,}92 \cdot tf \cdot \sqrt{\frac{E}{fy}} \cdot \left(1 - \frac{0{,}38}{\lambda h} \cdot \sqrt{\frac{E}{fy}}\right) = 26{,}3597\ \text{cm}$

$bef\_h := \text{if } bef\_h\_calc > bh = 26{,}3597\ \text{cm}$
$\quad bh$
$\quad \text{else}$
$\quad bef\_h\_calc$

Cálçculo da Área Efetiva Aef:

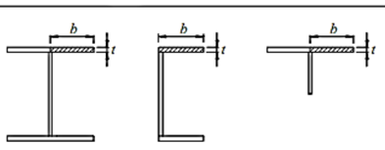
$Aef := Ag - \left(2 \cdot (bv - bef\_v) \cdot tw + 2 \cdot (bh - bef\_h) \cdot tf\right) = 93{,}7644\ \text{cm}^2$ $\quad Ag = 104{,}6\ \text{cm}^2$

$Qa := \frac{Aef}{Ag} = 0,8964$



Cálculo do Qs (elementos AL - em laranja):

- As abas (meias mesas) dos perfis I soldados devem ser analisadas;

5	— Mesas de seções I, H, T ou U soldadas [a]		$0,64\sqrt{\frac{E}{(f_y/k_c)}}$

$k_c = \frac{4}{\sqrt{hw/tw}}$ sendo $0,35 \leq k_c \leq 0,76$

$bmesa := \frac{bf}{2} = 15$ cm $\lambda mesa := \frac{bmesa}{tf} = 23,8095$

$kc := \frac{4}{\sqrt{\frac{hw}{tw}}} = 0,5252$ $\lambda\_lim\_r := 0,64 \cdot \sqrt{\frac{E}{\frac{fy}{kc}}} = 13,1189$

$\lambda\_lim\_e := 1,17 \cdot \sqrt{\frac{E}{\frac{fy}{kc}}} = 23,983$

- Como λ_lim_r < λmesa < λ_lim_e : ocorre flambagem local inelástica no elemento.

Grupo 5

$Q_s = 1,415 - 0,65\ \frac{b}{t}\sqrt{\frac{f_y}{k_c E}} \leq 1$ para $0,64\sqrt{\frac{E}{(\frac{fy}{kc})}} < \frac{b}{t} \leq 1,17\sqrt{\frac{E}{(\frac{fy}{kc})}}$

$Q_s = \frac{0,90 E k_c}{f_y \left(\frac{b}{t}\right)^2}$ para $\frac{b}{t} > 1,17\sqrt{\frac{E}{(f_y/k_c)}}$

$Qs := 1,415 - 0,65 \cdot \lambda mesa \cdot \sqrt{\frac{fy}{kc \cdot E}} = 0,66$

Cálculo do Q = Qa.Qs: $Q := Qa \cdot Qs = 0,5916$

Análise do Eixo X:

$\lambda x := \text{if } \lambda x > 200 = 29,9739$
$\quad 99999999$
$\quad \text{else}$
$\quad\quad \lambda x$

$\lambda ox := \lambda x \cdot \sqrt{\frac{Q \cdot fy}{\pi^2 \cdot E}} = 0,2595$

$\chi x := \text{if } \lambda ox \leq 1,5 = 0,9722$
$\quad 0,658^{\lambda ox^2}$
$\quad \text{else}$
$\quad\quad \frac{0,877}{\lambda ox^2}$

$Ncrdx := \frac{Q \cdot \chi x \cdot Ag \cdot fy}{\gamma a1} = 1367,3918$ kN

Análise do Eixo Y:

$\lambda y := \text{if } \lambda y > 200 = 38,3012$
$\quad 1 \cdot 10^{26}$
$\quad \text{else}$
$\quad\quad \lambda y$

$\lambda oy := \lambda y \cdot \sqrt{\frac{Q \cdot fy}{\pi^2 \cdot E}} = 0,3315$

$$\chi y := \text{if } \lambda oy \le 1{,}5 = 0{,}955$$
$$0{,}658^{\lambda oy^2}$$
$$\text{else}$$
$$\frac{0{,}877}{\lambda oy^2}$$

$$Ncrdy := \frac{Q \cdot \chi y \cdot Ag \cdot fy}{\gamma a1} = 1343{,}2259 \text{ kN}$$

$$Ncrd := \min\left(\left[\, Ncrdx \;\; Ncrdy \,\right]\right) = 1343{,}2259 \text{ kN}$$