REFERENCES	CALCULATIONS

MEMBER REPORT FOR LIPPED CHANNEL SECTION

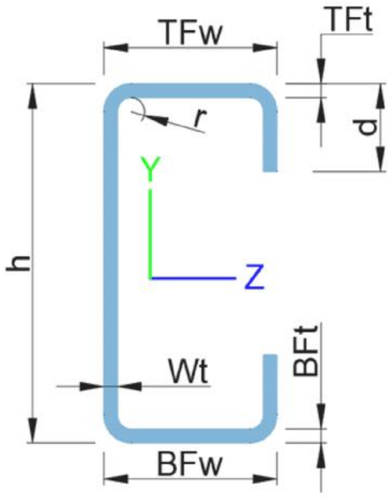
Design Provision used: AS/NZS 4600:2005

PROJECT DETAILS

Project Name:
Project ID:
Company:
Designer:
Client:
Project Notes:
Project Units: Metric

General member design information

Section Name: C10010
Shape: C-Section w/ Lips



Dimensions:
Height, ***h = 102 mm***
Web Thickness, ***Wt = 1 mm***
Top Flange Width, ***TFw = 51 mm***
Top Thickness, ***TFt = 1 mm***
Bottom Flange Width, ***BFw = 51 mm***
Bottom Thickness, ***BFt = 1 mm***
Lip Depth, ***d = 12.5 mm***
Fillet Radius, ***r = 5 mm***

Properties:
Area, ***A = 216 mm2***
Moment of Inertia about the z-axis, ***Iz = 364000 mm4***
Moment of Inertia about the Y-Axis, ***Iy = 75500 mm4***
Plastic Section Modulus about the z-axis, ***Zz = 9814.276 mm3***
Plastic Section Modulus about the Y-Axis, ***Zy = 4181.586 mm3***
Torsion Constant, ***J = 71.9 mm4***
Warping Constant, ***Iw = 160000000 mm6***

Material properties:
Material Name: ***Australian/New Zealand Standard (AS/NZS) - AS/NZS 1594 - HA300, HU300 - Standard***
Modulus of Elasticity, ***E = 200000 mpa***
Yield Strength, ***Fy = 300 mpa***
Ultimate Tensile Strength, ***Fu = 400 mpa***

Flexural Buckling parameters:
Member length for flexural buckling, ***L =3625 mm***
Length between braced points, ***Lb =3625 mm***

Lateral Torsional Buckling parameters:
Coefficient for lateral-torsional buckling, ***Cs =-1***
End moment coefficient in interaction formula, ***CTf =1.0***
Bending coefficient dependent on moment gradient, ***Cb =1.0***
Member length for Lateral Torsional Buckling, ***L =3625 mm***

Design Internal Forces

	Load Case: Name = ***Worst Case Load Combination*** For check axial strength: Absolute Maximum Axial Force, ***P*** = 56.4 N For check flexural strength about Z-Axis: Absolute Maximum Major Bending Moment, ***Mz*** = 40 N-mm For check flexural strength about Y-Axis: Absolute Maximum Major Bending Moment, ***My*** = 19470 N-mm For check shear strength Y-Axis: Absolute Maximum Shear Force, ***Vx*** = 0.01 N For check shear strength Z-Axis: Absolute Maximum Shear Force, ***Vy*** = 5.37 N For check interaction of combined compression and bending strength: Axial Force, ***P*** = 56.4 N Z-Axis Bending Moment, ***Mz*** = 40 N-mm Y-Axis Bending Moment, ***My*** = 19470 N-mm For check interaction of combined bending and shear strength: Z-Axis Bending Moment, ***Mz*** = 40 N-mm Y-Axis Bending Moment, ***My*** = 19470 N-mm Shear Force, ***Vx*** = 5.37 N Shear Force, ***Vy*** = 0.01 N

BENDING CAPACITY

Bending about Y-Axis

3.3.2 Nominal section moment capacity, Ms (Section 3.3.2) Clause 3.3.2.2

$$M_{sy} = Z_{ye} F_y$$

$$M_{sy} = (2033.16)\,(300) = 609948\ N - mm$$

$$\textit{Calculate Nominal flexural strength about Y-Axis } (M_{sy})$$

$$\text{Design Flexural Strength } = M_{sy}\phi_b = (609948)\,(0.9) = 548953.2\ N - mm$$

$$\frac{M_y^*}{\text{Design Flexural Strength}} = \frac{19470}{548953.2} = 0.035 \leq 1.0$$

Bending about Z-Axis

3.3.2 Nominal section moment capacity, Ms (Section 3.3.2) Clause 3.3.2.2

$$M_{sz} = Z_{ze} F_y$$

$$M_{sz} = (5811.98)\,(300) = 1832339\ N - mm$$

$$\textit{Calculate Nominal flexural strength about Z-Axis } (M_{sz})$$

$$\text{Design Flexural Strength } = M_{sz}\phi_b = (1832339)\,(0.9) = 1649105.1\ N - mm$$

$$\frac{M_z^*}{\text{Design Flexural Strength}} = \frac{40}{1649105.1} = 0 \leq 1.0$$

FLEXURAL BUCKLING CAPACITY

Concentrically loaded compression members, fox (Section 3.4) Clause 3.3.3.2(14)

$$\frac{L_x}{r_x} = \frac{3625}{41.051} = 88.305$$

$$\frac{L_y}{r_y} = \frac{3625}{18.696} = 193.892$$

$$Since\ \frac{L_y}{r_y} > \frac{L_x}{r_x},\ \text{Euler buckling about the y-axis will control.}$$

$$Determine\ controlling\ euler\ buckling$$

$$f_{oc} = \frac{\pi^2 E}{(l_y/r_y)^2} = \frac{\pi^2\,(200000)}{\left[(3625)\ /\ (18.696)\right]^2} = 52.506\ mpa$$

$$Calculate\ Elastic\ Buckling\ Stress\ (f_{oc})$$

$$\lambda_c = \sqrt{\frac{F_y}{f_{oc}}} = \sqrt{\frac{300}{52.506}} = 2.39$$

$$Calculate\ Slenderness\ factor\ (\lambda_c)$$

$$f_n = \left(0.877/(\lambda_c)^2\right) Fy = \left(0.877/(2.39)^2\right) 300 = 46.048\ mpa$$

$$Calculate\ Critical\ Stress\ (f_n)$$

$$N_c = A_e f_n = (216)(46.048) = 9946.27\ N$$

$$Calculate\ Nominal\ axial\ strength\ (N_c)$$

$$DesignStrength = N_c\phi = (9946.27)(0.85) = 8454.329\ N$$

$$\frac{N^*}{\text{Design Strength}} = \frac{56.4}{8454.329} = 0.007 \leq 1.0$$

Combined axial compression and bending, (Section 3.5.1) Clause 3.5.1

COMBINED AXIAL COMPRESSION AND BENDING CHECK

$$\frac{N^*}{\phi_c\,N_s} + \frac{C_{mx}\,M_z^*}{\phi_b\,M_{sz}\alpha_x} + \frac{C_{my}\,M_y^*}{\phi_b\,M_{sy}\alpha_y} = \frac{56.4}{0.85\,(29748.108)} + \frac{1\,(40)}{0.9\,(1832339)\,(0.999)} + \frac{1\,(19470)}{0.9\,(609948)\,(0.994)} =$$

$$\frac{N^*}{\phi_c\,N_c} + \frac{M_z^*}{\phi_b\,M_{sz}} + \frac{M_y^*}{\phi_b\,M_{sy}} = \frac{56.4}{0.85\,(41648.4)} + \frac{40}{0.9\,(1832339)} + \frac{19470}{0.9\,(609948)} = 0.037 \leq 1.0$$

3.4 Concentrically loaded compression members SECTION 3.4.3

FLEXURAL TORSIONAL BUCKLING CAPACITY CHECK

$$f_{oxz} = \frac{1}{2\beta}\left((f_{ox} + f_{oz}) - \sqrt{(f_{ox} + f_{oz})^2 - 4\beta f_{ox} f_{oz}}\right) = \frac{1}{2\,(0.558)}\left((253.14 + 37.803) - \sqrt{(253.14 + 37.803)^2 - 4\,(0.558)\,(253$$

$$\beta = 1 - (x_o/r_{o1})^2 = 1 - (-40.164/60.398)^2 = 0.558$$

$$f_{ox} = \frac{\pi^2 E}{(l_{ex}/r_x)^2} = \frac{\pi^2(200000)}{(3625/41.051)^2} = 253.14\ mpa$$

$$f_{oz} = \frac{GJ}{Ar_{01}^2}\left(1 + \frac{\pi^2 EI_w}{GJl_{ez}^2}\right) = \frac{(80000)(71.9)}{(216)(60.398)^2}\left(1 + \frac{\pi^2(200000)(160000000)}{(80000)(71.9)(3625)^2}\right) = 37.803\ mpa$$

Calculate Flexural-Torsional Buckling (f_{oxz})

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LATERAL TORSIONAL BUCKLING CHECK

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