

MEMBER DESIGN PER CISC- 8th. EDITION (CANADIAN CODE)

DESIGN OF BEAM:

(Assumes second order analysis has been done and results are input for this calculation)

Unsupported Length of Member along-X, $L_x := 3.70 \text{ m}$ Unsupported Length of Member along-Y, $L_y := 3.70 \text{ m}$

Member size, $\text{Section} := \text{"W310x118"}$ Member Type Braced / Unbraced, $\text{Member} := \text{"Unbraced"}$

Yield Strength of steel, $F_{y1} := 345 \text{ MPa}$ $\phi_s := 0.90$ Modulus of Elasticity, $E_s := 200000 \text{ MPa}$

For fabricated structural section, $n := 1.34$ for hot rolled sections. Shear Modulus, $G_s := 77000 \text{ MPa}$

Maximum factored Strong Axis moment $M_{fx} := 300 \text{ kN m}$ Maximum factored Weak Axis moment $M_{fy} := 20 \text{ kN m}$

Factored axial compression of the member, $C_f := 200 \text{ kN}$



SECTION PROPERTIES

Area of cross section,	Area = 15000 mm ²	Moment of Inertia about X-X,	I _{xx} = 27500 cm ⁴
Section Modulus about X-X,	S _x = 1750 cm ³	Plastic Section modulus about X-X,	Z _{xx} = 1950 cm ³
Moment of Inertia about Y-Y,	I _{yy} = 9020 cm ⁴	Section Modulus about Y-Y,	S _y = 588 cm ³
Plastic Section modulus about Y-Y,	Z _{yy} = 893 cm ³	Radius of gyration (YY),	r _{yy} = 77.6 mm
Torsional Constant,	J _{xy} = 160 cm ⁴	Warping constant,	C _w = 1.97 × 10 ⁶ cm ⁶
Flange Thickness,	T _f = 18.7 mm	Flange Width,	b _f = 307 mm
Radius of gyration (XX),	r _{xx} = 136 mm	Web Thickness,	t _w = 11.9 mm
		Section Depth,	D _f = 314 mm
		Depth of web,	h := D _f - 2 T _f = 276.6 mm

1.0 Section Class Detemination Refer Table-4-3 of CISC Handbook, 8th Edition, pg 4-7



Flange Class of the section, Flange_class = 2 Web class of the section, Web_class = 1

Section class of the meber, Section_class = 2 Yield stress of the member (based on section class), F_y = 345 MPa

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2.0 Member Strength Check (For design check, refer CISC Handbook, 8th edition, section 13.8),

(a) Cross-sectional strength check (required for members that are braced or sway prevented).

$$\beta_a := 0.6$$

$\omega_{1x} := 0.4$ $\omega_{1y} := 1.0$ Conservatively, can use $\omega_1 = 1.0$ for a series of point loads between the supports.



Factored Compressive resistance, $C_{r_a} = 4657.5 \text{ kN}$ Refer section 13.3 of CISC Handbook

Factored moment resistance about major axis, $M_{rx_a} = 605.5 \text{ kN m}$ Refer section 13.5 of CISC Handbook

Factored moment resistance about minor axis, $M_{ry_a} = 277.3 \text{ kN m}$ Refer section 13.5 of CISC Handbook

Euler's buckling strength: $C_{ex} = 39651.4 \text{ kN}$ $C_{ey} = 13005.7 \text{ kN}$ Refer section 13.8.4 of CISC Handbook

Factor to account for moment gradient and for second order effects of axial force acting on the deformed member,

$U_{1x_a} = 1$ $U_{1y_a} = 1.016$ Refer section 13.8.4 of CISC Handbook

Section capacity Checking for the member, Refer section 13.8.2 and 13.8.3 of CISC Handbook

MEMBER CHECK A = "DOES NOT GOVERN"

(b) Overall strength Check,

$$k := 1.0$$



Factored Axial Compressive resistance and slenderness calculation, Refer cl 13.3 of CISC Handbook, 8th Edition,

Slenderness parameters about X-X, $\lambda_x = 0.36$ Slenderness parameters about Y-Y, $\lambda_y = 0.63$

Factored Compressive resistance, $C_{r_b} = 3850.7 \text{ kN}$ Refer section 13.3 of CISC Handbook

Factored moment resistance about major axis, $M_{rx_b} = 605.5 \text{ kN m}$ Refer section 13.5 of CISC Handbook

Factored moment resistance about minor axis, $M_{ry_b} = 277.3 \text{ kN m}$ Refer section 13.5 of CISC Handbook

Euler's buckling strength: $C_{ex} = 39651.4 \text{ kN}$ $C_{ey} = 13005.7 \text{ kN}$ Refer section 13.8.4 of CISC Handbook

Factor to account for moment gradient and for second order effects of axial force acting on the deformed member,

$U_{1x_b} = 1$ $U_{1y_b} = 1$ Refer section 13.8.4 of CISC Handbook

Section capacity Checking for the member, **MEMBER CHECK B = "SAFE"** Refer section 13.8.2 and 13.8.3 of CISC Handbook

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(c) Lateral Torsional buckling strength Check,



Factored Axial Compressive resistance and slenderness calculation, Refer cl 13.3.1 of CISC Handbook, 8th Edition, pg 1-30

Maximum slenderness parameter, $\lambda = 0.630$

Factored Compressive resistance, $C_{r_c} = 3850.7 \text{ kN}$ Refer section 13.3 of CISC Handbook

Factored moment resistance about major axis, $M_{rx_c} = 605.5 \text{ kN m}$ Refer section 13.5 of CISC Handbook

Factored moment resistance about minor axis, $M_{ry_c} = 277.3 \text{ kN m}$ Refer section 13.5 of CISC Handbook

Euler's buckling strength: $C_{ex} = 39651.4 \text{ kN}$ $C_{ey} = 13005.7 \text{ kN}$ Refer section 13.8.4 of CISC Handbook

Factor to account for moment gradient and for second order effects of axial force acting on the deformed member,

$U_{lx_c} = 1$ $U_{ly_c} = 1$ Refer section 13.8.4 of CISC Handbook

Section capacity Checking for the member, **MEMBER CHECK C = "SAFE"** Refer section 13.8.2 and 13.8.3 of CISC Handbook

Overall Member Check, **OVERALL_MEMBER_CHECK = "SAFE"**