REFERENCES	CALCULATIONS	RESULTS
Code: AS 4100-1998	**MEMBER #11 DESIGN REPORT**	

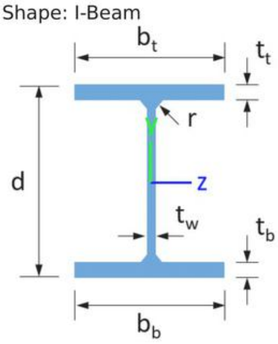
MEMBER #11 DESIGN REPORT

Project Details

Project Name: CSA-s16-frame
Project ID:
Company:
Designer:
Client:
Project Notes:
Project Units: metric

Section

Name: W1000x321
Shape: I-Beam



Dimensions

Height $d = 990\ mm$
Web Thick $t_w = 16.5\ mm$
Top Flange Width $b_t = 400\ mm$
Top Flange Thick $t_t = 31\ mm$
Bottom Flange Width $b_b = 400\ mm$
Bottom Flange Thick $t_b = 31\ mm$
Fillet $r = 32\ mm$

Properties

Area $A = 40.9 \times 10^{3}\ mm^2$
Moment of Inertia about the z-axis $I_z = 6.96 \times 10^{9}\ mm^4$
Moment of Inertia about the y-axis $I_y = 331 \times 10^{6}\ mm^4$
Elastic Section Modulus about the y-axis $Z_y = 1.655 \times 10^{6}\ mm^3$
Elastic Section Modulus about the z-axis $Z_z = 14.061 \times 10^{6}\ mm^3$
Plastic Section Modulus about the y-axis $S_y = 2.55 \times 10^{6}\ mm^3$
Plastic Section Modulus about the z-axis $S_z = 15.8 \times 10^{6}\ mm^3$
Torsion Contant $J = 10.3 \times 10^{6}\ mm^4$
Warping Contant $I_w = 76.1 \times 10^{12}\ mm^6$

Material

Name: Structural Steel
Modulus of Elasticity $E = 200\ GPa$
Yield Strength $F_y = 260\ MPa$
Ultimate Tensile Strength $F_u = 410\ MPa$

Member Properties

Member length $L = 10.4\ \mathrm{m}$
Length between braced points $L_b = 10.4\ \mathrm{m}$
Effective Length factor for flexural buckling about y-axis $K_y = 1.00$
Effective Length factor for flexural buckling about z-axis $K_z = 1.00$

Design Internal Forces

Absolute Maximum Tension Force: $-1.8518\ kN$
Absolute Maximum Compression Force: $0.57886\ kN$
Absolute Maximum Moment in y-axis: $-0.92399\ kN.m$
Absolute Maximum Moment in z-axis: $-56.654\ kN.m$
Absolute Maximum Shear Force in y-axis: $-37.186\ kN$
Absolute Maximum Shear Force in z-axis: $0.87965\ kN$

Design of Tension Members

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Critical Load Combination: SW1

Critical Evaluation Point: $-1.8518\ kN$ @ $1.6766\ m$ **from the beginning of the element**

Yield Tensile Strength Capacity $N_t = 10.634 \times 10^3\ kN$

$$N_t = f_y \times A$$

$$N_t = 260\ MPa \times 40.9 \times 10^3\ mm^2$$

$$N_t = 10.634 \times 10^3\ kN$$

$$\frac{N*}{\phi Nt} = \frac{|-1.8518\ kN|}{9.5706 \times 10^3\ kN} = 0.000 < 1.0$$

STATUS PASS UR = 0.000

Design of Compression Members

Critical Load Combination: SW1

Critical Evaluation Point: $0.57886\ kN$ @ $0.53345\ m$ **from the beginning of the element**

Sec. 6.2.3 Form Factor $k_f = 0.91935$

$$\text{Flanges} = \text{NONSLENDER},\ \text{Web} = \text{SLENDER},\ \implies k_f = 0.91935$$

Nominal Section Capactiy $N_s = 9.7763 \times 10^3\ kN$

$$N_s = k_f \times A \times f_y$$

$$N_s = 0.91935\ \times 40.9 \times 10^3\ mm^2 \times 260\ MPa$$

$$N_s = 9.7763 \times 10^3\ kN$$

$$\frac{N*}{\phi Ns} = \frac{0.57886\ kN}{8.7987 \times 10^3\ kN} = 0.000 < 1.0$$

STATUS PASS UR = 0.000

Design of Members for Axial Buckling

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Critical Load Combination: SW1

Critical Evaluation Point: $0.57886\ kN$ @ $0.53345\ m$ **from the beginning of the element**

MINOR AXIS

Sec. 6.2.3 Form Factor $k_f = 0.91935$

$$\text{Flanges} = \text{NONSLENDER},\ \text{Web} = \text{SLENDER},\ \implies k_f = 0.91935$$

Nominal Section Capactiy $N_s = 9.7763 \times 10^3\ kN$

$$N_s = k_f \times A \times f_y$$

$$N_s = 0.91935\ \times 40.9 \times 10^3\ mm^2 \times 260\ MPa$$

$$N_s = 9.7763 \times 10^3\ kN$$

Radius of Gyration $r_y = 89.961\ mm$

$$r_y = \sqrt{\frac{I_y}{A}}$$

$$r_y = \sqrt{\frac{331 \times 10^6\ mm^4}{40.9 \times 10^3\ mm^2}}$$

$$r_y = 89.961\ mm$$

Effective Length $l_{ey} = k_{ey} \times L = 1\ \times 10.439\ m = 10.439\ m$

Modified Compression Member Slenderness $\lambda_{ny} = 113.47$

$$\lambda_{ny} = \frac{l_e y}{r_y} \times \sqrt{\frac{f_y}{250}}$$

$$\lambda_{ny} = \frac{10.439}{89.961\ mm} \times \sqrt{\frac{260\ MPa}{250\ MPa}}$$

$$\lambda_{ny} = 113.47$$

Compression Member Factor $\alpha_{ay} = 15.917$

$$\alpha_{ay} = \frac{2100 \times (\lambda_{ny} - 13.5)}{{\lambda_{ny}}^2 - 15.3 \times \lambda_{ny} + 2050}$$

$$\alpha_{ay} = \frac{2100 \times (113.47\ - 13.5)}{113.47^{\ 2} - 15.3 \times 113.47\ + 2050}$$

$$\alpha_{ay} = 15.917$$

Tbl. 6.3.3(2) Member Section Constant $\alpha_{by} = 0$

$$k_f < 1, \text{I-Beam section, flange thickness} < 40\text{mm, therefore } \alpha_{by} = 0$$

Elastic Buckling Load Factor $\lambda_y = 113.47$

$$\lambda_y = \lambda_{ny} + \alpha_{ay} \times \alpha_b$$

$$\lambda_y = 113.47\ + 15.917\ \times 0$$

$$\lambda_y = 113.47$$

Compression Member Imperfection Factor $\eta_y = 0.32590$

$$\eta_y = 0.00326 \times (\lambda_y - 13.5) > 0$$

$$\eta_y = 0.00326 \times (113.47\ - 13.5) > 0$$

$$\eta_y = 0.32590\ > 0$$

$$\eta_y = 0.32590$$

Compression Member Factor $\xi_y = 0.91707$

$$\xi_y = \frac{\left(\frac{\lambda_y}{90}\right)^2 + 1 + \eta}{2 \times \left(\frac{\lambda_y}{90}\right)^2}$$

$$\xi_y = \frac{\left(\frac{113.47}{90}\right)^2 + 1 + 0.32590}{2 \times \left(\frac{113.47}{90}\right)^2}$$

$$\xi_y = 0.91707$$

Compression Member Slenderness Reduction Factor $\alpha_{cy} = 0.45674$

$$\alpha_{cy} = \xi_y \times \left[1 - \sqrt{\left[1 - \left(\frac{90}{\xi \times \lambda_y}\right)^2\right]}\right]$$

$$\alpha_{cy} = 0.91707\ \times \left[1 - \sqrt{\left[1 - \left(\frac{90}{0.91707\ \times 113.47}\right)^2\right]}\right]$$

$$\alpha_{cy} = 0.45674$$

Nominal Member Axial Compression Capactiy $N_{cy} = 4.4652 \times 10^3\ kN$

$$N_{cy} = \alpha_{cy} \times Ns \leq N_s$$

$$N_{cy} = 0.45674\ \times 9.7763 \times 10^3\ kN \leq 9.7763 \times 10^3\ kN$$

$$N_{cy} = 4.4652 \times 10^3\ kN$$

Reduced Yield Compressive Strength Capacity $\phi N_{cy} = 4.0187 \times 10^3\ kN$

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] capacity

[illegible]

Design of Flexural Members - about y axis

Critical Load Combination: [illegible]

Critical Evaluation Point: [illegible] from the beginning of the element

[illegible]

Design of Flexural Members - about z axis

Critical Load Combination: [illegible]

Critical Evaluation Point: [illegible] from the beginning of the element

[illegible]

[illegible]

[illegible] gross capacity

[illegible]

Design of Flexural Members - about y axis

Critical Load Combination: [illegible]

Critical Evaluation Point: [illegible] from the beginning of the element

[illegible]

Design of Flexural Members - about z axis

Critical Load Combination: [illegible]

Critical Evaluation Point: [illegible] from the beginning of the element

[illegible]

[illegible]

Design of Members for Shear - about [illegible] axis

Critical Load Combination: [illegible]

Critical Evaluation Point: [illegible] from the beginning of the element

[illegible]

Design of Members for Shear - about [illegible] axis

Critical Load Combination: [illegible]

Critical Evaluation Point: [illegible] from the beginning of the element

[illegible]

[illegible]

Design of Members for Combined Actions (Section)

Critical Load Combination: [illegible]

Critical Evaluation Point: [illegible] from the beginning of the element

[illegible]

Uniaxial bending about the major principal x-axis bending

[illegible]

Uniaxial bending about the minor principal y-axis

[illegible]

Biaxial bending

[illegible]

Design of Members for Combined Actions (Member Buckling)

Critical Load Combination: [illegible]

Critical Evaluation Point: [illegible] from the beginning of the element

[illegible]

Out-of-plane capacity - compression members

[illegible]

Biaxial bending

[illegible]

Tension Slenderness Check

[illegible]

Compression Slenderness Check

Deflection Check