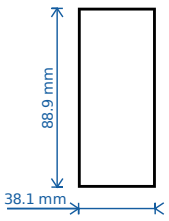
Input Summary

Input	Description	Value
$Standard$	*Standard used for calculations*	CSA O86-14
$Selections$	*Method of selection used*	Lookup
$Category$	*Category of the timber section*	Sawn Framing
Cat_{Sawn}	*Subcategory of sawn timber*	Structural framing
$Species$	*Species of timber*	Spruce Pine Fir
$Grade_{sawn}$	*Sawn timber grade*	No2
$Section_A$	*Structural framing section*	2x4
$Finish$	*Finish of the wood surface*	Surfaced
n_{ply}	*Number of plies for built-up members*	1
L_y	*Distance between strong direction (Y) or principal supports.*	1800 mm
L_z	*Distance between weak direction (Z) or lateral supports.*	1800 mm
K_D	*Considers the duration of the load*	Short
K_H	*Considers load sharing between repetitive members*	None
K_S	*Considers the member conditions (dry or wet)*	Dry
K_T	*Considers the member treatment*	None
M_{fz}	*Major Axis Factored moment (About the Z-Axis)*	0.5 kN*m
M_{fy}	*Minor Axis Factored Moment (About the Y-Axis)*	0.1 kN*m
V_{fy}	*Major Axis Factored Shear (Y direction)*	2 kN
V_{fz}	*Minor Axis Factored Shear (Z direction)*	1 kN
C_f	*Factored Axial Load (X direction, Tension negative)*	2 kN

Database Data

Input	Description	Value
b	Beam width	38 mm
d	Beam height	89 mm

Actual section dimensions



Standards Data

Description	Value	Reference
Flexural strength	$f_b = 11.8MPa$	Table 6.3.1A
Shear strength	$f_v = 1.5MPa$	Table 6.3.1A
Compressive strength	$f_c = 11.5MPa$	Table 6.3.1A
Tensile strength	$f_t = 5.5MPa$	Table 6.3.1A
Elastic modulus	$E = 9500MPa$	Table 6.3.1A
Reduced elastic modulus	$E_{05} = 6500MPa$	Table 6.3.1A

Load duration factor (K_D)

No load combinations entered $K_D =$ 1.15

Moment resistance

Description	Value	Reference
Flexural safety coefficient	$\phi_b = 0.9$	Cl. 6.5.4.1
Bending load sharing coefficient	$K_{Hb} = 1$	Table 6.4.4
Bending size factor coefficient	$K_{Zb} = 1.7$	Table 6.4.5
Weak-axis flexural reduction	$K_{bWeak} = 1$	Table 6.3.1C comm.
Weak-axis modulus reduction	$K_{EWeak} = 1$	Table 6.3.1C comm.

Strong axis flexure (about Z-axis)

Cl. 6.4.1

$$K_D = 1.15$$

Cl. 6.5.4.1

$$F_b = f_b * (K_D * K_{Hb} * K_{Sb} * K_T) = 13.57MPa$$

$$S_z = \frac{b * d^2}{6} = 50185mm^3$$

Cl. 7.5.6.4.3

$$C_B = \sqrt{\frac{1.92 * L_z * d}{b^2}} = 14.55$$

Cl. 7.5.6.4.4

$$C_K = \sqrt{\frac{0.97 * K_{EWeak} * E * K_{SE} * K_T}{F_b}} = 26.06$$

Cl. 7.5.6.4.4

$$10 < C_B < C_K \rightarrow K_{Lz} = 1 - 1/3 * (C_B/C_K)^4 = 0.968$$

Cl. 6.5.4.1

$$M_{rz} = \frac{\varphi_b \times F_b \times S_z \times K_{Zb} \times K_{Lz}}{(10)^6} = \frac{0.9 \times 13.57\ MPa \times 50185.38\ mm^3 \times 1.7 \times 0.97}{(10)^6} = 1.01\ kNm$$

$$UtMz = \frac{M_{fz}}{M_{rz}} = \frac{0.5\ kNm}{1.01\ kNm} = 0.5$$

UTILITY: 0.5

Weak axis flexure (about Y-axis)

Cl. 6.4.1

$$K_D = 1.15$$

$$S_y = \frac{d * b^2}{6} = 21508mm^3$$

Cl. 6.5.4.1

$$M_{ry} = \frac{\varphi_b \times K_{bWeak} \times F_b \times S_y \times K_{Zb} \times K_{Ly}}{(10)^6} = \frac{0.9 \times 1 \times 13.57\ MPa \times 21508\ mm^3 \times 1.7 \times 1}{(10)^6} = 0.45\ kNm$$

$$UtMy = \frac{M_{fy}}{M_{ry}} = \frac{0.1\ kNm}{0.45\ kNm} = 0.22$$

UTILITY: 0.22

Shear resistance

Description	Value	Reference
Shear safety coefficient	$\phi_v = 0.9$	Cl. 6.5.5.2
Shear load sharing coefficient	$K_{Hv} = 1$	Table 6.4.4
Shear size factor coefficient	$K_{Zv} = 1.7$	Table 6.4.5

Cl. 6.4.1

$$K_D = 1.15$$

Cl. 6.5.5.2

$$F_v = f_v * (K_D * K_{Hv} * K_{Sv} * K_T) = 1.72MPa$$

$$A_n = b * d = 3387mm^2$$

$$V_f = \sqrt{V_{fz}^2 + V_{fy}^2} = 2.24kN$$

Cl. 6.5.5.2

$$V_r = \frac{\varphi_v \times F_v \times \left(\frac{2}{3}\right) \times A_n \times K_{Zv}}{(10)^3} = \frac{0.9 \times 1.72\ MPa \times \left(\frac{2}{3}\right) \times 3387\ mm^2 \times 1.7}{(10)^3} = 5.96\ kN$$

$$UtV = \frac{V_f}{V_r} = \frac{2.24\ kN}{5.96\ kN} = 0.38$$

UTILITY: 0.38

Compressive resistance - Parallel to grain

Description	Value	Reference
Compression safety coefficient	$\phi_c = 0.8$	Cl. 6.5.6.2.3
Compression load sharing coefficient	$K_{Hc} = 1$	Table 6.4.4
Weak-axis modulus reduction	$K_{EWeak} = 1$	Table 6.3.1C comm.

Buckling around Z-axis

Cl. 6.4.1

$$K_D = 1.15$$

Cl. 6.5.6.2.3

$$F_c = f_c * (K_D * K_{Hc} * K_{Sc} * K_T) = 13.22MPa$$

$$A = b * d = 3387mm^2$$

Cl. 6.5.6.2.2

$$C_{Cz} = L_y/d = 20.25$$

Cl. 6.5.6.2.3

$$K_{Zcz} = 6.3 * (d * L_y)^{-0.13} <= 1.3 \rightarrow K_{Zcz} = 1.3$$

Cl. 6.5.6.2.4

$$K_{Cz} = \left(1 + \frac{F_C * K_{Zcz} * C_{Cz}^3}{35 * E_{05} * K_{SE} * K_T}\right)^{-1} = 0.61$$

Cl. 6.5.6.2.3

$$P_{rz} = \frac{\varphi_c \times F_c \times A \times K_{Zcz} \times K_{Cz}}{(10)^3} = \frac{0.8 \times 13.22\ MPa \times 3387\ mm^2 \times 1.3 \times 0.61}{(10)^3} = 28.63\ kN$$

$$UtPz = \frac{P_f}{P_{rz}} = \frac{2\ kN}{28.63\ kN} = 0.07$$

UTILITY: 0.07

Buckling around Y-axis

Cl. 6.4.1

$$K_D = 1.15$$

Cl. 6.5.6.2.2

$$C_{Cy} = L_z / b = 47.24$$

Cl. 6.5.6.2.3

$$K_{Zcy} = 6.3 * (b * L_z)^{-0.13} <= 1.3 \rightarrow K_{Zcy} = 1.3$$

Cl. 6.5.6.2.4

$$K_{Cy} = \left(1 + \frac{F_C * K_{Zy} * C_{Cy}^3}{35 * K_{EWeak} * E_{05} * K_{SE} * K_T}\right)^{-1} = 0.11$$

Cl. 6.5.6.2.3

$$P_{ry} = \frac{\varphi_c \times F_c \times A \times K_{Zcy} \times K_{Cy}}{(10)^3} = \frac{0.8 \times 13.22\ MPa \times 3387\ mm^2 \times 1.3 \times 0.11}{(10)^3} = 5.19\ kN$$

$$UtPy = \frac{P_f}{P_{ry}} = \frac{2\ kN}{5.19\ kN} = 0.39$$

UTILITY: 0.39

Compressive and flexural interaction

$$I_z = \left(\frac{b * d^3}{12}\right) = 2230740 mm^4$$

Cl. 6.5.10

$$P_{Ez} = \frac{\pi^2 * E_{05} * K_{SE} * K_T * I_z}{L_{ez}^2} = 44.2 kN$$

Cl. 6.5.10

$$\left(\frac{1}{1 - P_f / P_{ez}}\right) = 1.047$$

$$I_y = \left(\frac{d * b^3}{12}\right) = 409728 mm^4$$

Cl. 6.5.10

$$P_{Ey} = \frac{\pi^2 * E_{05} * K_{EWeak} * K_{SE} * K_T * I_y}{L_{ey}^2} = 8.1 kN$$

Cl. 6.5.10

$$\left(\frac{1}{1 - P_f / P_{ey}}\right) = 1.327$$

$$UtPMzMy = \left(\frac{P_f}{P_r}\right)^2 + \frac{\left(\frac{M_{fz}}{M_{rz}}\right)}{\left(1 - \frac{P_f}{P_{ez}}\right)} + \frac{\left(\frac{M_{fy}}{M_{ry}}\right)}{\left(1 - \frac{P_f}{P_{ey}}\right)} = \left(\frac{2\ kN}{5.19\ kN}\right)^2 + \frac{\left(\frac{0.5\ kNm}{1.01\ kNm}\right)}{\left(1 - \frac{2\ kN}{44.17\ kN}\right)} + \frac{\left(\frac{0.1\ kNm}{0.45\ kNm}\right)}{\left(1 - \frac{2\ kN}{8.11\ kN}\right)} = 0.96$$

UTILITY: 0.96

Tensile and flexural interaction

$$UtTMzMy = \left(\frac{T_f}{T_r}\right) + \left(\frac{M_{fz}}{M_{rz}}\right) + \left(\frac{M_{fy}}{M_{ry}}\right) = \left(\frac{0\ kN}{28.92\ kN}\right) + \left(\frac{0.5\ kNm}{1.01\ kNm}\right) + \left(\frac{0.1\ kNm}{0.45\ kNm}\right) = 0.72$$

UTILITY: 0.72

Results Summary

Result Name	Results
MEMBER CAPACITY	
M_{rz}	1.01 kNm
M_{ry}	0.45 kNm
V_r	5.96 kN
P_{rz}	28.63 kN
P_{ry}	5.19 kN
T_r	28.92 kN
UTILITY RATIOS	
M_{fz} / M_{rz}	0.50
M_{fy} / M_{ry}	0.22
V_f / V_r	0.38
P_f / P_{rz}	0.07
P_f / P_{ry}	0.39
PM_zM_y	0.96
T_f / T_r	0.00
TM_zM_y	0.72

About this Calculator

Calculator Name: CSA O86-14 Timber Beam Design
Description: The Canadian Wood Beam Design Calculator is a tool designed to aid structural engineers in their wood or timber design calculations based on the CSA-O86-14: Engineering Design in Wood Standard.

Powered by SkyCiv

URL: https://platform.skyciv.com/quick-design?uid=4001-wood-beam-calculator&standard=CSA O86-14&selection=Lookup&cat_input=Sawn&cat_sawn=A&species=SPF&grade_sawn=No2§ion_a=2x4&finish=Surfaced&n_ply=1&L_y=1800&L_z=1800&duration_factor=Short&system_factor=NoShare&condition_factor=Dry&treatment_factor=NoTreat&M_fz=0.5&M_fy=0.1&V_fy=2&V_fz=1&C_f=2

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