



WOOD BUILDING PRACTICE

(STW442NAA)

Assignment 1

Date: Feb 16, 2024

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Submitted to: Hamdy Elarabi

* Roof

Location - Ville-Marie

Snow Load (kPa) λ_{50}

$$\begin{array}{ll} S_s & S_r \\ 2.3 & 0.4 \end{array}$$

(*) Dead Load

$$\begin{aligned} \textcircled{1} \quad \text{Superimposed dead soil} &= 1700 \text{ kg/m}^3 \\ &= 1700 \text{ kg/m}^3 \times 0.4 \text{ m} \times 9.81 \text{ m/s}^2 \\ &= 6670.8 \text{ kN/m}^2 \\ &= 6.6708 \text{ kN/m}^2 \end{aligned}$$

$$\textcircled{2} \quad \text{Dead load of structures (self weight included)} = 1.3 \text{ kPa}$$

$$\textcircled{3} \quad \text{Spandrel load (DL)} = 2.6 \text{ kN/m}$$

* Live Load (Snow) Ville-Marie

$$S_s = 2.3 \text{ kPa} \quad C_w = 1 \quad C_a = 1$$

$$S_r = 0.4 \text{ kPa} \quad C_s = 1 \quad C_b = 0.8$$

$$I_s = 1 \text{ for ULS}$$

$$I_s = 0.9 \text{ for SLS}$$

$$\text{For } S_{ULS} = I_s [S_s (C_b \times C_w \times C_s \times C_a) + S_r]$$

$$= 1 [2.3 (0.8 \times 1 \times 1 \times 1) + 0.4]$$

$$= 2.24 \text{ kPa}$$

$$\text{For } S_{SLS} = 0.9 \times 2.24$$

$$= 2.016 \text{ kPa}$$

$$\therefore \text{Snow load} = 2.24 \text{ kPa}$$

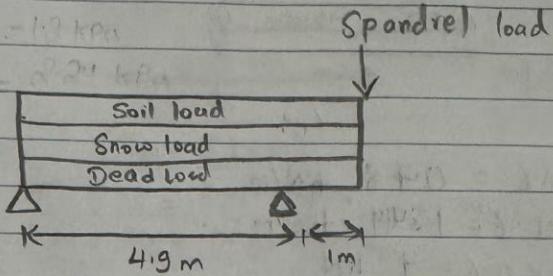
* Deflection limitations

Toists (Assuming 600 mm as Toists spacing)

1) Joist A

Dead load = 1.3 kPa

Snow load = 2.24 kPa



Uniform Load & Tributary width $T_w = 0.6 \text{ m}$

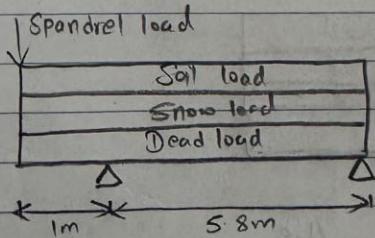
$$\text{Dead load} = 1.3 \times 0.6 = 0.78 \text{ kN/m}$$

$$\text{Snow load} = 2.24 \times 0.6 = 1.344 \text{ kN/m}$$

$$\text{Soil load} = 6.6708 \times 0.6 = 4 \text{ kN/m}$$

$$\text{Spandrel load} = 2.6 \times 0.6 = 1.56 \text{ kN}$$

2) Joist B



Uniform load

$$\text{Dead load} = 1.3 \times 0.6 = 0.78 \text{ kN/m}$$

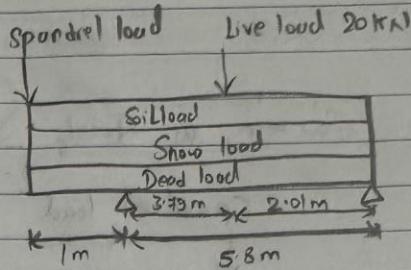
$$\text{Snow load} = 2.24 \times 0.6 = 1.344 \text{ kN/m}$$

$$\text{Soil load} = 6.6708 \times 0.6 = 4 \text{ kN/m}$$

$$\text{Spandrel load} = 2.6 \times 0.6 = 1.56 \text{ kN}$$

③

Toist C



Uniform load

$$\text{Dead load} = 1.3 \times 0.6 = 0.78 \text{ kN/m}$$

$$\text{Snow load} = 2.24 \times 0.6 = 1.344 \text{ kN/m}$$

$$\text{Soil load} = 6.67 \times 0.6 = 4 \text{ kN}$$

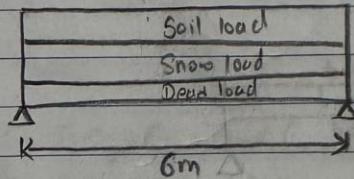
$$\text{Point Live load} = 20 \text{ kN}$$

$$\text{Spandrel load} = 2.6 \times 0.6 = 1.56 \text{ kN}$$

Beam

i) Beam A

Span



$$T_w \text{ (Tributary width)} = \frac{5.8}{2} + \frac{4.9}{2}$$

$$= 2.9 + 2.45$$

$$= 5.35 \text{ m}$$

Uniform load

$$\text{Dead load} = 1.3 \times 5.35 = 6.96 \text{ kN/m}$$

$$\text{Snow load} = 2.24 \times 5.35 = 11.98 \text{ kN/m}$$

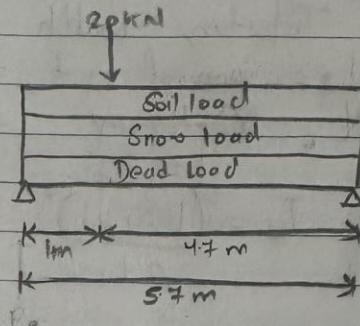
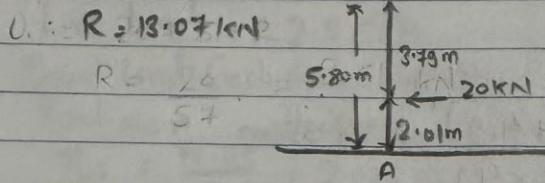
$$\text{Soil load} = 6.67 \times 5.35 = 35.68 \text{ kN/m}$$

2) Beam B

Calculating the reaction due to Point load from Joist C

$$M_B = 0 \quad (\text{Moment at } B \text{ is } 0)$$

$$M = 20 \times 3.79 = R \times 5.805 \quad \therefore R = 13.07 \text{ kN}$$



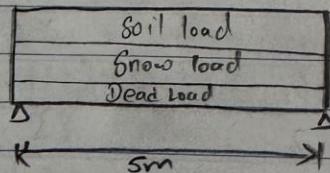
Uniform Load ($T_w = 5.35 \text{ m}$)

$$\text{Dead load} = 1.3 \times 5.35 = 6.96 \text{ kN/m}$$

$$\text{Snow load} = 2.24 \times 5.35 = 11.98 \text{ kN/m}$$

$$\text{Soil load} = 6.67 \times 5.35 = 35.68 \text{ kN/m}$$

3) Beam C



Uniform Load

$$\text{Dead load} = 1.3 \times 5.35 = 6.96 \text{ kN/m}$$

$$\text{Snow load} = 2.24 \times 5.35 = 11.98 \text{ kN/m}$$

$$\text{Soil load} = 6.67 \times 5.35 = 35.68 \text{ kN/m}$$

Header

For Tributary width

$$L_t = \text{Span of joist} = 4.9 \text{ m}$$

$$L_c = \text{Cantilever} = 1.0 \text{ m}$$

$$T_w = \frac{(L_c + L_t)^2}{2 L_t} = \frac{(1+4.9)^2}{2 \times 4.9} = 3.55 \text{ m}$$

$$\text{For Spandrel load} = w \times \frac{L_c + L_t}{L_t} = 2.6 \times \frac{(5.9)}{4.9} = 3.13 \text{ kN/m}$$

$$\text{Weight of the wall} = 0.25 \text{ kN/m}^2$$

$$\text{Height of the wall} = 4.000 \text{ m}$$

$$\begin{aligned}\text{Total wall load} &= 0.25 \times 4 \\ &= 1 \text{ kN/m}\end{aligned}$$

For Header A

$$\text{Header Span} = 2.6 \text{ m}$$

$$T_w = 3.55 \text{ m}$$

$$\text{Spandrel load} = 3.13 \text{ kN/m}$$

$$\text{Dead load} = 1.3 \text{ kPa}$$

$$\text{Snow load} = 2.24 \text{ kPa}$$

$$\text{Soil load} = 6.67 \text{ kN/m}^2$$

$$\text{Wall load} = 1 \text{ kN/m}$$

For Header B

$$\text{Header Span} = 3.1 \text{ m}$$

$$T_w = 3.55 \text{ m}$$

$$\text{Spandrel load} = 3.13 \text{ kN/m}$$

$$\text{Dead load} = 1.3 \text{ kPa}$$

$$\text{Snow load} = 2.24 \text{ kPa}$$

$$\text{Soil load} = 6.67 \text{ kN/m}^2$$

$$\text{Wall load} = 1 \text{ kN/m}$$

* Mezzanine floor

d) Joist D

Span of joist = 4.05 m

Live Load = 2.5 kPa

Dead Load (including weight of joists) = 1.6 kPa

Partition allowance (Dead load) = 1.1 kPa

$$T_w = \frac{4.05}{2} = 2.025 \text{ m}$$

Beam D

Beam span = 4.8 m

$$T_w = \frac{4.05}{2} = 2.025 \text{ m}$$

Uniform Load = Weight of the wall \times height above mezzanine

$$= 0.25 \times 3.05$$

$$= 0.76 \text{ kN/m}$$

Total DL = DL \times T_w + Uniform load

$$= (1.6 + 1.1) \times 2.025 + 0.76$$

$$= 6.23 \text{ kN/m}$$

Total Live load = 2.5×2.025

$$= 5.063 \text{ kN/m}$$

Shear
Calculation

$$\therefore V_p = \frac{wL}{2} = \frac{6.23 \times 4.8}{2} = 14.952 \text{ kN} \rightarrow \text{Dead load}$$

$$\therefore V_p = \frac{wL}{2} = \frac{5.063 \times 4.8}{2} = 12.151 \text{ kN} \rightarrow \text{Live load}$$

Beam E

Span = 4.6 m

$$T_w = \frac{4.05}{2} = 2.025 \text{ m}$$

: Uniform live load along wall = weight of the wall \times wall height above beam
 $= 0.25 \times 3.05$
 $= 0.76 \text{ kN/m}$

$$\begin{aligned}\text{Total DL} &= \text{DL} \times T_w + \text{Uniform load} \\ &= (1.6 + 1.1) \times 2.025 + 0.76 \\ &= 6.22 \text{ kN/m}\end{aligned}$$

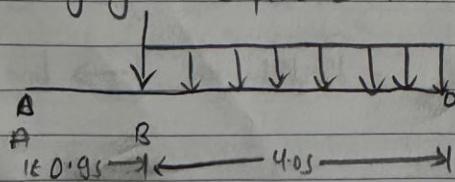
$$\begin{aligned}\text{Total LL} &= 2.5 \times 2.025 \\ &= 5.063 \text{ kN/m}\end{aligned}$$

$$\text{Shear calculation} \rightarrow V_{DL} = \frac{\omega L}{2} = \frac{6.227 \times 4.6}{2} = 14.32 \text{ kN}$$

$$V_{LL} = \frac{\omega L}{2} = \frac{5.063 \times 4.6}{2} = 11.645 \text{ kN}$$

Beam F

→ This is going to experience loads as shown in diagram



From B to C

Uniform Distributed Load

DL = 1.6 kPa

Point load = 1.1 kPa

Live load = 25 kPa

A to C

Total DL = 14.95 + 14.32 = 29.20 kN

Total LL = 12.15 + 11.645 = 23.795 kN



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Assignment 1
Joist A

Design Check Calculation Sheet

WoodWorks Sizer 2020 (Update 4)

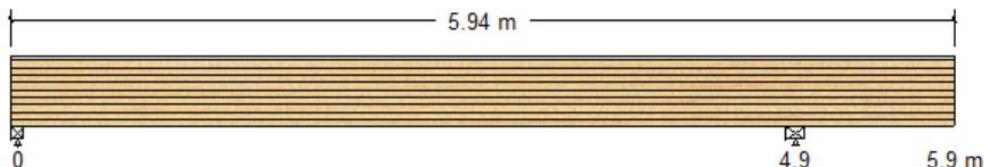
Loads:

Load	Type	Distribution	Pattern	Location [m]	Magnitude	Unit
				Start	End	
Dead L	Dead	Full Area	No		1.30 (0.60m)	kN/m ²
Soil	Dead (soil)	Full Area	No		6.67 (0.60m)	kN/m ²
Snow L	Snow	Full Area	Yes		2.24 (0.60m)	kN/m ²
Spandrel Load	Dead	Point	No	5.94	1.56	kN
Self-weight	Dead	Full UDL	No		0.14	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Load magnitude does not include Normal Importance factor from NBC Tables 4.1.6.2, 4.1.7.3, 4.1.8.2 which is applied during analysis.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:				
Dead	2.34			5.85
Snow	4.09			5.97
Dead soil	11.92			17.77
Factored:				
Total	26.94			42.92
Pt. load	0.39			
Bearing:				
Capacity				
Beam	26.94			42.92
Support	31.64			47.06
Des ratio				
Beam	1.00			1.00
Support	0.85			0.91
Load comb	#4			#2
Length	87			134
Min req'd	87			134
KB	1.00			1.07
KB min	1.00			1.07
KD	0.73			0.70
KB support	1.12			1.12
fcp sup	7.00			7.00
Kzcp sup	1.00			1.00

Joint A**Glulam-E, Spruce-Pine, 20f-E, 80x418 mm**

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 5.943 m; Clear span: 4.8, 0.9 m; Volume = 0.199 m^3; 80 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section **PASSES** the design code check.**Force vs. Resistance and Deflection using CSA O86-19:**

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	Vf @d = 23.88	Vr = 24.26	kN	
Shear 7.5.7.3a	Wf = 66.13	Wr = 101.36	kN	Wf/Wr = 0.65
Moment (+)	Mf = 30.56	Mr = 39.13	kN-m	Mf/Mr = 0.78
Moment (-)	Mf = 7.66	Mr = 21.03	kN-m	Mf/Mr = 0.36
Deflection:				
Interior Perm	7.8 = L/629	13.6 = L/360	mm	0.57
Live	2.1 = < L/999	13.6 = L/360	mm	0.16
Total	9.9 = L/493	27.2 = L/180	mm	0.36
Cantil. Perm	-4.2 = L/236	5.6 = L/180	mm	0.76
Live	-1.3 = L/748	5.6 = L/180	mm	0.24
Total	-5.6 = L/179	11.1 = L/90	mm	0.50

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
Fv	1.8	0.69	1.00	1.000	-	1.00	1.00	-	4.334	#4
Fb+	25.6	0.73	1.00	1.167	1.000	1.00	1.00	-	-	#2
Fb-	19.2	0.65	1.00	1.300	0.804	1.00	1.00	-	-	#2
Fcp	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
Es	10300	-	-	-	-	1.00	1.00	-	-	#1

Critical Load Combinations:

Shear : LC #4 = 1.25D + 1.5Ds + (1.0)1.5S (pattern: Ss)
 Moment (+) : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S
 Moment (-) : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S
 Deflection: LC #1 = 1.0D + 1.0Ds (permanent)
 LC #4 = 1.0D + 1.0Ds + (0.9)1.0S (pattern: Ss) (live)
 LC #4 = 1.0D + 1.0Ds + (0.9)1.0S (pattern: Ss) (total)

Bearing : Support 1 - LC #4 = 1.25D + 1.5Ds + (1.0)1.5S (pattern: Ss)

Support 2 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Load Types: D=dead S=snow Ds=dead load due to soil, plants

Load Patterns: s=S/2 L=L+Ls _no pattern load in this span

All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear Wr : O86 7.5.7.3(a) used; Wf = sum of all loads

EI = 5015e06 kN-mm^2

"Live" deflection is due to all non-permanent loads (live, wind, snow...)

Lateral stability(-): Lu = 4.90 m Le = 9.41 m CB = 24.8; Lu based on full span

Design Notes:

- WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.
- Please verify that the default deflection limits are appropriate for your application.
- EX grades should be considered when negative bending moment exceeds 75% of the negative bending capacity.
- BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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Assignment 1
Joist B

Design Check Calculation Sheet

WoodWorks Sizer 2020 (Update 4)

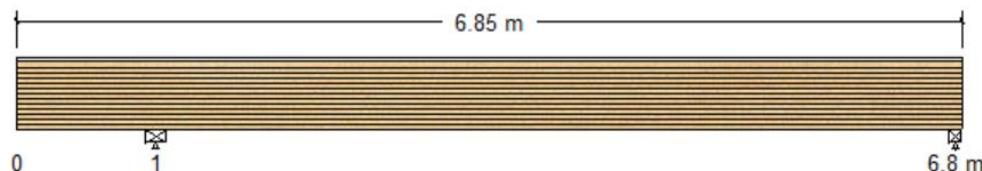
Loads:

Load	Type	Distribution	Pat- tern	Location [m]	Magnitude	Unit
				Start	Start	End
Dead L	Dead	Full Area	No		1.30 (0.60m)	kN/m ²
Soil L	Dead (soil)	Full Area	No		6.67 (0.60m)	kN/m ²
Snow L	Snow	Full Area	Yes		2.24 (0.60m)	kN/m ²
Spandrel	Dead	Point	No	0.00	1.56	kN
Self-weight	Dead	Full UDL	No		0.17	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Load magnitude does not include Normal Importance factor from NBC Tables 4.1.6.2, 4.1.7.3, 4.1.8.2 which is applied during analysis.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:					
Dead		6.39			2.99
Snow		6.70			4.87
Dead soil		19.94			14.29
Factored:					
Total		47.95			32.48
Pt. load					0.47
Bearing:					
Capacity					32.48
Beam		47.95			38.14
Support		56.31			
Des ratio					
Beam		1.00			1.00
Support		0.85			0.85
Load comb		#2			#5
Length		160			105
Min req'd		160			105
KB		1.00			1.00
KB min		1.00			1.00
KD		0.70			0.73
KB support		1.12			1.12
fcp sup		7.00			7.00
Kzcp sup		1.00			1.00

Joist B**Glulam-E, Spruce-Pine, 20f-E, 80x494 mm**

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 6.852 m; Clear span: 0.9, 5.7 m; Volume = 0.271 m^3; 80 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section **PASSES** the design code check.**Force vs. Resistance and Deflection using CSA O86-19:**

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	Vf @d = 27.86	Vr = 28.79	kN	
Shear 7.5.7.3a	Wf = 76.63	Wr = 110.96	kN	Wf/Wr = 0.69
Moment (+)	Mf = 44.41	Mr = 54.36	kN-m	Mf/Mr = 0.82
Moment (-)	Mf = 7.68	Mr = 22.81	kN-m	Mf/Mr = 0.34
Deflection:				
Interior Perm	9.8 = L/593	16.1 = L/360	mm	0.61
Live	2.6 = < L/999	16.1 = L/360	mm	0.16
Total	12.4 = L/469	32.2 = L/180	mm	0.38
Cantil. Perm	-4.8 = L/208	5.6 = L/180	mm	0.86
Live	-1.4 = L/721	5.6 = L/180	mm	0.25
Total	-6.2 = L/161	11.1 = L/90	mm	0.56

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
Fv	1.8	0.69	1.00	1.000	-	1.00	1.00	-	4.226	#5
Fb+	25.6	0.73	1.00	1.126	1.000	1.00	1.00	-	-	#2
Fb-	19.2	0.65	1.00	1.300	0.624	1.00	1.00	-	-	#2
Fcp	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
Es	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #5 = 1.25D + 1.5Ds + (1.0)1.5S (pattern: sS)

Moment (+) : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Moment (-) : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Deflection: LC #1 = 1.0D + 1.0Ds (permanent)

LC #5 = 1.0D + 1.0Ds + (0.9)1.0S (pattern: sS) (live)

LC #5 = 1.0D + 1.0Ds + (0.9)1.0S (pattern: sS) (total)

Bearing : Support 1 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Support 2 - LC #5 = 1.25D + 1.5Ds + (1.0)1.5S (pattern: sS)

Load Types: D=dead S=snow Ds=dead load due to soil, plants

Load Patterns: s=S/2 L=L+Ls _=no pattern load in this span

All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear Wr : O86 7.5.7.3(a)used; Wf = sum of all loads

EI = 8278e06 kN-mm^2

"Live" deflection is due to all non-permanent loads (live, wind, snow...)

Lateral stability(-): Lu = 5.80 m Le = 11.14 m CB = 29.3; Lu based on full span

Design Notes:

- WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.
- Please verify that the default deflection limits are appropriate for your application.
- EX grades should be considered when negative bending moment exceeds 75% of the negative bending capacity.
- BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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Assignment 1

Joist C

Design Check Calculation Sheet

WoodWorks Sizer 2020 (Update 4)

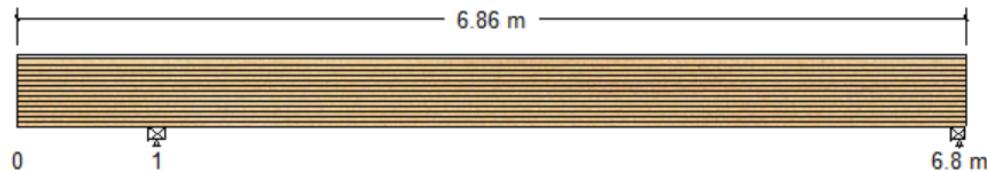
Loads:

Load	Type	Distribution	Pat-tern	Location [m]	Magnitude	Unit
				Start End	Start End	
Dead L	Dead	Full Area	No		1.30 (0.60m)	kN/m2
Soil L	Dead (soil)	Full Area	No		6.67 (0.60m)	kN/m2
Snow L	Snow	Full Area	Yes		2.24 (0.60m)	kN/m2
Spandrel Load	Snow	Point	Yes	0.00	1.56	kN
Point Load	Live ext	Point	Yes	4.79	20.00	kN
Self-weight	Dead	Full UDL	No		0.17	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Load magnitude does not include Normal Importance factor from NBC Tables 4.1.6.2, 4.1.7.3, 4.1.8.2 which is applied during analysis.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:					
Dead		4.56			3.27
Live		6.93			13.07
Snow		8.53			4.74
Dead soil		19.94			14.30
Factored:					
Total		48.41			45.14
Pt. load					0.39
Bearing:					
Capacity					
Beam		48.41			45.14
Support		53.17			53.01
Des ratio					
Beam		1.00			1.00
Support		0.91			0.85
Load comb		#3			#2
Length		138			113
Min req'd		138			113
KB		1.07			1.00
KB min		1.07			1.00
KD		0.77			0.94
KB support		1.12			1.12
fcp sup		7.00			7.00
Kzcp sup		1.00			1.00

Joist C**Glulam-E, Spruce-Pine, 20f-E, 80x494 mm**

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 6.856 m; Clear span: 0.9, 5.7 m; Volume = 0.271 m^3; 80 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section **PASSES** the design code check.**Force vs. Resistance and Deflection using CSA O86-19:**

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	Vf @d = 39.83	Vr = 34.85	kN	
Shear 7.5.7.3a	Wf = 90.76	Wr = 118.20	kN	Wf/Wr = 0.77
Moment(+)	Mf = 71.89	Mr = 74.97	kN-m	Mf/Mr = 0.96
Moment(-)	Mf = 8.07	Mr = 22.81	kN-m	Mf/Mr = 0.35
Deflection:				
Interior Perm	10.2 = L/570	16.1 = L/360	mm	0.63
Live	8.6 = L/670	16.1 = L/360	mm	0.54
Total	18.8 = L/309	32.2 = L/180	mm	0.58
Cantil. Perm	-5.2 = L/191	5.6 = L/180	mm	0.94
Live	-4.1 = L/242	5.6 = L/180	mm	0.74
Total	-9.4 = L/106	11.1 = L/90	mm	0.84

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
Fv	1.8	0.84	1.00	1.000	-	1.00	1.00	-	3.718	#2
Fb+	25.6	1.00	1.00	1.124	1.000	1.00	1.00	-	-	#2
Fb-	19.2	0.95	1.00	1.300	0.429	1.00	1.00	-	-	#3
Fcp	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
Es	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = 1.25D + 1.5Ds + 1.5L

Moment (+) : LC #2 = 1.25D + 1.5Ds + 1.5L

Moment (-) : LC #3 = 1.25D + 1.5Ds + (1.0)1.5S

Deflection: LC #1 = 1.0D + 1.0Ds (permanent)

LC #2 = 1.0D + 1.0Ds + 1.0L (live)

LC #2 = 1.0D + 1.0Ds + 1.0L (total)

Bearing : Support 1 - LC #3 = 1.25D + 1.5Ds + (1.0)1.5S

Support 2 - LC #2 = 1.25D + 1.5Ds + 1.5L

Load Types: D=dead S=snow L=live(use, occupancy)

Ds=dead load due to soil, plants

Load Patterns: s=S/2 L=L+Ls _ =no pattern load in this span

All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear Wr : O86 7.5.7.3(a)used; Wf = sum of all loads

EI = 8278e06 kN-mm^2

"Live" deflection is due to all non-permanent loads (live, wind, snow...)

Lateral stability(-): Lu = 5.80 m Le = 11.14 m CB = 29.3; Lu based on full span

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.
2. Please verify that the default deflection limits are appropriate for your application.
3. EX grades should be considered when negative bending moment exceeds 75% of the negative bending capacity.
4. BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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113208227
Feb. 16, 2024 11:53

PROJECT
Assignment 1
Beam A

Design Check Calculation Sheet

WoodWorks Sizer 2020 (Update 4)

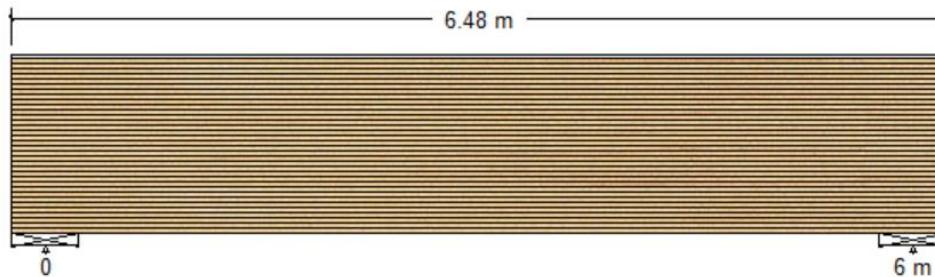
Loads:

Load	Type	Distribution	Pat-tern	Location [m]	Magnitude	Unit
				Start End	Start End	
Dead L	Dead	Full Area			1.30 (5.35m)	kN/m ²
Snow L	Snow	Full Area			2.24 (5.35m)	kN/m ²
Soil L	Dead (soil)	Full Area			6.67 (5.35m)	kN/m ²
Self-weight	Dead	Full UDL			0.92	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Load magnitude does not include Normal Importance factor from NBC Tables 4.1.6.2, 4.1.7.3, 4.1.8.2 which is applied during analysis.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:			
Dead	30.50		30.50
Snow	47.82		47.82
Dead soil	142.39		142.39
Factored:			
Total	323.43		323.43
Bearing:			
Capacity			
Beam	323.43		323.43
Support	339.44		339.44
Des ratio			
Beam	1.00		1.00
Support	0.95		0.95
Load comb	#2		#2
Length	480		480
Min req'd	480		480
KB	1.00		1.00
KB min	1.00		1.00
KD	0.72		0.72
KB support	1.00		1.00
fcp sup	7.00		7.00
Kzcp sup	1.00		1.00

Beam A**Glulam-E, Spruce-Pine, 20f-E, 175x1216 mm**

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 6.48 m; Clear span: 5.5 m; Volume = 1.379 m³; 175 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section **PASSES** the design code check.**Force vs. Resistance and Deflection using CSA O86-19:**

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	V _f @d = 156.52	V _r = 161.03	kN	V _f /V _r = 0.97
Shear 7.5.7.3a	W _f = 608.34	W _r = 395.56	kN	
Moment (+)	M _f = 456.25	M _r = 676.41	kN-m	M _f /M _r = 0.67
Perm. Defl'n	3.4 = < L/999	16.7 = L/360	mm	0.20
Live Defl'n	0.8 = < L/999	16.7 = L/360	mm	0.05
Total Defl'n	4.2 = < L/999	33.3 = L/180	mm	0.13

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
F _v	1.8	0.72	1.00	1.000	-	1.00	1.00	-	3.565	#2
F _{b+}	25.6	0.72	1.00	0.945	1.000	1.00	1.00	-	-	#2
F _{cp}	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
E _s	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Moment (+) : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Deflection: LC #1 = 1.0D + 1.0Ds (permanent)

LC #2 = 1.0D + 1.0Ds + (0.9)1.0S (live)

LC #2 = 1.0D + 1.0Ds + (0.9)1.0S (total)

Bearing : Support 1 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Support 2 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Load Types: D=dead S=snow Ds=dead load due to soil, plants

Load Patterns: s=S/2 L=L+Ls _=no pattern load in this span

All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:Shear V_r : O86 7.5.7.3(b) usedEI = 270081e06 kN-mm²

"Live" deflection is due to all non-permanent loads (live, wind, snow...)

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.

2. Please verify that the default deflection limits are appropriate for your application.

3. BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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Feb. 16, 2024 12:05

PROJECT

Assignment 1
Beam B

Design Check Calculation Sheet

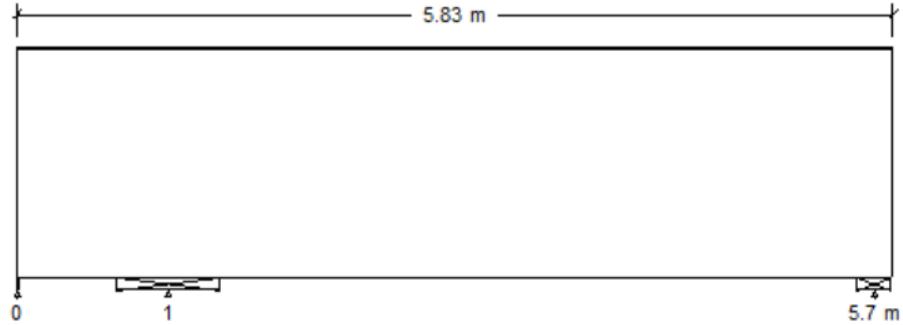
WoodWorks Sizer 2020 (Update 4)

Loads:

Load	Type	Distribution	Pattern	Location [m]	Magnitude	Unit
Dead L	Dead	Full Area	No		1.30 (5.35m)	kN/m ²
Snow L	Snow	Full Area	Yes		2.24 (5.35m)	kN/m ²
Soil L	Dead (soil)	Full Area	No		6.67 (5.35m)	kN/m ²
Point Load	Live ext	Point	No	1.01	20.00	kN
Self-weight	Dead	Full UDL	No		1.41	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Load magnitude does not include Normal Importance factor from NBC Tables 4.1.6.2, 4.1.7.3, 4.1.8.2 which is applied during analysis.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :

Beam B

Glulam-E, Spruce-Pine, 20f-E, 215x1520 mm

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 5.827 m; Clear span: 0.6, 4.2 m; Volume = 1.904 m³; 133 mm max lam width

Lateral support: top = continuous, bottom = at end supports;

This section PASSES the design code check.

Force vs. Resistance and Deflection using CSA O86-19:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	Vf @d = 234.23	Vr = 239.79	kN	Vf/Vr = 0.98
Shear 7.5.7.3a	Wf = 570.18	Wr = 552.83	kN	
Moment(+)	Mf = 176.62	Mr = 1365.27	kN-m	Mf/Mr = 0.13
Moment(-)	Mf = 234.23	Mr = 942.43	kN-m	Mf/Mr = 0.25
Perm. Defl'n	0.3 = < L/999	13.1 = L/360	mm	0.02
Live Defl'n	0.1 = < L/999	13.1 = L/360	mm	0.01
Total Defl'n	0.3 = < L/999	26.1 = L/180	mm	0.01

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
Fv	1.8	0.70	1.00	1.000	-	1.00	1.00	-	3.581	#7
Fb+	25.6	0.72	1.00	0.996	1.000	1.00	1.00	-	-	#3
Fb-	19.2	0.72	1.00	1.061	0.918	1.00	1.00	-	-	#7
Fcp	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
Es	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #7 = 1.25D + 1.5Ds + (1.0)1.5S (pattern: sS)

Moment(+) : LC #3 = 1.25D + 1.5Ds + (1.0)1.5S

Moment(-) : LC #7 = 1.25D + 1.5Ds + (1.0)1.5S (pattern: sS)

Deflection: LC #1 = 1.0D + 1.0Ds (permanent)

LC #7 = 1.0D + 1.0Ds + (0.9)1.0S (pattern: sS) (live)

LC #7 = 1.0D + 1.0Ds + (0.9)1.0S (pattern: sS) (total)

Bearing : Support 1 - LC #1 = 1.4D + 1.5Ds

Support 2 - LC #3 = 1.25D + 1.5Ds + (1.0)1.5S

Support 3 - LC #7 = 1.25D + 1.5Ds + (1.0)1.5S (pattern: sS)

Uplift : Support 1 - LC #7 = 1.25D + 1.5Ds + (1.0)1.5S (pattern: sS)

Load Types: D=dead S=snow L=live(use,occupancy)

Ds=dead load due to soil, plants

Load Patterns: s=S/2 L=L+Ls _=no pattern load in this span

All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear Vr : O86 7.5.7.3(b) used

EI = 648075e06 kN-mm²

"Live" deflection is due to all non-permanent loads (live, wind, snow...)

Lateral stability(-): Lu = 5.70 m Le = 10.94 m CB = 19.0; Lu based on full span

Design Notes:

- WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.
- Please verify that the default deflection limits are appropriate for your application.
- EX grades should be considered when negative bending moment exceeds 75% of the negative bending capacity.
- BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).
- This beam is restrained at end supports only.



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Feb. 16, 2024 12:10

PROJECT

Assignment 1
Beam C

Design Check Calculation Sheet
WoodWorks Sizer 2020 (Update 4)

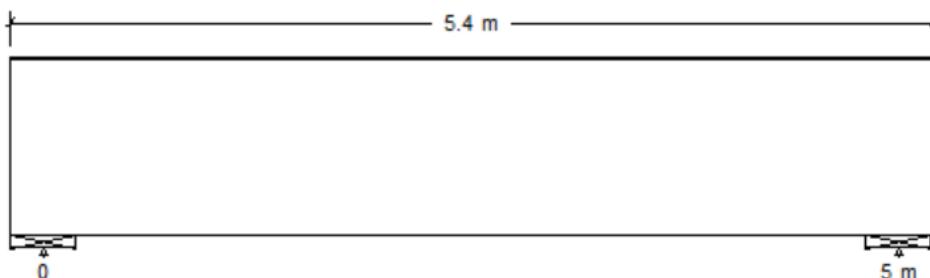
Loads:

Load	Type	Distribution	Pat- tern	Location [m]	Magnitude	Unit
				Start End	Start End	
Dead L	Dead	Full Area			1.30 (5.35m)	kN/m ²
Snow L	Snow	Full Area			2.24 (5.35m)	kN/m ²
Soil L	Dead (soil)	Full Area			6.67 (5.35m)	kN/m ²
Self-weight	Dead	Full UDL			0.77	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Load magnitude does not include Normal Importance factor from NBC Tables 4.1.6.2, 4.1.7.3, 4.1.8.2 which is applied during analysis.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:			
Dead	25.05		25.05
Snow	39.84		39.84
Dead soil	118.64		118.64
Factored:			
Total	269.04		269.04
Bearing:			
Capacity			
Beam	269.04		269.04
Support	282.35		282.35
Des ratio			
Beam	1.00		1.00
Support	0.95		0.95
Load comb	#2		#2
Length	399		399
Min req'd	399		399
KB	1.00		1.00
KB min	1.00		1.00
KD	0.72		0.72
KB support	1.00		1.00
fcp sup	7.00		7.00
Kzcp sup	1.00		1.00

Beam C

Glulam-E, Spruce-Pine, 20f-E, 175x1026 mm

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 5.399 m; Clear span: 4.6 m; Volume = 0.969 m³; 175 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section PASSES the design code check.

Force vs. Resistance and Deflection using CSA O86-19:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	Vf @d = 128.98	Vr = 135.98	kN	Vf/Vr = 0.95
Shear 7.5.7.3a	Wf = 506.05	Wr = 355.88	kN	
Moment (+)	Mf = 316.28	Mr = 499.21	kN-m	Mf/Mr = 0.63
Perm. Defl'n	2.7 = < L/999	13.9 = L/360	mm	0.20
Live Defl'n	0.7 = < L/999	13.9 = L/360	mm	0.05
Total Defl'n	3.4 = < L/999	27.8 = L/180	mm	0.12

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
Fv	1.8	0.72	1.00	1.000	-	1.00	1.00	-	3.565	#2
Fb+	25.6	0.72	1.00	0.978	1.000	1.00	1.00	-	-	#2
Fcp	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
Es	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Moment (+) : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Deflection: LC #1 = 1.0D + 1.0Ds (permanent)

LC #2 = 1.0D + 1.0Ds + (0.9)1.0S (live)

LC #2 = 1.0D + 1.0Ds + (0.9)1.0S (total)

Bearing : Support 1 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Support 2 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Load Types: D=dead S=snow Ds=dead load due to soil, plants

Load Patterns: s=S/2 l=L+Ls _=no pattern load in this span

All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear Vr : O86 7.5.7.3 (b) used

EI = 162232e06 kN-mm²

"Live" deflection is due to all non-permanent loads (live, wind, snow...)

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.

2. Please verify that the default deflection limits are appropriate for your application.

3. BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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Feb. 16, 2024 12:35

PROJECT
Assignment 1
Header A

Design Check Calculation Sheet
WoodWorks Sizer 2020 (Update 4)

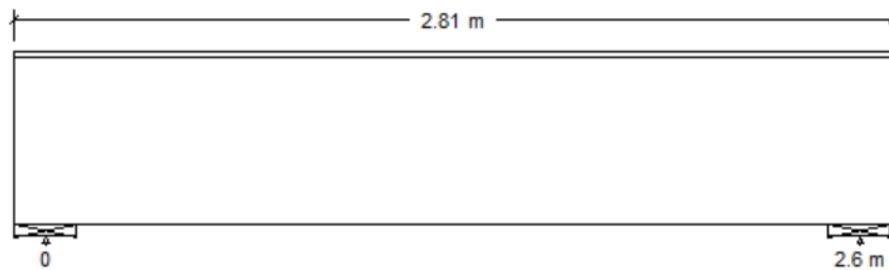
Loads:

Load	Type	Distribution	Pat-tern	Location [m]	Magnitude	Unit
				Start End	Start End	
Dead L	Dead	Full Area			1.30 (3.55m)	kN/m2
Snow L	Snow	Full Area			2.24 (3.55m)	kN/m2
Soil L	Dead (soil)	Full Area			6.67 (3.55m)	kN/m2
Wall L	Dead	Full UDL			1.00	kN/m
Spandrel L	Dead	Full UDL			3.13	kN/m
Self-weight	Dead	Full UDL			0.30	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Load magnitude does not include Normal Importance factor from NBC Tables 4.1.6.2, 4.1.7.3, 4.1.8.2 which is applied during analysis.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:			
Dead	14.15		14.15
Snow	13.74		13.74
Dead soil	40.91		40.91
Factored:			
Total	99.67		99.67
Bearing:			
Capacity			
Beam	99.67		99.67
Support	112.27		112.27
Des ratio			
Beam	1.00		1.00
Support	0.89		0.89
Load comb	#2		#2
Length	206		206
Min req'd	206		206
KB	1.00		1.00
KB min	1.00		1.00
KD	0.70		0.70
KB support	1.07		1.07
fcp sup	7.00		7.00
Kzcp sup	1.00		1.00



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Header A

WoodWorks® Sizer 2020 (Update 4)

Page 2

Header A

Glulam-E, Spruce-Pine, 20f-E, 130x532 mm

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 2.806 m; Clear span: 2.4 m; Volume = 0.194 m³; 130 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section PASSES the design code check.

Force vs. Resistance and Deflection using CSA O86-19:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	V _f @d = 47.93	V _r = 50.74	kN	V _f /V _r = 0.94
Shear 7.5.7.3a	W _f = 187.34	W _r = 177.38	kN	
Moment (+)	M _f = 60.88	M _r = 98.73	kN-m	M _f /M _r = 0.62
Perm. Defl'n	1.4 = < L/999	7.2 = L/360	mm	0.20
Live Defl'n	0.3 = < L/999	7.2 = L/360	mm	0.04
Total Defl'n	1.7 = < L/999	14.4 = L/180	mm	0.12

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
F _v	1.8	0.70	1.00	1.000	-	1.00	1.00	-	3.565	#2
F _{b+}	25.6	0.70	1.00	1.149	1.000	1.00	1.00	-	-	#2
F _{cp}	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
E _s	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Moment (+) : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Deflection: LC #1 = 1.0D + 1.0Ds (permanent)

LC #2 = 1.0D + 1.0Ds + (0.9)1.0S (live)

LC #2 = 1.0D + 1.0Ds + (0.9)1.0S (total)

Bearing : Support 1 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Support 2 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Load Types: D=dead S=snow Ds=dead load due to soil, plants

Load Patterns: s=S/2 I=L+Ls _=no pattern load in this span

All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear V_r : O86 7.5.7.3(b) used

EI = 16801e06 kN-mm²

"Live" deflection is due to all non-permanent loads (live, wind, snow...)

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.

2. Please verify that the default deflection limits are appropriate for your application.

3. BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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Lenin Rai
113208227
Feb. 16, 2024 12:41

PROJECT

Assignment 1
Header B

Design Check Calculation Sheet

WoodWorks Sizer 2020 (Update 4)

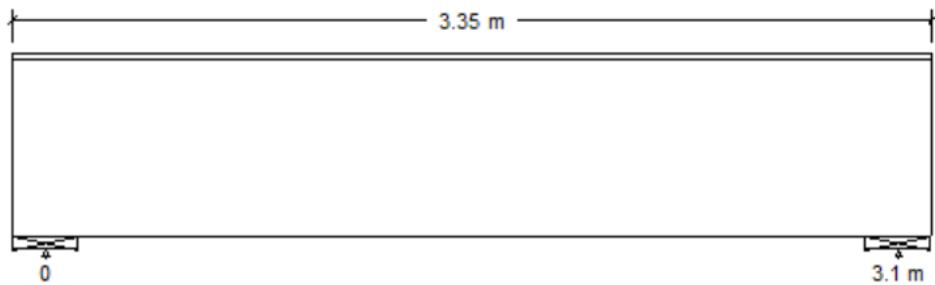
Loads:

Load	Type	Distribution	Pat-tern	Location [m]	Magnitude	Unit
				Start End	Start End	
Dead L	Dead	Full Area			1.30 (3.55m)	kN/m ²
Snow L	Snow	Full Area			2.24 (3.55m)	kN/m ²
Soil L	Dead (soil)	Full Area			6.67 (3.55m)	kN/m ²
Wall L	Dead	Full UDL			1.00	kN/m
Spandrel L	Dead	Full UDL			3.13	kN/m
Self-weight	Dead	Full UDL			0.36	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Load magnitude does not include Normal Importance factor from NBC Tables 4.1.6.2, 4.1.7.3, 4.1.8.2 which is applied during analysis.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:			
Dead	16.98		16.98
Snow	16.38		16.38
Dead soil	48.79		48.79
Factored:			
Total	118.97		118.97
Bearing:			
Capacity			
Beam	118.97		118.97
Support	134.01		134.01
Des ratio			
Beam	1.00		1.00
Support	0.89		0.89
Load comb	#2		#2
Length	246		246
Min req'd	246		246
KB	1.00		1.00
KB min	1.00		1.00
KD	0.70		0.70
KB support	1.07		1.07
fcp sup	7.00		7.00
Kzcp sup	1.00		1.00



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Header B

WoodWorks® Sizer 2020 (Update 4)

Page 2

Header B

Glulam-E, Spruce-Pine, 20f-E, 130x646 mm

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 3.346 m; Clear span: 2.9 m; Volume = 0.281 m³; 130 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section PASSES the design code check.

Force vs. Resistance and Deflection using CSA O86-19:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	V _f @d = 56.35	V _r = 61.59	kN	V _f /V _r = 0.91
Shear 7.5.7.3a	W _f = 223.61	W _r = 201.41	kN	
Moment (+)	M _f = 86.65	M _r = 145.50	kN-m	M _f /M _r = 0.60
Perm. Defl'n	1.6 = < L/999	8.6 = L/360	mm	0.19
Live Defl'n	0.4 = < L/999	8.6 = L/360	mm	0.04
Total Defl'n	2.0 = < L/999	17.2 = L/180	mm	0.11

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	kN	Cv	LC#
F _v	1.8	0.70	1.00	1.000	-	1.00	1.00	-	3.565	#2
F _{b+}	25.6	0.70	1.00	1.107	1.000	1.00	1.00	-	-	#2
F _{cp}	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
E _s	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Moment (+) : LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Deflection: LC #1 = 1.0D + 1.0Ds (permanent)

LC #2 = 1.0D + 1.0Ds + (0.9)1.0S (live)

LC #2 = 1.0D + 1.0Ds + (0.9)1.0S (total)

Bearing : Support 1 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Support 2 - LC #2 = 1.25D + 1.5Ds + (1.0)1.5S

Load Types: D=dead S=snow Ds=dead load due to soil, plants

Load Patterns: s=S/2 L=L+Ls _ =no pattern load in this span

All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear V_r : O86 7.5.7.3(b) used

EI = 30081e06 kN-mm²

"Live" deflection is due to all non-permanent loads (live, wind, snow...)

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.

2. Please verify that the default deflection limits are appropriate for your application.

3. BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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 Feb. 16, 2024 13:10

PROJECT
 Assignment 1
 M JOIST D

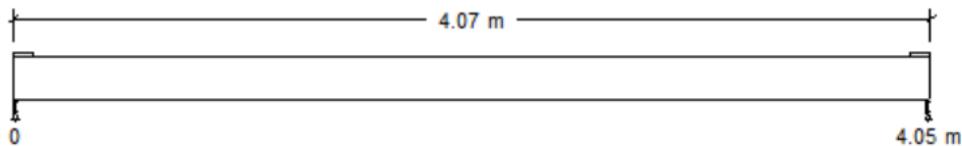
Design Check Calculation Sheet
 WoodWorks Sizer 2020 (Update 4)

Loads:

Load	Type	Distribution	Pat- tern	Location [m]	Magnitude	Unit
				Start End	Start End	
Dead L	Dead	Full Area			1.60 (0.40m)	kN/m ²
Live L	Live	Full Area			2.50 (0.40m)	kN/m ²
Partation L	Dead	Full Area			1.10 (0.40m)	kN/m ²
Self-weight	Dead	Full UDL			0.07	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:			
Dead	2.88		2.88
Live	2.54		2.54
Factored:			
Total	7.40		7.40
Bearing:			
Capacity			
Beam	7.40		7.40
Support	8.70		8.70
Des ratio			
Beam	1.00		1.00
Support	0.85		0.85
Load comb	#2		#2
Length	18		18
Min req'd	18		18
KB	1.00		1.00
KB min	1.00		1.00
KD	0.97		0.97
KB support	1.12		1.12
fcp sup	7.00		7.00
Kzcp sup	1.00		1.00

Mezzanine Joist D
Glulam-E, Spruce-Pine, 20f-E, 80x190 mm

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 4.068 m; Clear span: 4 m; Volume = 0.062 m³; 80 mm max lam width

Lateral support: top = at supports, bottom = at supports;

This section PASSES the design code check.



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M JOIST D

WoodWorks® Sizer 2020 (Update 4)

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Force vs. Resistance and Deflection using CSA O86-19:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	$V_f @d = 6.65$	$V_r = 15.53$	kN	
Shear 7.5.7.3a	$W_f = 14.76$	$W_r = 65.84$	kN	$W_f/W_r = 0.22$
Moment (+)	$M_f = 7.47$	$M_r = 10.79$	kN-m	$M_f/M_r = 0.69$
Perm. Defl'n	$10.5 = L/384$	$11.2 = L/360$	mm	0.94
Live Defl'n	$9.3 = L/435$	$11.2 = L/360$	mm	0.83
Total Defl'n	$19.8 = L/204$	$22.5 = L/180$	mm	0.88

Additional Data:

FACTORS: f/E (MPa) KD KH KZ KL KT KS KN Cv LC#
 F_v 1.8 0.97 1.00 1.000 - 1.00 1.00 - 3.565 #2
 F_{b+} 25.6 0.97 1.00 1.279 1.000 1.00 1.00 - - - #2
 F_{cp} 5.8 - - 1.150 - 1.00 1.00 - - - #-
 E_s 10300 - - - - 1.00 1.00 - - - #1

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = 1.25D + 1.5L
Moment (+) : LC #2 = 1.25D + 1.5L
Deflection: LC #1 = 1.0D (permanent)
 LC #2 = 1.0D + 1.0L (live)
 LC #2 = 1.0D + 1.0L (total)
Bearing : Support 1 - LC #2 = 1.25D + 1.5L
 Support 2 - LC #2 = 1.25D + 1.5L
Load Types: D=dead L=live(use,occupancy)
Load Patterns: s=S/2 L=L+Ls _=no pattern load in this span
All Load Combinations (LCs) are listed in the Analysis output
CALCULATIONS:
Shear Wr : O86 7.5.7.3(a)used; W_f = sum of all loads
 $EI = 471e06 \text{ kN-mm}^2$
"Live" deflection is due to all non-dead loads (live, wind, snow...)

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.
2. Please verify that the default deflection limits are appropriate for your application.



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PROJECT
Assignment 1
M BEAM D

Design Check Calculation Sheet

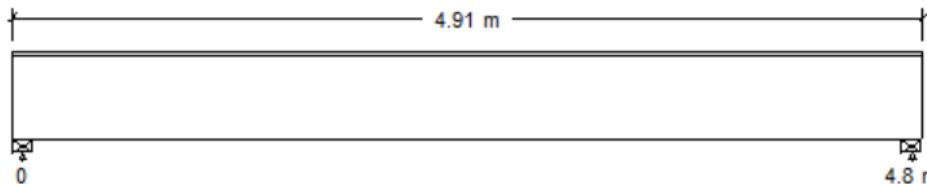
WoodWorks Sizer 2020 (Update 4)

Loads:

Load	Type	Distribution	Pat- tern	Location [m]	Magnitude	Unit
				Start End	Start End	
Dead L	Dead	Full Area			1.60 (2.03m)	kN/m ²
Live L	Live	Full Area			2.50 (2.03m)	kN/m ²
Partation All	Dead	Full Area			1.10 (2.03m)	kN/m ²
Unifom L	Dead	Full UDL			0.76	kN/m
Self-weight	Dead	Full UDL			0.16	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:				
Dead	18.96			18.96
Live	15.48			15.48
Factored:				
Total	46.92			46.92
Bearing:				
Capacity				
Beam	46.92			46.92
Support	55.10			55.10
Des ratio				
Beam	1.00			1.00
Support	0.85			0.85
Load comb	#2			#2
Length	115			115
Min req'd	115			115
KB	1.00			1.00
KB min	1.00			1.00
KD	0.96			0.96
KB support	1.12			1.12
fcp sup	7.00			7.00
Kzcp sup	1.00			1.00

Mezzanine Beam D

Glulam-E, Spruce-Pine, 20f-E, 80x456 mm

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 4.915 m; Clear span: 4.7 m; Volume = 0.179 m³; 80 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section PASSE S the design code check.



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M BEAM D

WoodWorks® Sizer 2020 (Update 4)

Page 2

Force vs. Resistance and Deflection using CSA O86-19:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	$V_f @d = 36.19$	$V_r = 36.62$	kN	
Shear 7.5.7.3a	$W_f = 92.07$	$W_r = 128.61$	kN	$W_f/W_r = 0.72$
Moment (+)	$M_f = 55.24$	$M_r = 61.06$	kN-m	$M_f/M_r = 0.90$
Perm. Defl'n	$8.2 = L/583$	$13.3 = L/360$	mm	0.62
Live Defl'n	$6.7 = L/714$	$13.3 = L/360$	mm	0.50
Total Defl'n	$14.9 = L/321$	$26.7 = L/180$	mm	0.56

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
Fv	1.8	0.96	1.00	1.000	-	1.00	1.00	-	3.565	#2
Eb+	25.6	0.96	1.00	1.152	1.000	1.00	1.00	-	-	#2
Fcp	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
Es	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = 1.25D + 1.5L
 Moment (+) : LC #2 = 1.25D + 1.5L
 Deflection: LC #1 = 1.0D (permanent)
 LC #2 = 1.0D + 1.0L (live)
 LC #2 = 1.0D + 1.0L (total)
 Bearing : Support 1 - LC #2 = 1.25D + 1.5L
 Support 2 - LC #2 = 1.25D + 1.5L
 Load Types: D=dead L=live(use,occupancy)
 Load Patterns: s=S/2 L=L+Ls _=no pattern load in this span
 All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear Wr : O86 7.5.7.3(a)used; Wf = sum of all loads
 EI = 6511e06 kN-mm²
 "Live" deflection is due to all non-dead loads (live, wind, snow...)

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.
2. Please verify that the default deflection limits are appropriate for your application.
3. BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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PROJECT
Assignment 1
M BEAM E

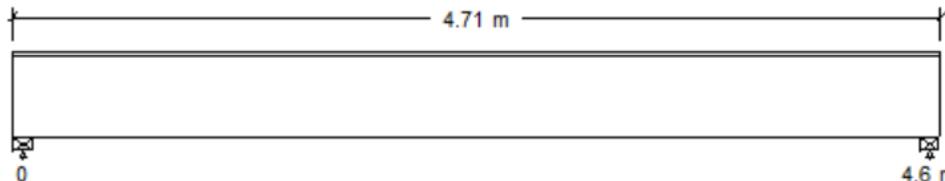
Design Check Calculation Sheet
WoodWorks Sizer 2020 (Update 4)

Loads:

Load	Type	Distribution	Pat- tern	Location [m]	Magnitude	Unit
				Start	End	
Dead L	Dead	Full Area			1.60 (2.03m)	kN/m ²
Live L	Live	Full Area			2.50 (2.03m)	kN/m ²
Partation All	Dead	Full Area			1.10 (2.03m)	kN/m ²
Uniform L	Dead	Full UDL			0.76	kN/m
Self-weight	Dead	Full UDL			0.14	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:			
Dead	18.14		18.14
Live	14.83		14.83
Factored:			
Total	44.93		44.93
Bearing:			
Capacity			
Beam	44.93		44.93
Support	52.76		52.76
Des ratio			
Beam	1.00		1.00
Support	0.85		0.85
Load comb	#2		#2
Length	110		110
Min req'd	110		110
KB	1.00		1.00
KB min	1.00		1.00
KD	0.96		0.96
KB support	1.12		1.12
fcp sup	7.00		7.00
Kzcp sup	1.00		1.00

Mezzanine Beam E
Glulam-E, Spruce-Pine, 20f-E, 80x418 mm

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 4.71 m; Clear span: 4.5 m; Volume = 0.158 m³; 80 mm max lam width

Lateral support: top = continuous, bottom = at supports;

This section PASSES the design code check.



Force vs. Resistance and Deflection using CSA O86-19:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	$V_f @d = 35.01$	$V_r = 33.58$	kN	
Shear 7.5.7.3a	$W_f = 88.16$	$W_r = 120.72$	kN	
Moment (+)	$M_f = 50.69$	$M_r = 51.33$	kN-m	$W_f/W_r = 0.73$ $M_f/M_r = 0.99$
Perm. Defl'n	$9.0 = L/511$	$12.8 = L/360$	mm	0.70
Live Defl'n	$7.4 = L/625$	$12.8 = L/360$	mm	0.58
Total Defl'n	$16.4 = L/281$	$25.6 = L/180$	mm	0.64

Additional Data:

FACTORS: f/E (MPa) KD KH KZ KL KT KS KN Cv LC#
Fv 1.8 0.96 1.00 1.000 - 1.00 1.00 - 3.565 #2
Fb+ 25.6 0.96 1.00 1.167 1.000 1.00 1.00 - - #2
Fcp 5.8 - - 1.150 - 1.00 1.00 - - #-
Es 10300 - - - - 1.00 1.00 - - #1

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = 1.25D + 1.5L
Moment (+) : LC #2 = 1.25D + 1.5L
Deflection: LC #1 = 1.0D (permanent)
LC #2 = 1.0D + 1.0L (live)
LC #2 = 1.0D + 1.0L (total)
Bearing : Support 1 - LC #2 = 1.25D + 1.5L
Support 2 - LC #2 = 1.25D + 1.5L
Load Types: D=dead L=live (use,occupancy)
Load Patterns: s=S/2 I=L+Ls _=no pattern load in this span
All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:
Shear Wr : O86 7.5.7.3(a) used; $W_f = \text{sum of all loads}$
 $EI = 5015e06 \text{ kN-mm}^2$
"Live" deflection is due to all non-dead loads (live, wind, snow...)

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.
2. Please verify that the default deflection limits are appropriate for your application.
3. BEAMS require restraint against lateral displacement and rotation at points of bearing (O86 7.5.6.3.1).



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PROJECT
Assignment 1
M BEAM F

Design Check Calculation Sheet

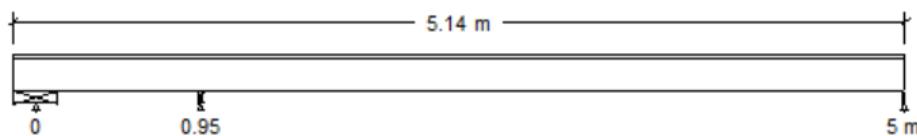
WoodWorks Sizer 2020 (Update 4)

Loads:

Load	Type	Distribution	Pattern	Location [m]	Magnitude	Unit
				Start	End	
Dead L	Dead	Full Area	No		1.60 (0.40m)	kN/m ²
Live L	Live	Full Area	Yes		2.50 (0.40m)	kN/m ²
Partation all	Dead	Full Area	No		1.10 (0.40m)	kN/m ²
Dead point lod	Dead	Point	No	0.13	29.20	kN
Live point lod	Live	Point	Yes	0.13	23.80	kN
Self-weight	Dead	Full UDL	No		0.07	kN/m

Beam is a continuous support for all area loads, such that 125% of load on tributary width is applied to beam.

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:						
Dead	27.51		6.63			2.29
Live	24.49		5.86			2.03
Factored:						
Uplift	0.08					
Total	71.13					5.90
Pt. load	72.57		17.08			0.02
Bearing:						
Capacity						
Beam	72.57		17.08			5.90
Support	130.40		17.92			6.92
Des ratio						
Beam	1.00^		1.00			1.00
Support	0.55		0.95			0.85
Load comb	#4		#2			#5
Length	267^		41			14
Min req'd	267^		41			14
KB	1.00		1.00			1.00
KB min	1.00		1.00			1.00
KD	0.97		0.97			0.97
KB support	1.12		1.00			1.12
fcp sup	7.00		7.00			7.00
Kzcp sup	1.00		1.00			1.00

[^] = O86 7.5.9.3 for point loads near support govems.

Mezzanine Beam F

Glulam-E, Spruce-Pine, 20f-E, 80x190 mm

Supports: All - Timber Beam, D.Fir-L No.2

Total length: 5.141 m; Clear span: 0.8, 4 m; Volume = 0.078 m³; 80 mm max lam width

Lateral support: top = continuous, bottom = at end supports;

This section PASSES the design code check.



Force vs. Resistance and Deflection using CSA O86-19:

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear 7.5.7.3b	$V_f @d = 6.88$	$V_r = 14.80$	kN	
Shear 7.5.7.3a	$W_f = 16.44$	$W_r = 59.26$	kN	
Moment (+)	$M_f = 4.74$	$M_r = 10.81$	kN-m	$W_f/W_r = 0.28$
Moment (-)	$M_f = 6.13$	$M_r = 8.09$	kN-m	$M_f/M_r = 0.44$
Perm. Defl'n	$5.4 = L/745$	$11.2 = L/360$	mm	$M_f/M_r = 0.76$
Live Defl'n	$4.9 = L/834$	$11.2 = L/360$	mm	0.48
Total Defl'n	$10.3 = L/393$	$22.5 = L/180$	mm	0.43
				0.46

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	KZ	KL	KT	KS	KN	Cv	LC#
Fv	1.8	0.93	1.00	1.000	-	1.00	1.00	-	3.497	#5
Fb+	25.6	0.97	1.00	1.300	1.000	1.00	1.00	-	-	#5
Fb-	19.2	0.97	1.00	1.300	1.000	1.00	1.00	-	-	#2
Fcp	5.8	-	-	1.150	-	1.00	1.00	-	-	#-
Es	10300	-	-	-	-	1.00	1.00	-	-	#1

CRITICAL LOAD COMBINATIONS:

Shear : LC #5 = 1.25D + 1.5L (pattern: _L)
 Moment (+) : LC #5 = 1.25D + 1.5L (pattern: _L)
 Moment (-) : LC #2 = 1.25D + 1.5L
 Deflection: LC #1 = 1.0D (permanent)
 LC #5 = 1.0D + 1.0L (pattern: _L) (live)
 LC #5 = 1.0D + 1.0L (pattern: _L) (total)
 Bearing : Support 1 - LC #4 = 1.25D + 1.5L (pattern: L_)
 Support 2 - LC #2 = 1.25D + 1.5L
 Support 3 - LC #5 = 1.25D + 1.5L (pattern: L_)
 Uplift : Support 1 - LC #0 = Self-weight
 Load Types: D=dead L=live(use,occupancy)
 Load Patterns: s=S/2 L=L+Ls =no pattern load in this span
 All Load Combinations (LCs) are listed in the Analysis output

CALCULATIONS:

Shear Wr : O86 7.5.7.3(a)used; Wf = sum of all loads
 EI = 471e06 kN-mm²
 "Live" deflection is due to all non-dead loads (live, wind, snow...)

Design Notes:

1. WoodWorks analysis and design are in accordance with the 2015 National Building Code of Canada (NBC), Division B, Part 4, and the CSA O86 - 19 Engineering Design in Wood standard.
2. Please verify that the default deflection limits are appropriate for your application.
3. EX grades should be considered when negative bending moment exceeds 75% of the negative bending capacity.