

Mastering Structural Design
Shearwalls, Sizer & Connections
 April 2024

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WoodWorks
 SOFTWARE FOR WOOD DESIGN

Canadian Wood Council
 Conseil canadien du bois

Philip J. Currie Dinosaur Museum

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The Canadian Wood Council (CWC) represents the Canadian wood products industry through a national federation of associations

AFPA ALBERTA FOREST PRODUCTS ASSOCIATION

CMSA

MLB

OFIA

The Canadian Wood Truss Association
 L'Association Canadienne Des Fabricants De Fermes De Bois

APA

Québec Forest Industry Council

Wood Preservation Canada
 Préservation du bois Canada

Interior Lumber Manufacturers' Association

olma

PFS-TECO

CFPA Central Forest Products Association

CCFI BC COUNCIL OF FOREST INDUSTRIES

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About CWC

Codes and Standards
(structural, fire, sustainability)

- Building code development
- Design standards development

Technical tools

- Publications
- Design tools, including WoodWorks software

Red Deer College Student Residence

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SIZER
Gravity Design

- Beam Mode
- Column Mode
- Concept Mode

SHEARWALLS
Lateral Design

- Wind
- Seismic

CONNECTIONS
Fasteners

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SIZER

Gravity Design

- **Beam Mode**
- Column Mode
- Concept Mode



SHEARWALLS

Lateral Design

- Wind
- Seismic



CONNECTIONS

Fasteners



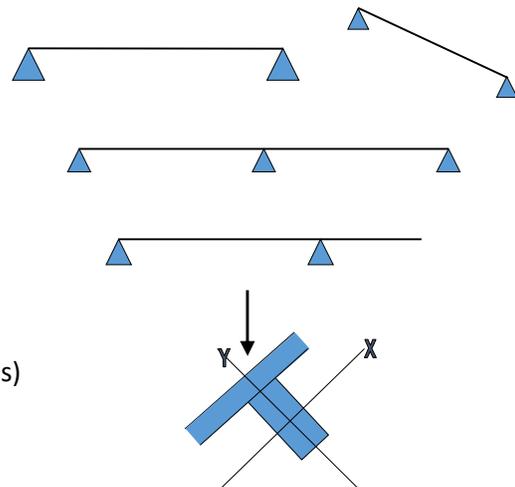
5



SIZER
Beam Mode

Detailed Design for Beams, Joists, Rafters and CLT Panels

- Simply Supported
- Multi-Span (max. 6 spans)
- Cantilevers
- Biaxial bending members (such as oblique purlins)



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SIZER
Beam Mode

Wood Materials

- Lumber, Timber, Rough Sawn Timber
- Built-up beam
- Glulam
- Wood I-joists
 - APA PRI
- PSL, LVL, LSL
 - Nordic
 - Weyerhaeuser
 - Louisiana Pacific
 - Boise Cascade
- CLT



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SIZER
Beam Mode

Beam Span



Description

Spans

8 m

3 m

Cantilevers: None

Pitch: 0 /12

Oblique angle: 0 deg.

Joist spacing*: [] mm

Load sharing: No

Span type: Design span

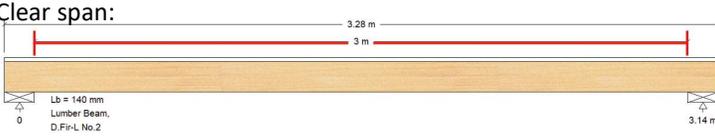
Design span

Clear span

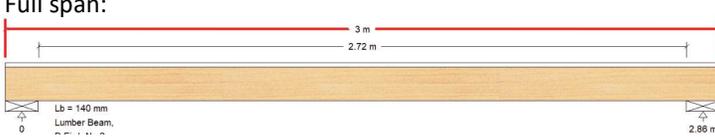
Full span

*You can select these items or enter your own value

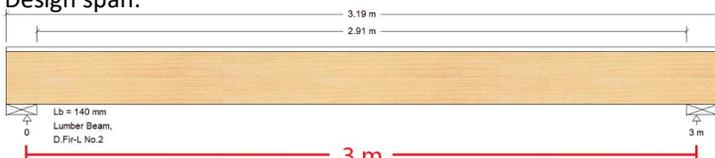
Clear span:



Full span:



Design span:

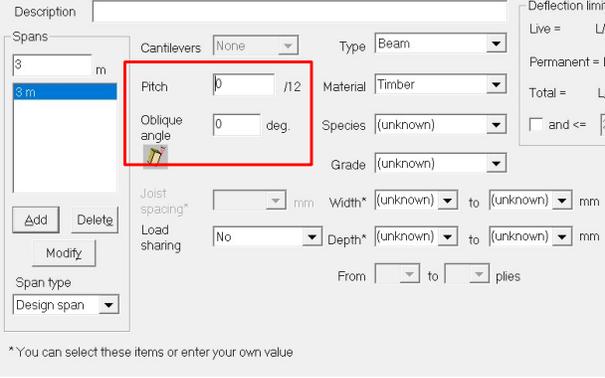


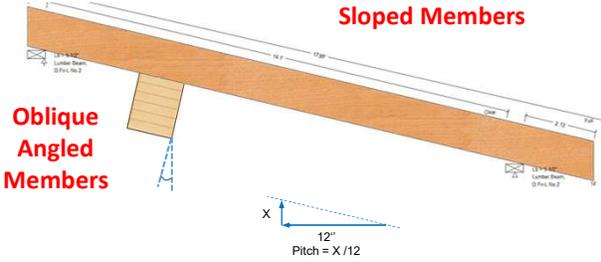
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SIZER
Beam Mode

Oblique & slope angle





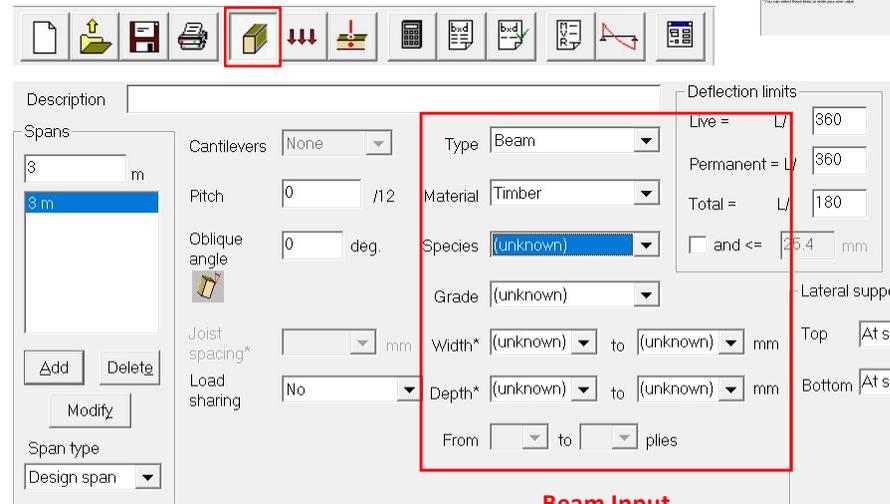


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SIZER
Beam Mode

Beam Input





Beam details can be left as "unknown" and designed by Sizer



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SIZER
Beam Mode

Deflection Limits

Deflection limits

Live = L/

Permanent = L/

Total = L/

and \leq mm

Lateral support spacing*

Top mm

Bottom mm

Used when $d/b > 4$
Interior support(s) not laterally restrained

Modification factors

Service conditions

Treatment

Fire-retardant factor

Fire design

Sides exposed

Protection

Required duration

Wet Service, Preservative-treated, or Fire-treated

Lateral Stability

Fire Design (O86 Annex B and NBC Appendix D)

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SIZER
Beam Mode

Bearing Design

Supports for bearing and notch design

Applies to

Type

Material

Species

Grade

Bearing where support ends or is highly stressed

Bearing length* mm

Bearing width* mm

For unknown bearing length...

Use exact minimum

Round minimum to closest

From list of bearing length choices

End supports: Round minimum, Interior: from bearing length choices

Beam

Hanger

Other non-wood

Simpson Hanger

Sill plate

Beam

Column

Wall

Wall panel



Bearing Design at Supports

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SIZER Beam Mode Load Input

Name	Type	Distribution	Magnitude	Width	Location from left (m)	Pattern loading
Load1	Dead	Full Uniform Line	1 kN/m			
Load2	Live	Full Uniform Line	2 kN/m			
Load3	Snow	Trapezoidal Line	3 kN/m	6 kN/m	1 m 2 m	P
Load4	Wind	Point Load	10 kN		5 m	
Concentrated	Live	Concentrated	9.00	750 mm		

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SIZER Beam Mode Results

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

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	Vf @d = 3.40	Vr = 12.38	kN	Vf/Vr = 0.27
Moment (+)	Mf = 3.62	Mr = 8.00	kN-m	Mf/Mr = 0.45
Perm. Defl'n	3.2 = < L/999	10.0 = L/360	mm	0.32
Live Defl'n	4.9 = L/739	10.0 = L/360	mm	0.49
Total Defl'n	8.1 = L/444	20.0 = L/180	mm	0.40
Vibration	L = 3.600	Lv = 4.412	m	L/Lv = 0.82
Fire	Req'd = 60	Dur = 50.0	min	Req'd/Dur = 1.20

Additional Data:

FACTORS:	f/E (MPa)	KD	KH	K2	KL	KT	KS	KN	LC#
Fv	1.5	1.15	1.40	1.200	-	1.00	1.00	-	#5
Fb+	11.8	1.15	1.40	1.200	1.000	1.00	1.00	-	#5
Fcp	5.3	-	-	1.000	-	1.00	1.00	-	#-
Es	9500	-	-	-	-	1.00	1.00	-	#5

CRITICAL LOAD COMBINATIONS:

- Shear : LC #5 = 1.25D + (1.0)1.4W + 0.5L
- Moment (+): LC #5 = 1.25D + (1.0)1.4W + 0.5L
- Deflection: LC #1 = 1.0D (permanent)
- LC #5 = 1.0D + (0.75)1.0W + 0.5L (live)
- LC #5 = 1.0D + (0.75)1.0W + 0.5L (total)
- Bearing : Support 1 - LC #5 = 1.25D + (1.0)1.4W + 0.5L
- Support 2 - LC #4 = 1.25D + 1.5L + (1.0)0.4W

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Beam Mode

Step-by-Step Examples

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SIZER
Beam Mode

Example 1

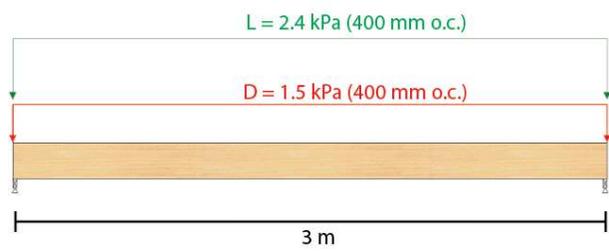
WDM 2020 page 40

Example 1: Joists

Design single span floor joists for the following conditions:

- joist spacing = 400 mm
- joist span = 3.0 m
- specified dead load = 1.5 kPa (includes partitions)
- specified live load = 2.4 kPa (commercial use and occupancy)
- standard load duration --> $K_D = 1.0$
- dry service condition --> $K_S = 1.0$
- untreated --> $K_T = 1.0$
- fully laterally supported by subfloor --> $K_L = 1.0$
- Case 2 system --> $K_H = 1.4$

Use an S-P-F No.1/No.2 sawn lumber.



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SIZER
Beam Mode

Example 1

WDM 2020 page 40

$$\text{Total factored load} = (1.25 \times 1.5) + (1.5 \times 2.4) = 5.48 \text{ kPa}$$

$$\text{Total specified load} = 1.5 + 2.4 = 3.90 \text{ kPa}$$

$$w_f = 5.48 \times 0.40 = 2.19 \text{ kN/m}$$

$$w = 3.90 \times 0.40 = 1.56 \text{ kN/m}$$

$$w_L = 2.40 \times 0.40 = 0.96 \text{ kN/m}$$

$$M_f = \frac{w_f L^2}{8} = \frac{2.19 \times 3.0^2}{8} = 2.46 \text{ kN}\cdot\text{m}$$

$$V_f = \frac{w_f L}{2} = \frac{2.19 \times 3.0}{2} = 3.29 \text{ kN}$$

Calculate a required $E_S I$ for the specified live load or select the required $E_S I$ from the Serviceability Table.

$$E_S I_{\text{REQ'D}} = 122 \times 10^9 \text{ N}\cdot\text{mm}^2 \text{ for } L/360 \text{ deflection based on live load } (w_L)$$

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SIZER
Beam Mode

Example 1

WDM 2020 page 40

O86-19 Equations

Try 38 x 184 mm (2x8):

$$M_r = \phi F_b S K_{zb} K_L$$

$$F_b = f_b (K_D K_H K_{Sv} K_T) = 11.8 (1 \times 1.4 \times 1 \times 1) = 16.52 \text{ MPa}$$

$$S = (38 \times 184^2) / 6 = 214421 \text{ mm}^3$$

$$K_{zb} = 1.2$$

$$K_L = 1.0$$

$$M_r = 0.9 \times 16.52 \text{ MPa} \times 214421 \text{ mm}^3 \times 1.2 \times 1.0 \times 10^{-6} = 3.83 \text{ kNm}$$

$$V_r = \phi F_v 2/3 A_n K_{zv}$$

$$F_v = f_v (K_D K_H K_{Sv} K_T) = 1.5 (1 \times 1.4 \times 1 \times 1) = 2.1 \text{ MPa}$$

$$A_n = 38 \times 184 = 6992 \text{ mm}^2$$

$$K_{zv} = 1.2$$

$$K_L = 1.0$$

$$V_r = 0.9 \times 2.1 \text{ MPa} \times 2/3 \times 6992 \text{ mm}^2 \times 1.2 \times 10^{-3} = 10.6 \text{ kN}$$

$$EI = 9500 \text{ MPa} \times 38 \times 184^3 / 12 = 187 \times 10^9 \text{ Nmm}^2$$

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SIZER
Beam Mode

Example 1

WDM 2020 page 40

Joist Selection Table

WDM 2020 (page 43)

38 mm Sawn Lumber

No.1/No.2	Species	Size (b x d) mm	Single member		System Case 2		E _s I ×10 ⁹ N•mm ²
			M _r kN•m	V _r kN	M _r kN•m	V _r kN	
No.1/No.2	D.Fir-L	38 x 89	0.768	6.55	1.07	9.18	24.6
		38 x 114	1.11	7.41	1.56	10.4	51.6
		38 x 140	1.56	8.49	2.19	11.9	95.6
		38 x 184	2.32	9.57	3.24	13.4	217
		38 x 235	3.46	11.2	4.85	15.7	452
		38 x 286	4.66	12.4	6.53	17.3	815
Hem-Fir	38 x 89	0.844	5.52	1.18	7.73	24.6	
		38 x 114	1.22	6.24	1.71	8.73	51.6
		38 x 140	1.72	7.15	2.41	10.0	95.6
		38 x 184	2.55	8.05	3.57	11.3	217
		38 x 235	3.81	9.43	5.33	13.2	452
		38 x 286	5.13	10.4	7.18	14.6	815
S-P-F	38 x 89	0.906	5.17	1.27	7.24	21.2	
		38 x 114	1.31	5.85	1.84	8.19	44.6
		38 x 140	1.85	6.70	2.68	9.28	82.6
		38 x 184	2.73	7.55	3.83	10.6	187
		38 x 235	4.09	8.84	5.72	12.4	390
		38 x 286	5.50	9.78	7.70	13.7	704
Northern	38 x 89	0.583	4.48	0.817	6.28	15.6	
		38 x 114	0.844	5.07	1.18	7.10	32.8
		38 x 140	1.19	5.81	1.66	8.13	60.8
		38 x 184	1.76	6.54	2.46	9.16	138
		38 x 235	2.63	7.66	3.68	10.7	288
		38 x 286	3.54	8.48	4.96	11.9	519

M_r = 3.83 kNm

V_r = 10.6 kN

E_sI = 187 × 10⁹ Nmm²

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SIZER
Beam Mode

Example 1

WDM 2020 page 40

Joist Selection Table

WDM 2020 (page 43)

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M_r = 3.83 kNm

V_r = 10.6 kN

E_sI = 187 × 10⁹ Nmm²

Checklist: Joists (Strength and Stiffness)

To verify that the tabulated resistances and E_sI values are appropriate for the structure being designed, the following questions should be asked (the appropriate modification factor is given in brackets):

1. Is load duration "standard" (K_D = 1.0)?
2. Is the service condition "dry" (K_S = 1.0)?
3. Is the material free of incising and/or strength-reducing chemicals (K_T = 1.0)?
4. Are the joists free of notches (K_N = 1.0)?
5. Does the construction provide lateral stability to the joists (K_L = 1.0)?

If the answer to any of these questions is no, refer to the description of modification factors below and make the necessary adjustments to tabulated resistances and E_sI values. Otherwise, the Joist Selection Tables may be used directly.

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Example 1

WDM 2020 page 40

From Joist Selection Tables select 38 x 184 mm:

$$M_r = 3.83 > 2.46 \text{ kN}\cdot\text{m} \quad \text{Acceptable}$$

$$V_r = 10.6 > 3.29 \text{ kN} \quad \text{Acceptable}$$

$$E_g I = 187 \times 10^9 > 122 \times 10^9 \text{ N}\cdot\text{mm}^2 \quad \text{Acceptable}$$

Note: Verify acceptable bearing capacity as per Chapter 6

Use 38 x 184 mm No.1/No.2 S-P-F sawn lumber.

- Compressive resistance perpendicular to grain at bearing?
- Continuous joists instead of simply supported joists?
- Notched joists?
- Vibration?

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Beam Mode Training Videos

<http://woodworks-software.com/canadian-training-videos/>

Video 1 – Bearing Design

Video 3 – Beam Mode

Video 4.1 – Lateral Stability Option

Video 5 – Understanding Load Input (Beams & Columns)

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SOFTWARE FOR WOOD DESIGN



SIZER
Gravity Design

- Beam Mode
- Column Mode
- Concept Mode



DATABASE EDITOR
Add Proprietary Products



CONNECTIONS
Fasteners



SHEARWALLS
Lateral Design

- Wind
- Seismic



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SIZER
Column Mode

- Columns, Wall Stud or CLT Wall Panel

Timber

- Timber
- Rough Timber
- Lumber
- Rough Lumber
- Glulam-C
- Glulam-EX
- Built-up
- Rough Built-up
- Steel
- Versa-Lam
- V-Lam Built-up
- LP LSL
- LP LVL
- Nordic Lam
- Nordic Lam nply
- Nordic Lam+
- NordicLam+ nply
- Weyerhaeuser
- Weyerhaeuser BU
- Timber (086-14)
- R.Timb (086-14)

Lumber

- Lumber
- MEL
- MSR Lumber
- Built-up
- Versa-Lam
- Rough Lumber
- LP LSL
- LP LVL
- Nordic Lam
- Weyerhaeuser

CLT

- CLT
- Element5 CLT
- Katerra CLT



- Compression & Tension
- Eccentric loading
- Combined axial & lateral loads
- Fixed or pinned supports

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SIZER
Column Mode

Column Mode Input

Column Details

Height	12	ft		Built-up members	
Type	Column		From		plies
Material	Timber		Connection		
Species	D.Fir-L				
Grade	No.2				
Width	6	to	6	in. nom.	
Depth	6	to	6	in.	
Stud Spacing	16				in

Deflection Limits

Service Conditions and Treatment

Modification factors

Load sharing	None	Treatment	None
Service conditions	Dry	Fire-retardant factor	

Deflection limits

Live = L / 180

Permanent = L / 360

Total = L / 180

and <= 1.00 in

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SIZER
Column Mode

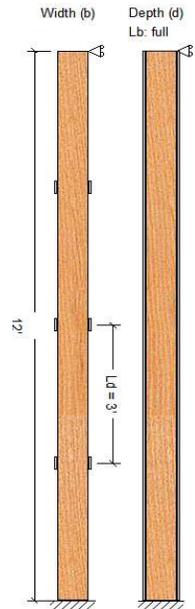
Lateral Support:

End Conditions:

Lateral support spacing		End conditions	
	Width b	Depth d	
Lb	Continuous	in	Ld
			36
			in
Ke	0.8	Ke	0.8

Required duration	1 h	Sides exposed	
Protection	1/2" gypsum board	<input type="checkbox"/>	<input type="checkbox"/>
		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Fire Design (Annex B and CAM)



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SIZER
Column Mode

Compression (+) and Tension (-) Axial Forces

Loads Input

Name	Type	Distribution	Magnitude kN	Eccentricity (mm)
Load1	Dead	Axial	2	Auto
Load4	Wind	Axial	-1 kN	Auto
Load3	Wind	Full Uniform Line	1 kN/m	Auto

Apply auto-eccentricity % from Design Settings

Sustained live loads due to... (principal, companion)
 Storage, equipment (1.5, 1.0 or 1.5)

Importance category and factor
 Normal (ULS = 1.0, SLS = 1.0)

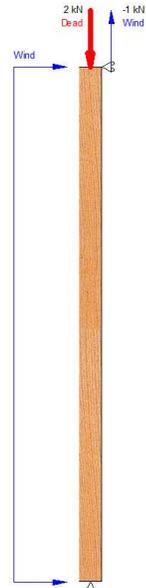
Importance factor not included in the input load Magnitude - the program applies this factor later.

Live and snow loads come directly from exterior surface

Self-weight
 Automatically included in loads analysis
 Must be manually input as load

Load face (all loads)
 Width (b) Depth (d)

Combine loads of same type in drawing



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WoodWorks[®]

SOFTWARE FOR WOOD DESIGN



SIZER
Gravity Design

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SHEARWALLS
Lateral Design

- Wind
- Seismic



CONNECTIONS
Fasteners



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SHEARWALLS Capabilities:

- Model **light-frame** wood structures up to **6-storey**.
- Generate **wind** and **seismic** loads based on location.
- **Distribute** loads to each **shearline**.
- **Distribute** loads to each shearwall **segment** within a shearline.
- Design shearwalls for **worst case** of wind and seismic.
- Add loads **manually**.

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Lakehouse Condos, Grimsby, ON Kirkor Architects + Planners, Tacoma Engineers

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SHEARWALLS
Lateral Design

SHEARWALLS Capabilities:

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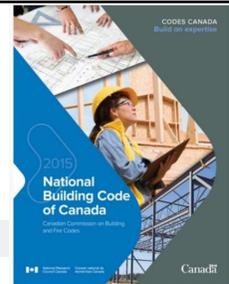


SHEARWALLS
Lateral Design

National Building Code of Canada

Division B Acceptable Solutions

Part 1	General
Part 2	Reserved
Part 3	Fire Protection, Occupant Safety and Accessibility
Part 4	Structural Design
Part 5	Environmental Separation
Part 6	Heating, Ventilating and Air-conditioning
Part 7	Plumbing Services
Part 8	Safety Measures at Construction and Demolition Sites
Part 9	Housing and Small Buildings
Appendix A	Explanatory Material
Appendix B	Fire and Safety in Small Buildings
Appendix C	Climatic Information
Appendix D	Fire-Performance Ratings
User's Guide	NBC 2015 Structural Commentaries (Part 4)

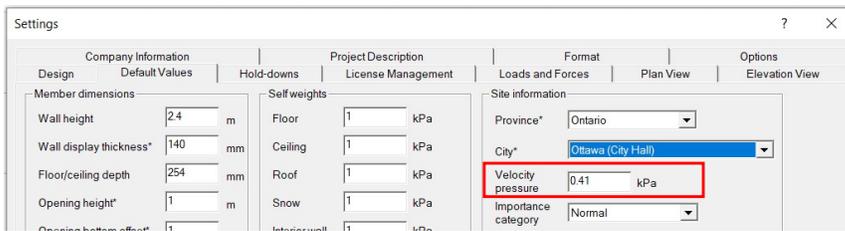


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**Table C-2
Climatic Design Data for Selected Locations in Canada**

Province and Location	Elev., m	Design Temperature				De-gree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, 1/50, mm	Ann. Rain, mm	Moist. Index	Ann. Tot. Ppn., mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa	
		January		July 2.5%									S _s	S _r	1/10	1/50
		2.5% °C	1% °C	Dry °C	Wet °C											
Ottawa (Metropolitan)																
Ottawa (City Hall)	70	-25	-27	30	23	4440	23	86	750	0.84	900	160	2.4	0.4	0.32	0.41
Ottawa (Barrhaven)	98	-25	-27	30	23	4500	25	92	750	0.84	900	160	2.4	0.4	0.32	0.41
Ottawa (Kanata)	98	-25	-27	30	23	4520	25	92	730	0.84	900	160	2.5	0.4	0.32	0.41

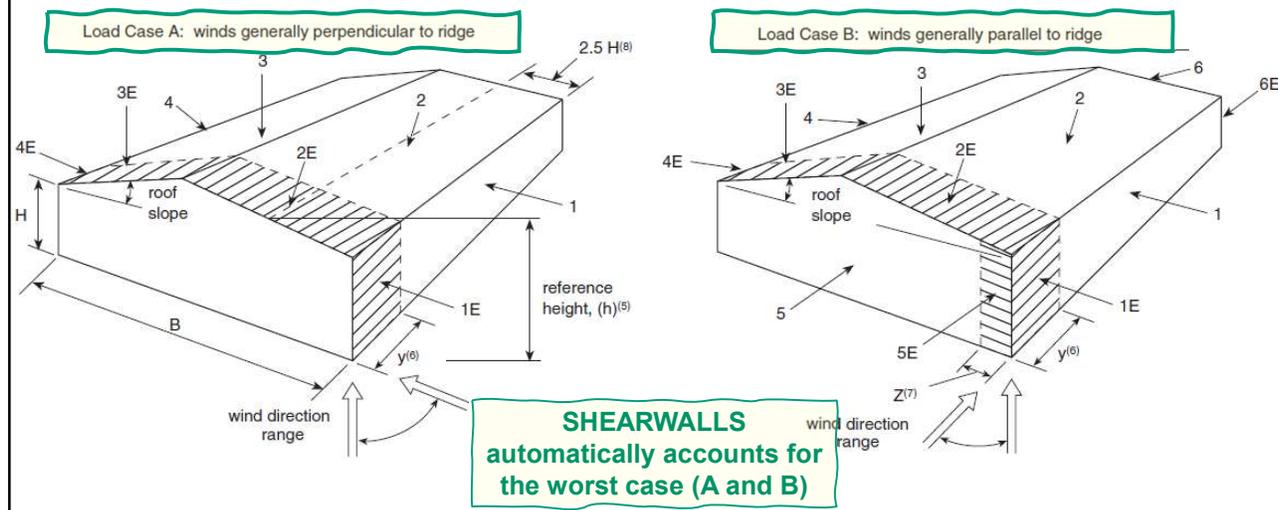


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Lateral Design – Wind

Low Buildings (Figure NBC 4.1.7.6-A)



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Lateral Design – Wind

Other Buildings (NBC 4.1.7.5)

On roof

$C_p = -1.0$ for $\frac{H}{D} \geq 1.0$

$C_p = -1.0$ for $x \leq H$ $\left| \frac{H}{D} < 1.0 \right.$

$C_p = -0.5$ for $x > H$ $\left| \frac{H}{D} < 1.0 \right.$

$C_e = C_e(H)$

On leeward face

$C_p = -0.3$ for $\frac{H}{D} < 0.25$

$C_p = -0.27 \left(\frac{H}{D} + 0.88 \right)$
for $0.25 \leq \frac{H}{D} < 1.0$

$C_p = -0.5$ for $\frac{H}{D} \geq 1.0$

$C_e = C_e(H/2)$

On windward face

$C_p = 0.6$ for $\frac{H}{D} < 0.25$

$C_p = 0.27 \left(\frac{H}{D} + 2 \right)$
for $0.25 \leq \frac{H}{D} < 1.0$

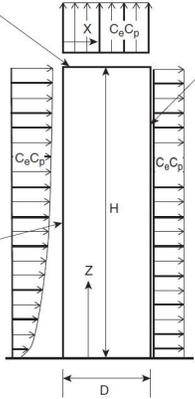
$C_p = 0.8$ for $\frac{H}{D} \geq 1.0$

$C_e = C_e(Z)$

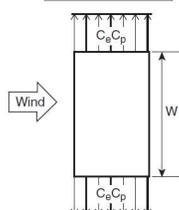
On side walls

$C_e = C_e(H)$

$C_p = -0.7$



Elevation View of Building

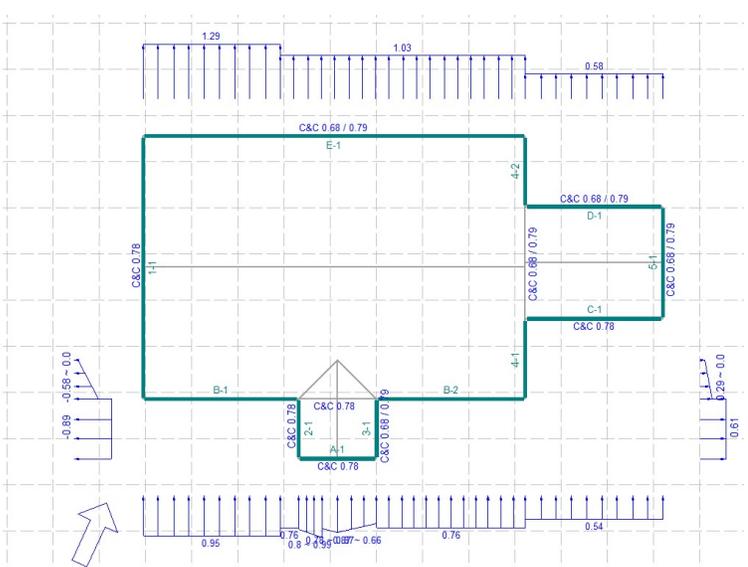


Plan View of Building

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Lateral Design – Wind



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Table C-3
Seismic Design Data for Selected Locations in Canada

Province and Location	Seismic Data							
	S _a (0.2)	S _a (0.5)	S _a (1.0)	S _a (2.0)	S _a (5.0)	S _a (10.0)	PGA	PGV
Ottawa (Metropolitan)								
Ottawa (City Hall)	0.439	0.237	0.118	0.056	0.015	0.0055	0.281	0.196

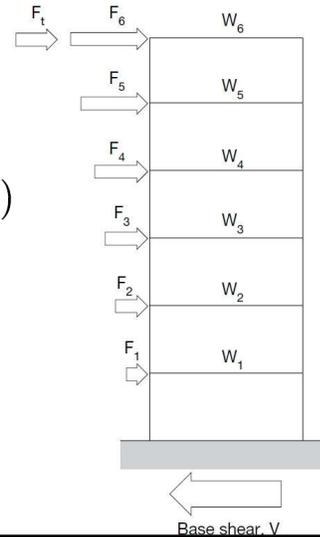
46



Lateral Design – Seismic

Equivalent Static Force Procedure (NBC 4.1.8.11)

$$\text{Base shear } V = S(T_a) M_v I_E W / (R_d R_o)$$



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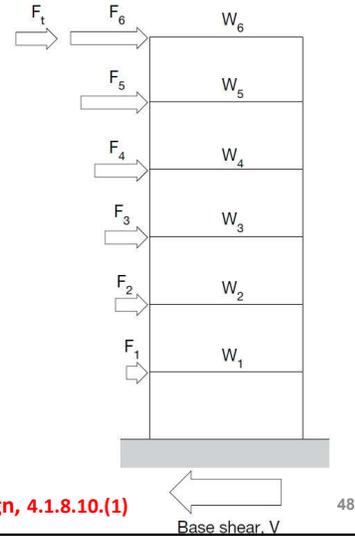
Lateral Design – Seismic

Equivalent Static Force Procedure (NBC 4.1.8.11)

- When $I_E F_a S_a(0.2)$ is **less than 0.35**
- or
- For **regular structures**, less than 60m in height with period less than 2s
- or
- For irregular structures (Types 1, 2, 3, 4, 5, **6*** or 8), less than 20m in height with period less than 0.5s

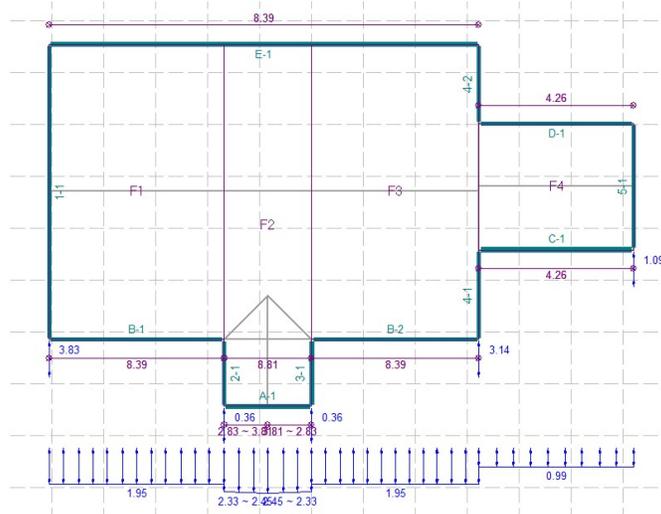
SHEARWALLS checks compliancy and warns the user when building does not conform

*permitted only with $I_E F_a S_a(0.2) < 0.2$ and elastic design, 4.1.8.10.(1)



Lateral Design – Seismic

Equivalent Static Force Procedure (NBC 4.1.8.11)





SHEARWALLS
Lateral Design

SHEARWALLS Capabilities:

- Model light-frame wood structures up to 6-storey.
- Generate wind and seismic loads based on location.
- **Distribute loads to each shearline.**
- Distribute loads to each shearwall segment within a shearline.
- Design shearwalls for worst case of wind and seismic.
- Add loads manually.

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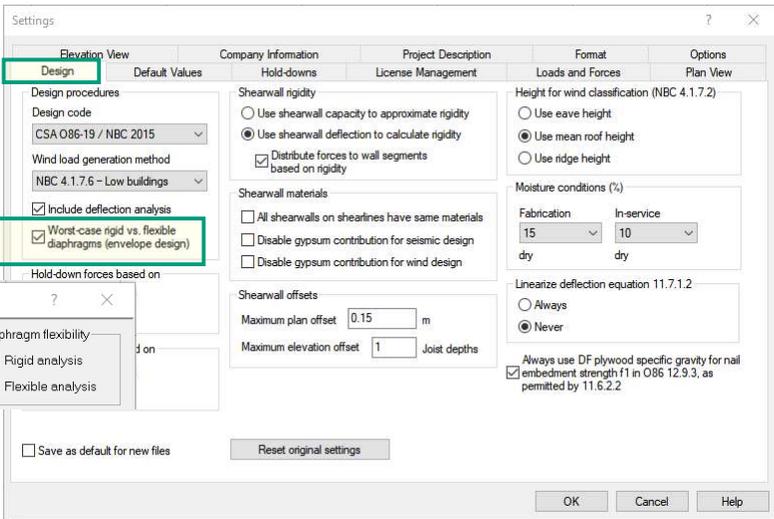
50



SHEARWALLS
Lateral Design

Design Tab

↳ Design for Envelope of Rigid & Flexible Diaphragm



The screenshot shows the 'Settings' dialog box for SHEARWALLS. The 'Design' tab is selected. Under 'Design procedures', 'Worst-case rigid vs. flexible diaphragms (envelope design)' is checked. In the 'Diaphragm flexibility' section, both 'Rigid analysis' and 'Flexible analysis' are checked. The 'Design code' is set to 'CSA O86-19 / NBC 2015' and the 'Wind load generation method' is 'NBC 4.1.7.6 - Low buildings'. The 'Shearwall rigidity' section has 'Use shearwall deflection to calculate rigidity' selected, with 'Distribute forces to wall segments based on rigidity' checked. The 'Shearwall materials' section has 'All shearwalls on shearlines have same materials' checked. The 'Shearwall offsets' section has 'Maximum plan offset' set to 0.15 m and 'Maximum elevation offset' set to 1 Joist depths. The 'Height for wind classification' section has 'Use mean roof height' selected. The 'Moisture conditions (%)' section has 'Fabrication' set to 15 and 'In-service' set to 10. The 'Linearize deflection equation 11.7.1.2' section has 'Never' selected. The 'Always use DF plywood specific gravity for nail embedment strength f1 in O86 12.9.3, as permitted by 11.6.2.2' checkbox is checked. The 'Save as default for new files' checkbox is unchecked. The 'Reset original settings' button is visible. The 'OK', 'Cancel', and 'Help' buttons are at the bottom right.

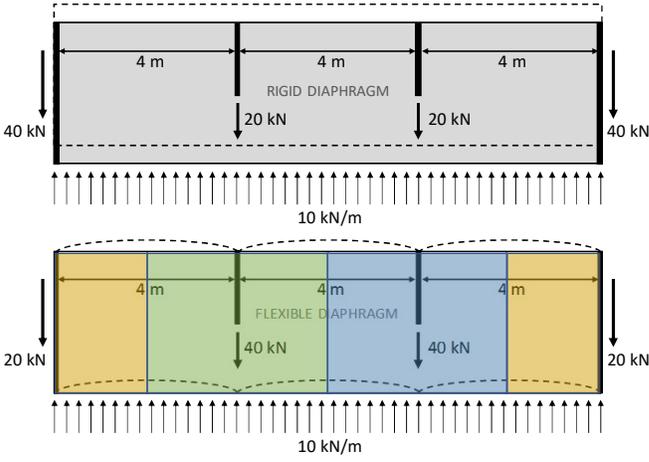
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 **SHEARWALLS**
Lateral Design

Lateral Design – Wind and Seismic

Loads Distribution to each Shearline



The diagram illustrates two diaphragm assumptions for a three-bay structure with three 4m shearlines. A uniform lateral load of 10 kN/m is applied across the entire diaphragm. In the rigid diaphragm assumption, the total lateral load is 120 kN, which is distributed equally to each of the three shearlines, resulting in 40 kN per shearline. In the flexible diaphragm assumption, the total lateral load is 120 kN, but it is distributed based on the tributary area of each shearline. The central shearline has a tributary area of 8m (4m on each side) and receives 40 kN. The two end shearlines each have a tributary area of 4m and receive 20 kN each.

Rigid diaphragm assumption
Distributes based on wall stiffness

Flexible diaphragm assumption
Distributes based on wall tributary area

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 **SHEARWALLS**
Lateral Design

SHEARWALLS Capabilities:

- Model light-frame wood structures up to 6-storey.
- Generate wind and seismic loads based on location.
- Distribute loads to each shearline.
- Distribute loads to each shearwall segment within a shearline.
- Design shearwalls for worst case of wind and seismic.
- Add loads manually.

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SHEARWALLS
Lateral Design

Settings

Design procedures

Design code: CSA O86-19 / NBC 2015

Wind load generation method: NBC 4.1.7.6 - Low buildings

Include deflection analysis: Worst-case rigid vs. flexible diaphragms (envelope design)

Hold-down forces based on: Applied loads

Drag strut forces based on: Applied loads

Save as default for new files: Reset original settings

Shearwall rigidity

- Use shearwall capacity to approximate rigidity
- Use shearwall deflection to calculate rigidity
- Distribute forces to wall segments based on rigidity

Shearwall materials

- All shearwalls on shearlines have same materials
- Disable gypsum contribution for seismic design
- Disable gypsum contribution for wind design

Shearwall offsets

Maximum plan offset: 0.15 m

Maximum elevation offset: 1 Joist depths

Height for wind classification (NBC 4.1.7.2)

- Use eave height
- Use mean roof height
- Use ridge height

Moisture conditions (%)

Fabrication: 15 In-service: 10

Linearize deflection equation 11.7.1.2

- Always
- Never

Always use DF plywood specific gravity for nail embedment strength f1 in O86 12.9.3, as permitted by 11.6.2.2

OK Cancel Help

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SHEARWALLS
Lateral Design

Loads distribution to each shearwall (segment) in shearline
Capacity-based load distribution

$V_{fsi} = F_f \frac{V_{rsi}}{\sum V_{rsj}}$

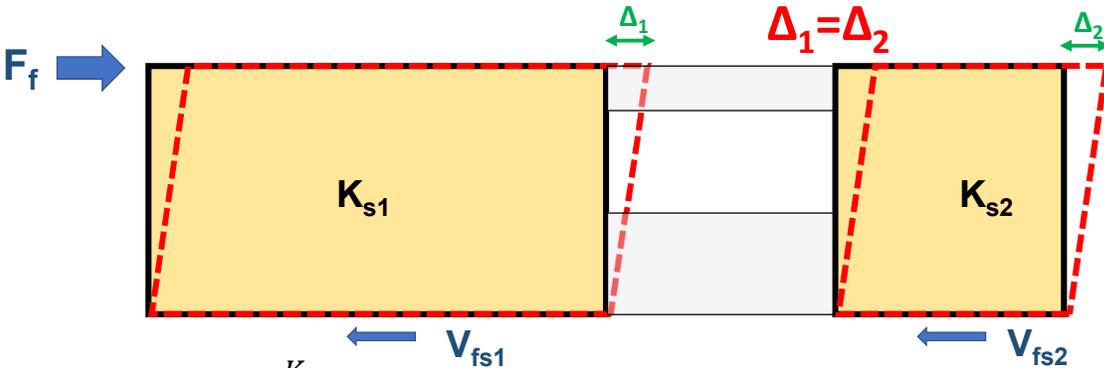
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SHEARWALLS
Lateral Design

Loads distribution to each shearwall (segment) in shearline
Deflection-based load distribution



$V_{fsi} = F_f \frac{K_{si}}{\sum K_{sj}}$

SHEARWALLS iterates until $\Delta_1 = \Delta_2$

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SIZER
Gravity Design

- Beam Mode
- Column Mode
- Concept Mode



SHEARWALLS
Lateral Design

- Wind
- Seismic



CONNECTIONS
Fasteners



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CONNECTIONS
Fasteners

Types of Connections

CSA O86-19

- 12.3 Split-ring and shear-plate connectors
- 12.4 Bolts and dowels
- 12.5 Drift pins
- 12.6 Lag screws
- 12.7 Timber rivets
- 12.8 Truss plates
- 12.9 Nails and spikes
- 12.10 Joist hangers
- 12.11 Wood screws



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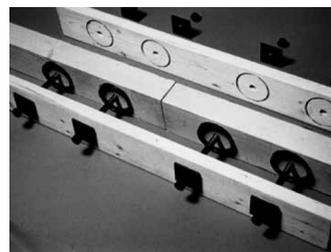
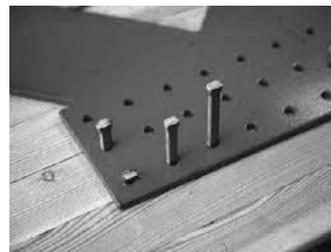


CONNECTIONS
Fasteners

Types of Connections

WoodWorks® Connections 2020

- Nails
- Wood screws
- Bolts
- Lag screws
- Timber rivets
- Shear plates, etc.



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CONNECTIONS
Fasteners

Connections Types

- All Geometries
 - Post and Beam
 - Beam-to-beam
 - One-sided
 - Two-sided
 - Sloped
 - Beam-to-column
 - One-sided
 - Two-sided
 - Beam over column
 - Column-to-base
 - Concrete base
 - Lapped Shear
 - Wood-to-wood
 - Orthogonal, two member
 - Orthogonal, three-member
 - Skew, one side member
 - Skew, two side members
 - Skew, two main members
 - Splice, two member
 - Splice, three-member
 - Wood-to-steel
 - Orthogonal, one steel plate
 - Orthogonal, two steel plates
 - Skew, one steel plate
 - Skew, two steel plates
 - Splice, one wood, one steel
 - Splice, two wood, one steel
 - Splice, two steel, one wood
 - Wood-to-concrete
 - Perpendicular load
 - Parallel load

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CONNECTIONS
Fasteners

Single Shear Nail Example

Choose Connection Geometry

geometry details diagram results accept

- All Geometries
 - Post and Beam
 - Lapped Shear
 - Wood-to-wood
 - Orthogonal, two member
 - Nails
 - Bolts
 - Wood screws
 - Orthogonal, three-member
 - Bolts
 - Skew, one side member
 - Nails
 - Bolts
 - Wood screws
 - Skew, two side members
 - Bolts
 - Skew, two main members
 - Bolts
 - Splice, two member
 - Nails
 - Bolts
 - Wood screws
 - Splice, three-member
 - Bolts
 - Wood-to-steel
 - Wood-to-concrete

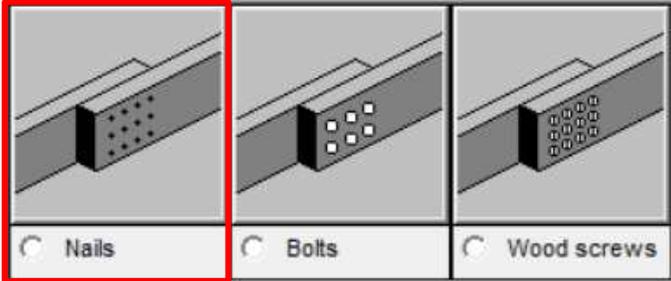
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CONNECTIONS
Fasteners

geometry details diagram results accept

Single Shear Nail Example

Choose Fastener Type



Nails Bolts Wood screws

Nailed Splice Connection with Wood Side Plate

One wooden side member is spliced, using nails, to main member, which is loaded parallel to grain, in compression or tension. The user may specify the length of overlap, or

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CONNECTIONS
Fasteners

geometry details diagram results accept

Single Shear Nail Example

Specify Properties of Main Member

Main Side

Name: Main

Material: Lumber joist

Species: S-P-F

Grade: No.1/No.2

Thickness: 64 mm

Width: 89 mm

Ply:

End Type: Overlap

Overlap: 0 mm

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Single Shear Nail Example

Specify Properties of Side Member

geometry
details
diagram
results
accept

Main
Side

Name

Material

Species

Grade

Thickness mm

Width mm

Ply

End Type

Overlap mm

Manual input section sizes, if necessary



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Single Shear Nail Example

Specify Additional Parameters

geometry
details
diagram
results
accept

Service condition factor (K_{SF}) →

Treatment factor (K_T) →

Load duration factor (K_D) →

Moisture Content

In-Service

Fabrication

Treatment

Fire treatment factor

Preservative-treated incised

Factored Loads (kN)

Force

Duration

Force

Duration

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CONNECTIONS
Fasteners

Single Shear Nail Example

Specify Fastener Parameters

geometry details diagram results accept

Nail Type	Common	▼	<input type="checkbox"/>	Allow Clinching
Nail Length	102 mm (4")	▼	26	mm
Number of Rows	1	▼		Max. Protrusion
Nails Per Row	1	▼	<input type="checkbox"/>	Add Staggered Nails Between Rows
Spacing Within Rows	(unknown)	▼		mm
Spacing Between Rows	(unknown)	▼		mm

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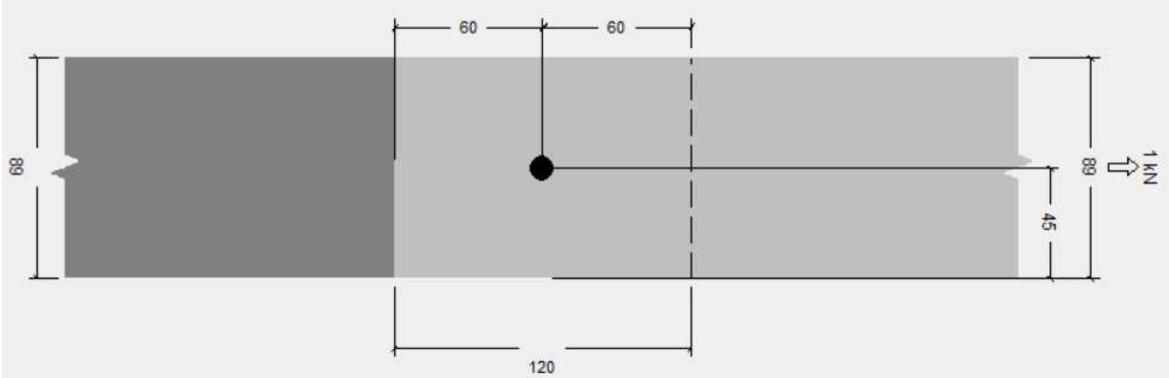


CONNECTIONS
Fasteners

Single Shear Nail Example

Preliminary Connection Layout

geometry details diagram results accept



The diagram illustrates a preliminary connection layout for a single shear nail. It shows a horizontal beam with a total width of 120 mm and a height of 88 mm. A central nail is positioned 60 mm from each end of the beam. A downward force of 1 kN is applied at the center of the beam. The nail is located 45 mm from the bottom edge of the beam. The beam is divided into three sections: a dark grey section on the left, a light grey section in the middle containing the nail, and a medium grey section on the right.

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CONNECTIONS
Fasteners

Single Shear Nail Example

Results



One Wooden Side Member Nailed in Spliced Joint to Main Member

Connection Data:

Main:
Lumber joist S-P-F No.1/No.2 dry service, dry fab 38 x 89 mm

Side:
Lumber joist S-P-F No.1/No.2 dry service, dry fab 64 x 89 mm

Length of member overlap is 120 mm.

Factored Loads:
Along main member: 1.00 kN standard duration in tension.

Connector Design:
Fasteners:
Nail type: Common
Nail length: 102 mm Diameter: 4.88 mm
1 rows of 1 nails per row = 1 nails in total.

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Questions?

Mastering Structural Design Shearwalls, Sizer & Connections

April 2024

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