WFCM

Wood Frame Construction Manual for One- and Two-Family Dwellings

WORKBOOK

Design of Wood Frame Buildings for High Wind, Snow, and Seismic Loads

2012 EDITION

AMERICAN WOOD COUNCIL

2012 WFCM Workbook – Design of Wood Frame Buildings for High Wind, Snow, and Seismic Loads

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FOREWORD

This *Wood Frame Construction Manual Workbook (WFCM Workbook)* provides a design example and typical checklist related to design of a wood-frame structure in accordance with the American Wood Council's (AWC) *Wood Frame Construction Manual (WFCM) for One- and Two-Family Dwellings*, 2012 Edition. The design example uses plans from a 2-story residence designed to resist high wind, seismic, and snow loads. Typically, these load conditions do not all apply to the same structure (e.g., usually only 2 of these conditions are evaluated depending on the geographic location and local building code requirements). However, all three load conditions are evaluated in this example to show the broader range of applicability of the *WFCM*. The authority having jurisdiction should be consulted for applicable load conditions.

The design example is based primarily on prescriptive provisions found in Chapter 3 of the *WFCM*. References to tables and section numbers are for those found in the *2012 WFCM*, unless noted otherwise. Additional engineering provisions or alternate solutions are provided where necessary. See the AWC website (www.awc.org) for an in-depth overview of the *WFCM*.

While building codes (and the *WFCM*) are organized based on the construction sequence (foundation to roof), this design example is organized based on the typical design sequence (roof to foundation).

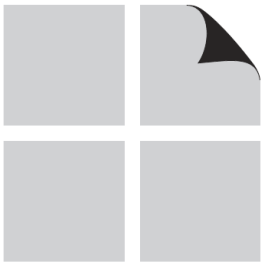
Special effort has been made to assure that the information presented in this document reflects the state of the art. However, the American Wood Council does not assume responsibility for particular designs or calculations prepared from this publication.

AWC invites and welcomes comments, inquiries, and suggestions relative to the provisions of this document.

American Wood Council

The design example is based in part on AWC's Colonial Homes Idea House in Williamsburg, VA designed by nationally acclaimed architect William E. Poole. The house was opened to the public in June 1995, and was featured in the October 1995 issue of Colonial Homes *magazine.*

The colonial style home featured both traditional and modern wood applications. The façade replicates an historic home in Connecticut. Clad in southern pine siding, the house had glulam door headers, oak floors, and antiqued wood kitchen cabinets. But what caught visitors' attention most were the intricate wood moldings throughout the house and the inlaid wood design bordering the foyer floor.



EFFECTIVE USE OF THE WFCM WORKBOOK

The following key explains the color code and nomenclature used throughout the WFCM Workbook.

Value	Indicates "value" may be used for design – could include multiple options.
Value	Bold font indicates "value" controls design.
OK	Indicates "value" meets design criteria.
NG	Indicates "value" does not meet design criteria.

For ease of reference, Tables created in the WFCM Workbook are numbered to correspond with the respective section in which they are located. All table numbers are preceded by a capital "W" (e.g. Table W4.4) to distinguish them from Tables which are referenced in the WFCM (e.g. Table 3.15).

Abbreviations used in the WFCM Workbook

- 1F – one floor (for calculating loads)
- 2F – two floors (for calculating loads)
- C – ceiling (for calculating loads)
- FHS – full height stud
- L – lateral load or header span
- NFH – number of full height studs
- NP – not permitted
- OH – overhang
- PSW – perforated shear wall
- R – roof (for calculating loads)
- S – shear load
- SDPWS – *Special Design provisions for Wind and Seismic*
- SSW – segmented shear wall
- U – uplift load
- w – unit lateral load per linear foot
- WSP – wood structural panel
- Z – connection lateral design value

Table of Contents

NOTES

GENERAL INFORMATION

BUILDING DESCRIPTION

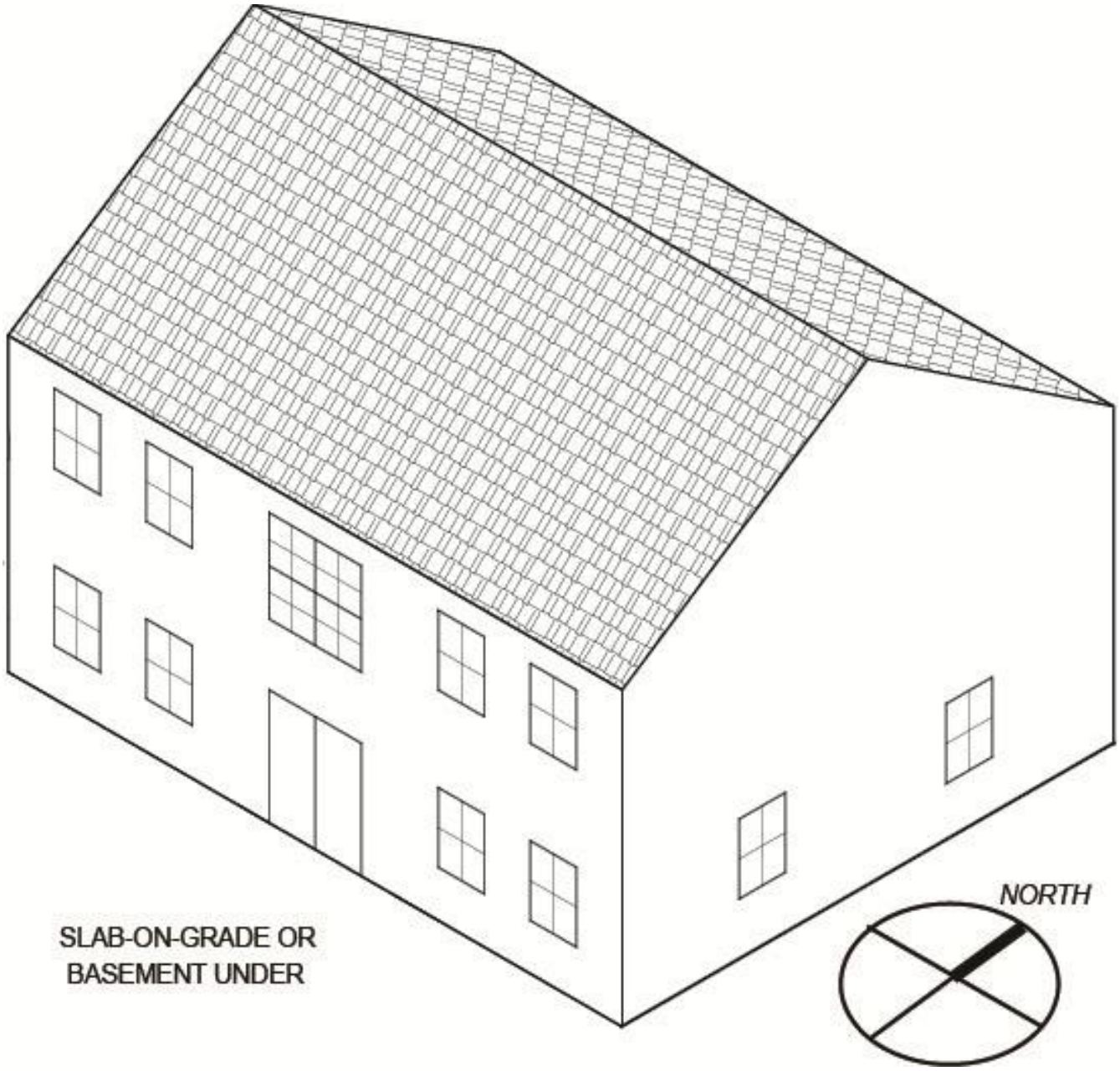
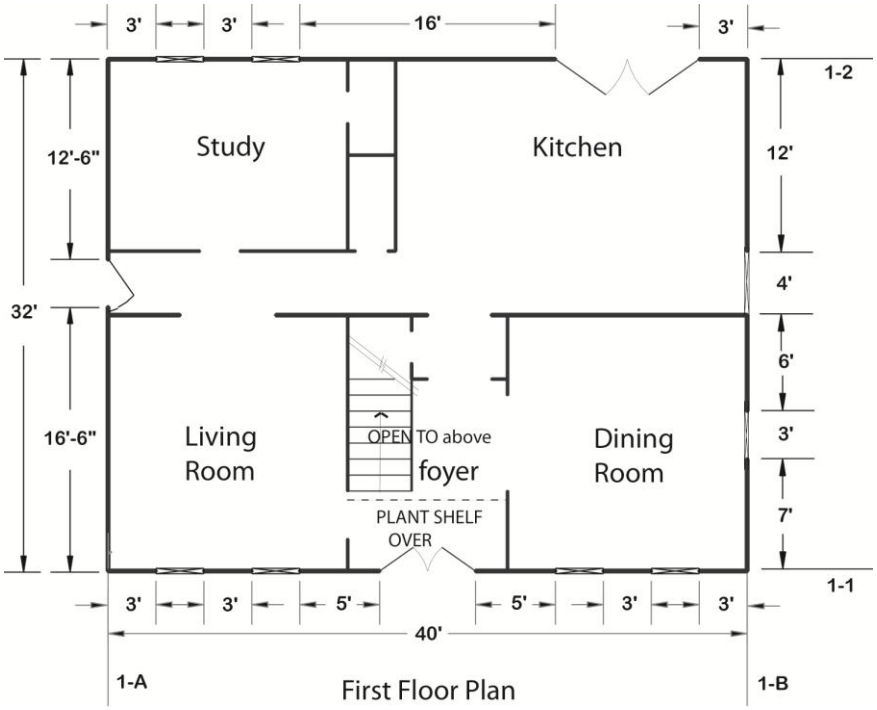
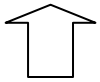
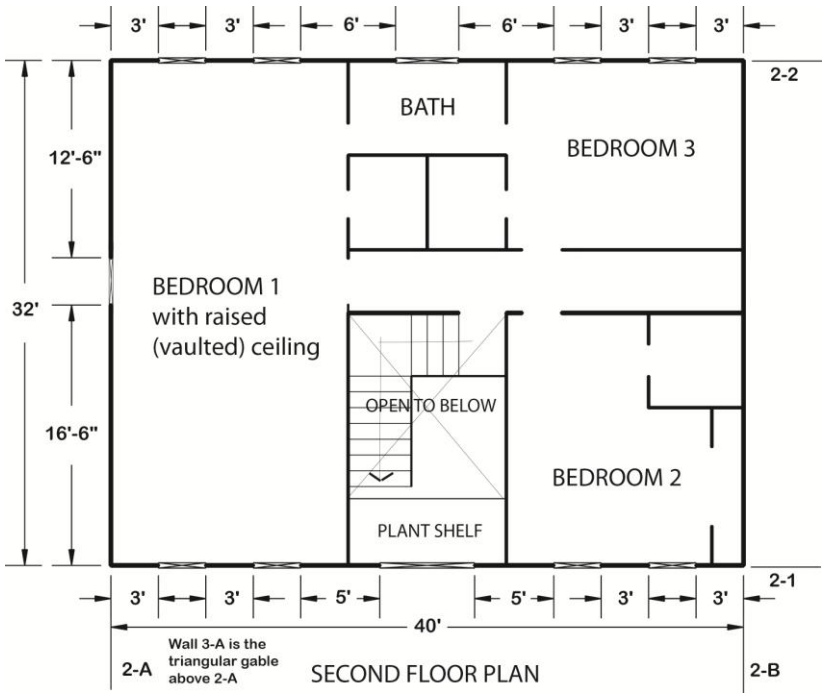


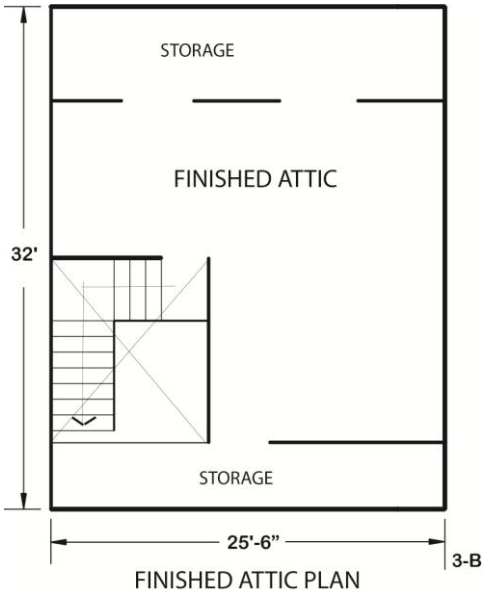
Figure 1: Isometric view (roof overhangs not shown).

BUILDING DESCRIPTION









Wall Heights	= 9'	<u>Windows</u>
Finished Grade to Foundation Top	= 1'	Typical 3'x4'-6"
Floor Assembly Height	= 1'	Foyer 6'x4'-6"
Roof Pitch	= 7:12	Kitchen 4'x4'-6"
House Mean Roof Height	= 24.7'	Bath 4'x6'
Roof Overhangs	= 2'	<u>Doors</u>
Building Length (L)	= 40'	Typical 3'x7'-6"
Building Width (W)	= 32'	Foyer 6'x7'-6"
Top plate to ridge height	= 9.3'	Kitchen 9'x7'-6"

LOADS ON THE BUILDING

Structural systems in the *WFCM 2012Edition* have been sized using dead, live, snow, seismic and wind loads in accordance with *ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures*.

Lateral Loads:

Wind:

3-second gust wind speed in Exposure Category B (700 yr. return) = 160 mph

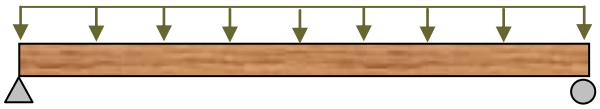
Seismic:

Simplified Procedure (ASCE 7-10 Section 12.14)

Seismic Design Category (SDC) – (ASCE 7-10 Section 11.4.2 and IRC Subcategory) = D_1

Vertical force distribution factor (F) - (ASCE 7-10 Section 12.14.8.1) = 1.2

Gravity Loads*:



Roof:

Roof Dead Load = 10 psf

Ground Snow Load, P_g = 30 psf

Ceiling:

Roof Ceiling Load = 10 psf

Floors:

First Floor Live Load = 40 psf

Second Floor Live Load = 30 psf

Attic Floor Live Load = 30 psf

Floor Dead Load = 10 psf

Walls:

Wall Dead Load = 11 psf

*Assumptions vary for wind and seismic dead loads

Deflection limits per 2012 IRC Table R301.7:

Roof Rafters with Ceiling Attached	L/Δ = 240
Roof Rafters with no Ceiling Attached	L/Δ = 180
Floor Joists	L/Δ = 360
Exterior Studs (wood siding)	L/Δ = 180

WFCM APPLICABILITY LIMITATIONS

The following table is used to determine whether the building geometry is within the applicability limitations of the *WFCM*. Conditions not complying with the limitations shall be designed in accordance with accepted engineer practice (see *WFCM* 1.1.3).

Table W1.1 Applicability Limitations

Attribute		Limitation	Design Case	√
BUILDING DIMENSIONS				
Mean Roof Height (MRH)	maximum	33'	29'	√
Number of Stories	maximum	3	3*	√
Building Dimension (L or W)	maximum	80'	40'	√

*Building designed as a 3-story structure for purposes of determining gravity and seismic loads since the building contains a habitable attic (see WFCM 3.1.3.1).

PRESCRIPTIVE DESIGN LIMITATIONS

The following table is used to determine whether the building geometry is within the applicability limitations of the *WFCM* Chapter 3 prescriptive provisions. Conditions not complying with the limitations shall be designed in accordance with *WFCM* Chapter 2 (see *WFCM* 3.1.3).

Table W1.2 Prescriptive Design Limitations

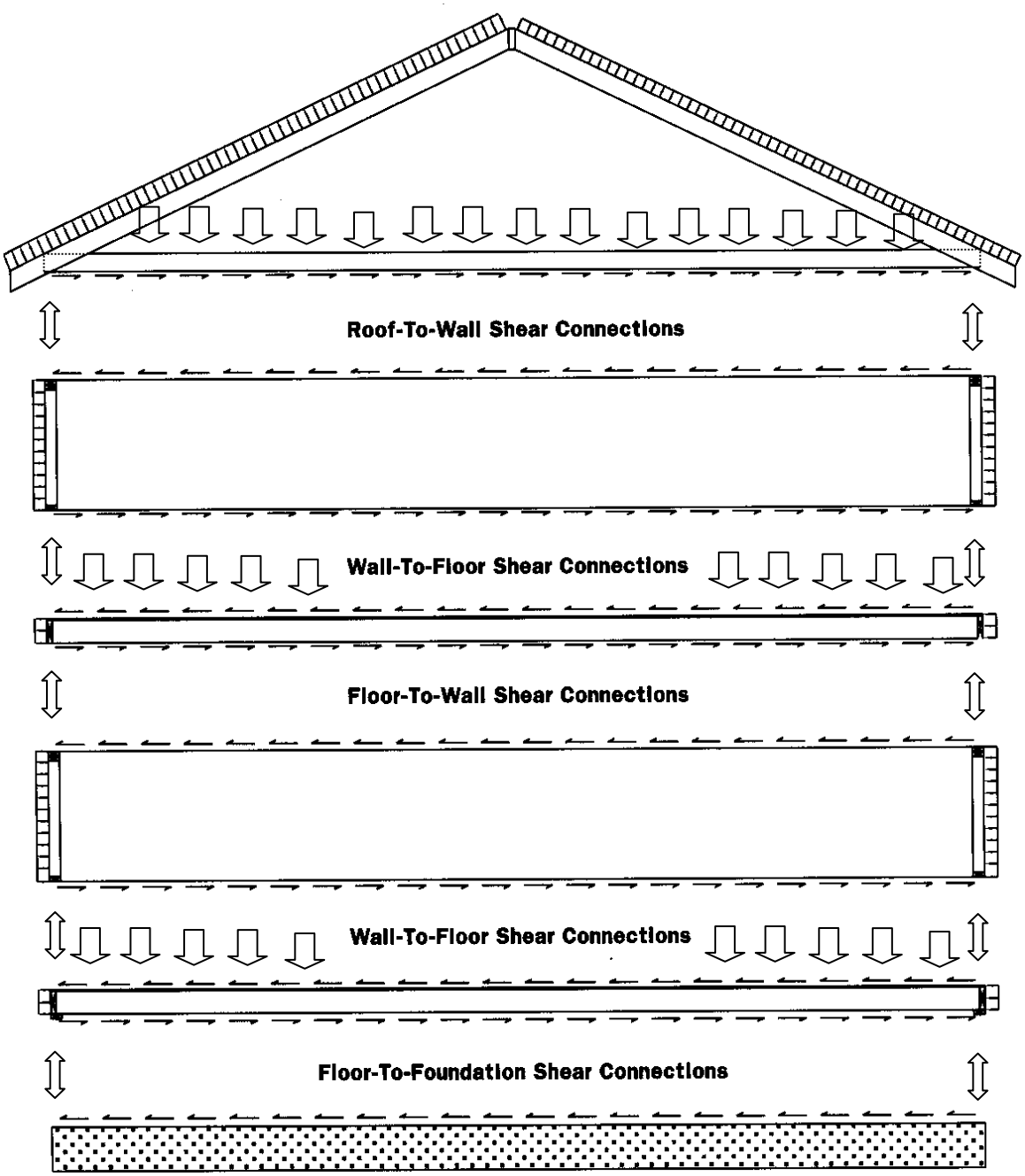
Element	Attribute	Limitation	Design Case	√
FLOOR SYSTEMS				
Lumber Joists	Joist Span	26'	16'	√
	Joist Spacing	24"	16"	√
	Cantilevers/Setback - Supporting loadbearing walls	d	N/A	√
	Cantilevers - Supporting non-loadbearing walls	L/4	N/A	√
Floor Diaphragms	Vertical Floor Offset	d_f	N/A	√
	Floor Diaphragm Aspect Ratio	Table 3.16B L_{min}=12.5' and L_{max}=74' (interpolated); Table 3.16C1 L_{max}=80'	L=40' L=25.5' (attic)	√
	Floor Diaphragm Openings	Lesser of 12' or 50% of Diaphragm Dimension	12'	√
WALL SYSTEMS				
Wall Studs	Loadbearing Wall Height	10'	9'	√
	Non-Loadbearing Wall Height	20'	16'	√
	Wall Stud Spacing	24"	16"	√
Shear Walls	Shear Wall Line Offset	4'	0	√
	Shear Wall Story Offset	No offset unless per Exception	0	√
	Shear Wall Segment Aspect Ratio	3½:1	3:1	√
ROOF SYSTEMS				
Lumber Rafters	Rafter Span (Horizontal Projection)	26'	16'	√
	Rafter Spacing	24"	16"	√
	Eave Overhang Length	Lesser of 2' or rafter length/3	2'	√
	Rake Overhang Length	Lesser of 2' or purlin span/2	24"	√
	Roof Slope	Flat - 12:12	7:12	√
Roof Diaphragms	Roof Diaphragm Aspect Ratio	Table 3.16A1 L_{min}=12.7' and L_{max}=70.6' (interpolated); Table 3.16C1 L_{max}=80'	L=40	√

LOAD PATHS

WFCM 2.1.2 - A continuous load path shall be provided to transfer all lateral and vertical loads from the roof, wall, and floor systems to the foundation.

WFCM 1.3 Definitions - Continuous Load Path: The interconnection of all framing elements of the lateral and vertical force resisting systems, which transfers *lateral* and *vertical* forces to the foundation.

2012 WFCM Figure 2.2b for shear connection locations is shown here as an example. See *2012 WFCM* Figures 2.2a and c for typical lateral and uplift connections, respectively.



CHECKLIST

The following checklist is used to assist with the evaluation of a structure in accordance with *WFCM* Chapter 3 prescriptive provisions. Items are keyed to sections of the *WFCM* Chapter 3 to allow a systematic evaluation of the structure. Blank checklists are reproduced in the Appendix of the workbook.

WFCM 3.2 CONNECTIONS CHECKLIST

3.2.1 Lateral Framing and Shear Connections

3.2.1.1 Roof Assembly .....Ok? √

3.2.1.2 Roof Assembly to Wall Assembly.....Ok? √

3.2.1.3 Wall Assembly .....Ok? √

3.2.1.4 Wall Assembly to Floor Assembly.....Ok? √

3.2.1.5 Floor Assembly.....Ok? √

3.2.1.6 Floor Assembly to Wall Assembly or Sill Plate .....Ok? √

3.2.1.7 Wall Assembly or Sill Plate to Foundation.....Ok? √

3.2.2 Uplift Connections

3.2.2.1 Roof Assembly to Wall Assembly.....Ok? √

3.2.2.2 Wall Assembly to Wall Assembly.....Ok? √

3.2.2.3 Wall Assembly to Foundation .....Ok? √

3.2.3 Overturning Resistance

3.2.3.1 Hold-downs .....Ok? √

3.2.4 Sheathing and Cladding Attachment

3.2.4.1 Roof Sheathing .....Ok? √

3.2.4.2 Wall Sheathing .....Ok? √

3.2.4.3 Floor Sheathing.....Ok? √

3.2.4.4 Roof Cladding.....Ok? √

3.2.4.5 Wall Cladding.....Ok? √

3.2.5 Special Connections

3.2.5.1 Ridge Straps.....Ok? √

3.2.5.2 Jack Rafters.....Ok? √

3.2.5.3 Non-Loadbearing Wall Assemblies.....Ok? √

3.2.5.4 Connections around Wall Openings .....Ok? √

WFCM 3.3 FLOOR SYSTEMS CHECKLIST

3.3.1 Wood Joist Systems

3.3.1.1 Floor Joists ..... Ok? √

3.3.1.1.1 Notching and Boring ..... Ok? √

3.3.1.2 Bearing ..... Ok? √

3.3.1.3 End Restraint ..... Ok? √

3.3.1.4 Lateral Stability ..... Ok? √

3.3.1.5 Single or Continuous Floor Joists

3.3.1.5.1 Supporting Loadbearing Walls ..... Ok? √

3.3.1.5.2 Supporting Non-Loadbearing Walls ..... Ok? √

3.3.1.5.3 Supporting Concentrated Loads ..... Ok? √

3.3.1.6 Cantilevered Floor Joists

3.3.1.6.1 Supporting Loadbearing Walls ..... Ok? √

3.3.1.6.2 Supporting Non-Loadbearing Walls ..... Ok? √

3.3.1.7 Floor Diaphragm Openings ..... Ok? √

3.3.2 Wood I-Joist Systems ..... Ok? √

3.3.3 Wood Floor Truss Systems ..... Ok? √

3.3.4 Floor Sheathing

3.3.4.1 Sheathing Spans ..... Ok? √

3.3.4.2 Sheathing Edge Support ..... Ok? √

3.3.5 Floor Diaphragm Bracing ..... Ok? √

WFCM 3.4 WALL SYSTEMS CHECKLIST

3.4.1 Exterior Walls

3.4.1.1 Wood Studs ..... Ok? √

3.4.1.1.1 Notching and Boring ..... Ok? √

3.4.1.1.2 Stud Continuity ..... Ok? √

3.4.1.1.3 Corners ..... Ok? √

3.4.1.2 Top Plates ..... Ok? √

3.4.1.3 Bottom Plates ..... Ok? √

3.4.1.4 Wall Openings

3.4.1.4.1 Headers ..... Ok? √

3.4.1.4.2 Full Height Studs ..... Ok? √

3.4.1.4.3 Jack Studs ..... Ok? √

3.4.1.4.4 Window Sill Plates ..... Ok? √

3.4.2 Interior Loadbearing Partitions

3.4.2.1 Wood Studs ..... Ok? √

3.4.2.1.1 Notching and Boring ..... Ok? √

3.4.2.1.2 Stud Continuity ..... Ok? √

3.4.2.2 Top Plates ..... Ok? √

3.4.2.3 Bottom Plates ..... Ok? √

3.4.2.4 Wall Openings

3.4.2.4.1 Headers ..... Ok? √

3.4.2.4.2 Studs Supporting Header Beams ..... Ok? √

3.4.3 Interior Non-Loadbearing Partitions

3.4.3.1 Wood Studs ..... Ok? √

3.4.3.1.1 Notching and Boring ..... Ok? √

3.4.3.2 Top Plates ..... Ok? √

3.4.3.3 Bottom Plates ..... Ok? √

3.4.4 Wall Sheathing

3.4.4.1 Sheathing and Cladding ..... Ok? √

3.4.4.2 Exterior Shear Walls ..... Ok? √

3.4.4.2.1 Sheathing Type Adjustments ..... Ok? √

3.4.4.2.2 Perforated Shear Wall Adjustments ..... Ok? √

3.4.4.2.3 Hold-downs ..... Ok? √

WFCM 3.5 ROOF SYSTEMS CHECKLIST

3.5.1 Wood Rafter Systems

3.5.1.1 Rafters .....Ok? √

3.5.1.1.1 Jack Rafters .....Ok? √

3.5.1.1.2 Rafter Overhangs.....Ok? √

3.5.1.1.3 Rake Overhangs .....Ok? √

3.5.1.1.4 Notching and Boring .....Ok? √

3.5.1.2 Bearing .....Ok? √

3.5.1.3 End Restraint.....Ok? √

3.5.1.4 Ridge Beams .....Ok? √

3.5.1.5 Hip and Valley Beams.....Ok? √

3.5.1.6 Ceiling Joists .....Ok? √

3.5.1.7 Open Ceilings.....Ok? √

3.5.1.8 Roof Openings.....Ok? √

3.5.2 Wood I-Joist Roof Systems .....Ok? √

3.5.3 Wood Roof Truss Systems.....Ok? √

3.5.4 Roof Sheathing

3.5.4.1 Sheathing .....Ok? √

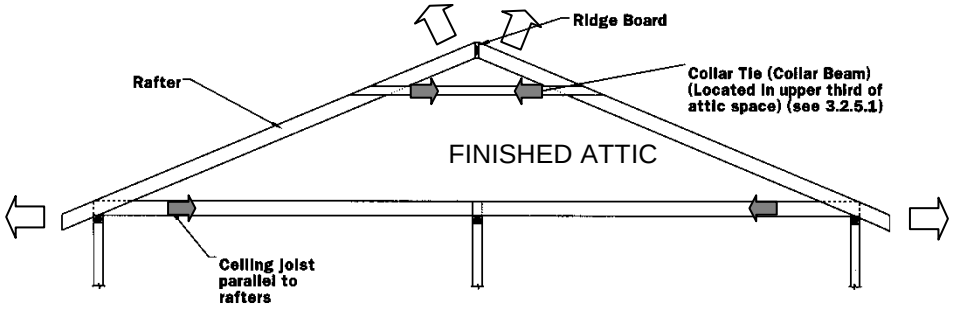
3.5.4.2 Sheathing Edge Support .....Ok? √

3.5.5 Roof Diaphragm Bracing.....Ok? √

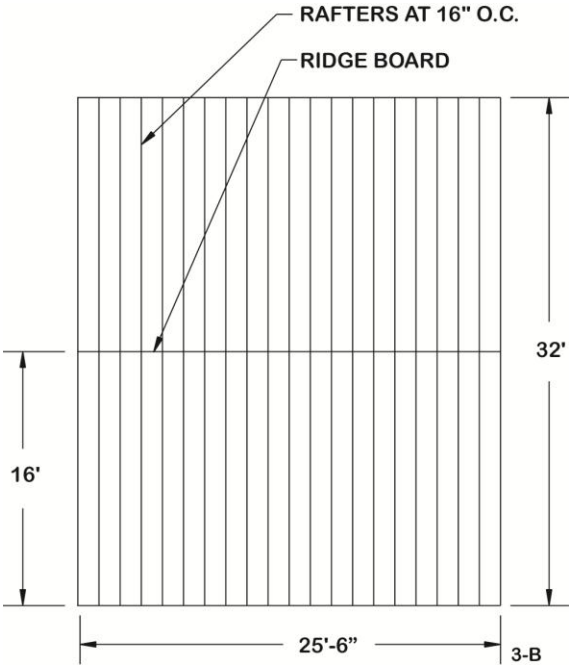
Notes

ROOF STORY DESIGN

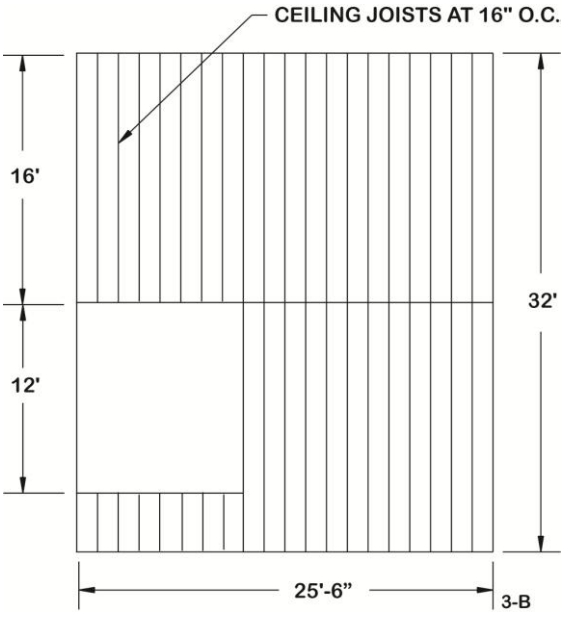
Figure W4.1 Roof and Ceiling Framing - Finished Attic Details



Cross Section (East Section)

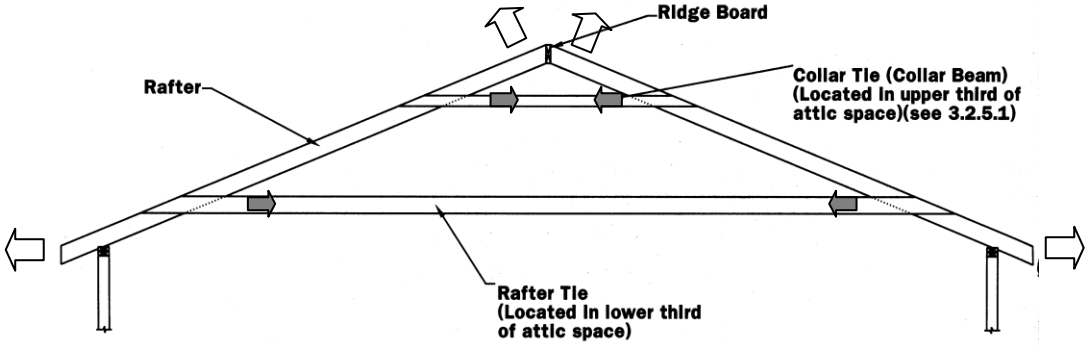


Roof Framing Plan (East Section)

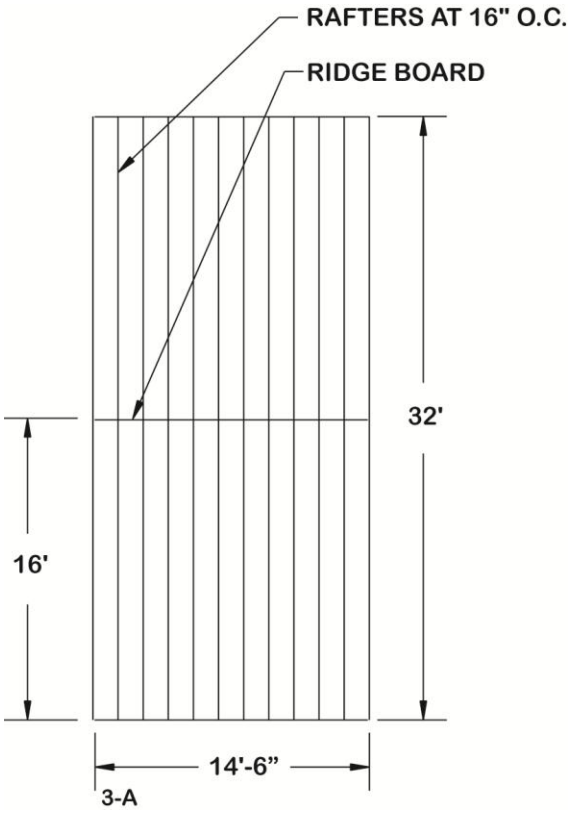


Ceiling Framing Plan (East Section)

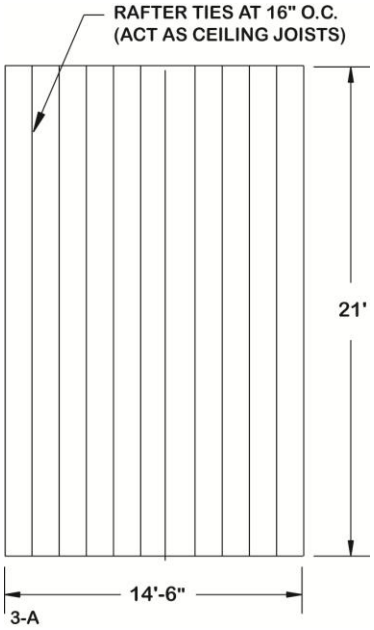
Figure W4.2 Roof and Ceiling Framing – Raised Ceiling Details



Cross Section (West Section)

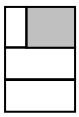


Roof Framing Plan (West Section)



Ceiling Framing Plan (West Section)

Roof Framing – Finished Attic



Rafters (WFCM 3.5.1.1)

Assuming ceiling attached to rafters, choose rafters from Tables 3.26B and 3.26D

Ground Snow Load: ..... 30 psf
Live Load: ..... 20 psf
Dead Load: ..... 10 psf
Three second gust wind speed (700 yr) and exposure category: ..... 160 mph Exp. B
Rafter Vertical Displacement L/Δ: 240
Required Span (Horizontal Projection): ..... 16 ft.

Thrust Factor (Footnote 1): ..... 1.0 (C_{tf})
Wind Factor (Footnote 3): ..... 0.95 (C_w)
Sloped Roof Adjustment (Footnote 2): ..... 1.05 (C_{sr})

Table W4.1 Selection of Species, Grade, Size, and Spacing for Rafters: (Table 3.26B & D)

Species	Douglas Fir-Larch		Hem-Fir		Southern Pine		Spruce-Pine-Fir	
Spacing	16"		16"		16"		16"	
Grade	#2		#2		#2		#2	
Table 3.26B Span (L_t)	2x8	18'-5"	2x8	17'-3"	2x8	17'-1"	2x8	17'-9"
Live Load Span $L_{LL}=L_t(C_{tf})(C_{sr})$	18.4(1.0)(1.05) = 19'-4" Ok		17.3(1.0)(1.05) = 18'-2" Ok		17.1(1.0)(1.05) = 18'-0" Ok		17.75(1.0)(1.05)= 18'-6" Ok	
Table 3.26B Span (L_t)	2x8	18'-5"	2x8	17'-3"	2x8	17'-1"	2x8	17'-9"
Wind Load Span $L_{WL}=L_t(C_w)(C_{sr})$	18.4(0.95)(1.05) = **18'-4"** Ok		17.3(0.95)(1.05) = **17'-3"** Ok		17.1(0.95)(1.05) = **17'-0"** Ok		17.75(0.95)(1.05) = **17'-8"** Ok	
Table 3.26D Span (L_t)	2x10	18'-9"	2x10	18'-2"	2x10	16'-10"	2x10	18'-5"
Snow Load Span $L_{SL}=L_t(C_{tf})$	18.75(1.0) = 18'-9" Ok		18.2(1.0) = 18'-2" Ok		16.8(1.0) = 16'-10" Ok		18.4(1.0) = 18'-5" Ok	

Trial and error

Trial and error

Trial and error

Notes: as an energy consideration, 2x12 rafters might be a minimum requirement for batt insulation.

Ridge Beams (WFCM 3.5.1.4)

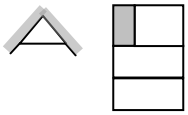
Since thrust is accounted for in rafter selection, per 3.5.1.4 exception use: 1x10 Ridge Board

* Alternatively, a Ridge Beam could be designed per Table 3.29. Additional columns at beam ends would be required to establish load path to the foundation. Also, fasteners will need to be designed to resist uplift from the rafters at each end of the ridge beam.

Ground Snow Load: ..... 30 psf
Live Load: ..... 20 psf
Dead Load: ..... 10 psf
Required Span: ..... 25' - 6"
Building Width: ..... 32' - 0" (interpolation req'd)

5-1/8" x 19-1/4" or 3-1/8" x 24-3/4" 20F-1.5E Glulam with F_{vx}=210psi **OK**

Roof Framing – Raised Ceiling



Rafters (WFCM 3.5.1.1)

Assuming a finished ceiling attached to rafters (on lower rafter tails) and ceiling joists raised 1/3 of the ridge height from the top plate, choose rafters from Table 3.26B (dead and live load) and 3.26D (dead and snow load) and evaluate roof live, wind, and snow load spans. The smaller span controls.

Ground Snow Load:..... 30 psf
Live Load:..... 20 psf
Dead Load:..... 10 psf
Three second gust wind speed (700 yr) and exposure category: ..... 160 mph Exp. B
Rafter Vertical Displacement L/Δ: 240
Required Span (Horizontal Projection):..... 16 ft
Thrust Span Adjustment Factor (Footnote 1): ..... 0.67 (C_{tf})
Sloped Roof Span Adjustment Factor (Footnote 2):..... 1.05 (C_{sr})
Wind Span Adjustment Factor (Footnote 3):..... 0.95 (C_w)

Table W4.2 Selection of Species, Grade, Size, and Spacing for Rafters with a Raised Ceiling: (Table 3.26B & D)

Species	Douglas Fir-Larch		Hem-Fir		Southern Pine		Spruce-Pine-Fir		
Spacing	16"		16"		16"		16"		
Grade	#2		#2		#2		#2		
Table 3.26B Span (L_t)	2x12	26'-0"	2x12	25'-5"	2x12	23'-10"	2x12	25'-9"	Trial and error
Live Load Span $L_{LL}=L_t(C_{tf})(C_{sr})$	26.0(0.67)(1.05) = 18'-3" Ok		25.5(0.67)(1.05) = 17'-11" Ok		23.8(0.67)(1.05)= 16'-8" Ok		25.75(0.67)(1.05) = 18'-1" Ok		
Table 3.26B Span (L_t)	2x12	26'-0"	2x12	25'-5"	2x12	17'-1"	2x12	25'-9"	Trial and error
Wind Load Span $L_{WL}=L_t(C_{tf})(C_{sr})(C_w)$	26.0(0.67)(1.05)(0.95)=17'-4" Ok		25.5(0.67)(1.05)(0.95)=17'-0" Ok		23.8(0.67)(1.05)(0.95)=15'-11" NG		25.75(0.67)(1.05)(0.95)=17'-2" Ok		
Table 3.26D or Span Calc Span* (L_c)	2x12 12" o.c.	25'-1"	2x12 12" o.c.	24'-4"	2x12 #1 12" o.c.	26'-5"	2x12 12" o.c.	24'-8"	
Snow Load Span $L_{SL}=L_c(C_{tf})$	25.1(0.67)= **16'-9" Ok**		24.3(0.67)= **16'-3" Ok**		26.5(0.67)= **17'-9" Ok**		24.7(0.67)= **16'-6" Ok**		Trial and error

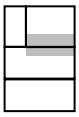
*AWC Span Calculator used since tabulated values are not given in the WFCM for spans greater than 20 feet.

Ridge Boards (WFCM 3.5.1.4)

Since thrust is accounted for in rafter selection, per 3.5.1.4 exception use: 13" deep Ridge Board
Could use 1" or 1-1/8" engineered wood rimboard or ¾" thick wood structural panel.

Some building codes require that ridge boards be of continuous length. Long lengths are possible with engineered wood products, or one could be built up using two layers of 3/8" wood structural panel material ripped to depth and end joints offset.

Ceiling Framing – Finished Attic



Floor Joists (WFCM 3.3.1.1)

For habitable attics, use residential sleeping area with 30psf live load, choose floor joists from Table 3.18A:

Live Load:..... 30 psf
Dead Load:..... 10 psf
Joist Vertical Displacement L/Δ: 360
Required Span:..... 16 ft

Table W4.3 Selection of Specie, Grade, Size, and Spacing for Floor Joists: (Table 3.18A)

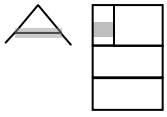
Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	16"	16"	16"	16"
Grade	#2	#2	#2	#2
Size	2x10	2x10	2x12	2x10
Maximum Span	17'-5" Ok	16'-10" Ok	18'-6" Ok	17'-2" Ok

Floor Sheathing (WFCM 3.3.4.1)

Choose floor sheathing from Table 3.14:

Floor Joist Spacing:..... 16 in.
Sheathing Type (Wood Structural Panel or Board Sheathing): ..... WSP Single Floor
Span Rating or Grade: ..... 16 o.c.
Tabulated Minimum Panel Thickness: ..... 19/32 in. **Ok**

Ceiling Framing – Raised Ceiling



As a variation on ceiling joist selection, use WFCM Chapter 2 to calculate spans.

Ceiling Joists (WFCM 2.5.1.6)

For uninhabitable attics without storage, choose required ceiling joist capacities from Table 2.12A.

Live Load:..... 10 psf
Dead Load:..... 5 psf
Joist Vertical Displacement L/Δ: 240

Required Span (raised 1/3 vertical distance from the top plate):..... 21.3 ft
Spacing (see rafter spacing in Table W4.2):..... 12 in.

Required E and F_b at 12"o.c. joist spacing for 21.3' span from Table 2.12A:

Size	2x6	2x8	
Required E	2,100,000	1,000,000	psi
Required F_b	1354	825	psi

Table W4.4 Select Grade and adjustment factors from *NDS* Table 4A and 4B based on required E and F_b above:

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Size & Grade	2x8 No.2	2x8 No. 2	2x8 No. 2	2x8 No. 2
Tabulated E, psi	1,600,000	1,300,000	1,400,000	1,400,000
Tabulated F_b, psi	900	850	925	875
Size Factor, C_F	1.2	1.2	1.0	1.2
Load Duration Factor, C_D	1.0	1.0	1.0	1.0
Repetitive Member Factor, C_r	1.15	1.15	1.15	1.15
Allowable F_b, psi	900(1.2)(1.0)(1.15) = 1,242 psi Ok	850(1.2)(1.0)(1.15) = 1,173 psi Ok	925(1.0)(1.0)(1.15) = 1064 psi Ok	875(1.2)(1.0)(1.15) = 1,208 psi Ok

Trial and error

Roof and Ceiling Sheathing

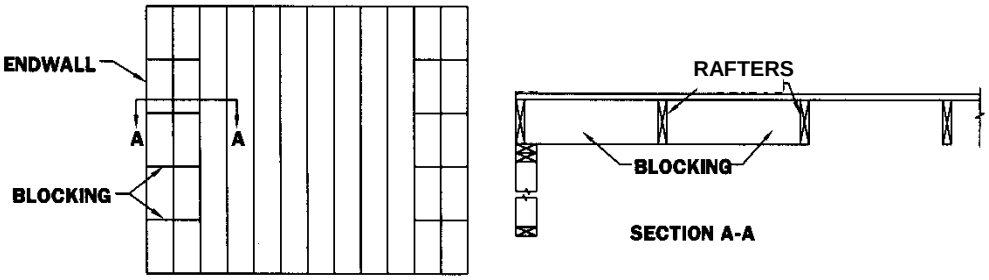
Sheathing (WFCM 3.5.4.1)

Choose Roof Sheathing from Tables 3.12A and 3.12B:

Ground Snow Load ..... 30 psf
Live Load ..... 20 psf
Dead Load ..... 10 psf
Three second gust wind speed (700 yr) and exposure category: ..... 160 mph Exp. B
Rafter/Truss Spacing: ..... 16 in.
Sheathing Type: ..... WSP Sheathing Grade/OSB
Tabulated Minimum Panel Thickness:
From Table 3.12A (wind): ..... 3/8 in. Ok
From Table 3.12B (live and snow): ..... 3/8 in. Ok

Roof Diaphragm Bracing – Finished Attic (WFCM 3.1.3.1g, 3.5.5, and 3.4.1.1.2)

Blocking 4 ft o.c. in first two rafter bays per Figure 3.7b and Table 3.1 fastener schedule.
Blocking to Joist (toe-nailed): 2-8d Common



OR

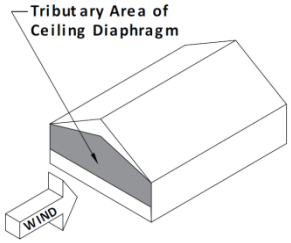
Bracing Gable End Wall with Attic Floor/Ceiling Sheathing Length from Table 3.15 (assumes windward and leeward loads and sheathing length from gable end to gable end)

Three second gust wind speed (700 yr) and exposure category: ..... 160 mph Exp. B
Roof Pitch: 7:12
Roof (diaphragm) Span: ..... 32 ft
Diaphragm Length Available: ..... 25.5 ft
Sheathing Type: ..... WSP
Maximum Opening ≤ 12 ft or 50% diaphragm dimension: ..... 12 ft

Tabulated Minimum Length of Attic Floor/Ceiling Diaphragm: ..... 10.67 ft interpolated
Bracing One Gable End Adjustment (Table 3.15 Footnote 1): 0.84
Wall Height Adjustment (Table 3.15 Footnote 2): ..... 1.0 9 ft walls
Ceiling Framing Spacing Adjustment (Table 3.15 Footnote 4): ..... 1.0 WSP not gypsum

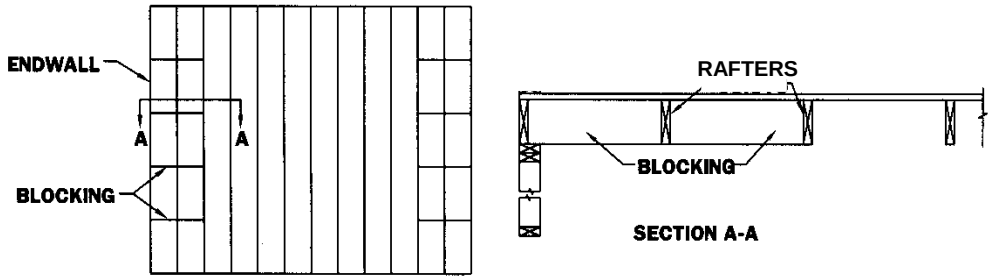
Required Minimum Length of Attic Floor/Ceiling Diaphragm:
Tabulated minimum Length x Applicable Adjustment Factors: .... 8.96 ft
Tabulated min. length ≥ 1/3 distance between bracing end walls: **10.67** ft Ok
(per Table 3.15 Footnote 1 to maintain 3:1 aspect ratio)

Use Table 3.1 fastener schedule for floor sheathing.



Roof Diaphragm Bracing – Raised Ceiling (WFCM 3.5.5 and 3.4.1.1.2)

Blocking at 4 ft o.c. in first two rafter bays with full height studs on second floor end wall framing is possible with balloon framing. The stud length of 12.1 ft to the raised ceiling plus maximum gable height of 6.2 ft at the ridge gives 18.3 ft which is less than the 20 ft maximum non-loadbearing stud height (3.1.3.3a). Balloon framed studs would have to be designed for wind loads.



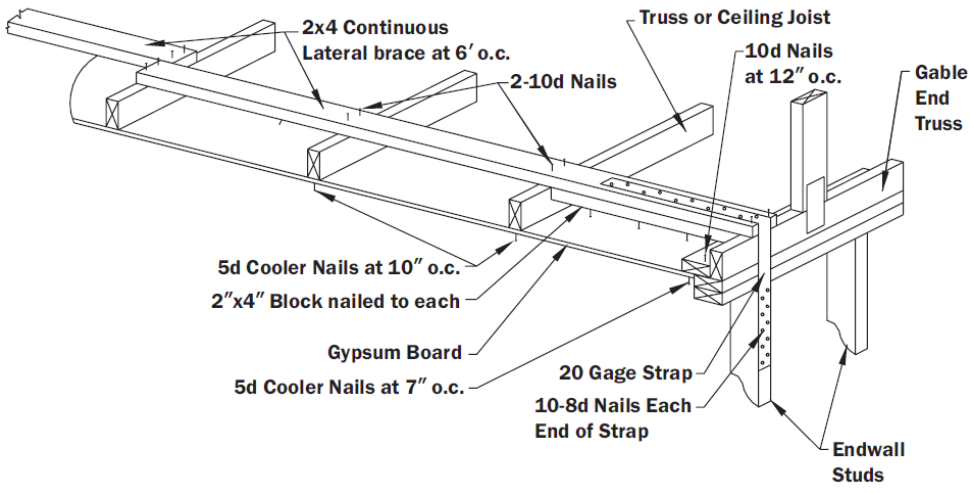
OR

Bracing Gable Endwall with Attic Floor/Ceiling Sheathing Length from Table 3.15 with Gable Brace Figure 3.7a.

Three second gust wind speed (700 yr) and exposure category:	160	mph Exp. B	
Roof Pitch:	7:12		
Roof (diaphragm) Span (see raised ceiling calculations):	21.3	ft	
Diaphragm Length Available:	14.5	ft	
Sheathing Type (wood structural panels or gypsum):	WSP		GYP
Tabulated Min. Length of Attic Floor/Ceiling Diaphragm (interpolated):	7.1	ft	18.5 ft
Bracing One Gable End Adjustment (Footnote 1):	0.84		0.84
Wall Height Adjustment (Footnote 2): (13.1'/10')	1.31		1.31
Ceiling Framing Spacing Adjustment (Footnote 4):	1.0		0.78
Required Minimum Length of Attic Floor/Ceiling Diaphragm: Tabulated Minimum Length x Applicable Adjustment Factors:	**7.8**	ft Ok	15.9 ft NG

WSP sheathing is required for the ceiling diaphragm since 15.9' required length of gypsum diaphragm is greater than the 14.5' length of the raised ceiling.

Figure 3.7a Ceiling Bracing Gable Endwall



Wall Framing

Non-Loadbearing (3-A and 2-A)

There are 2 options for designing gable end studs: 1) balloon framing from the second floor to the rafters with a maximum stud length of 18.3 ft, or 2) stud length of 12.1 ft to the raised ceiling and gable studs of 6.2 ft above with the raised ceiling diaphragm used for bracing.

Choose Studs from Table 3.20A or 3.20B and Table 3.20C

Three second gust wind speed (700 yr) and Exposure category:..... 160 mph Exp. B
Exterior Studs (ext. wood siding and int. gypsum bd.) Deflection:..... L/180 in.
Sheathing Type (wood structural panel or minimum sheathing): ..... WSP

Option 1: Wall Height:..... 18.3 (max) ft

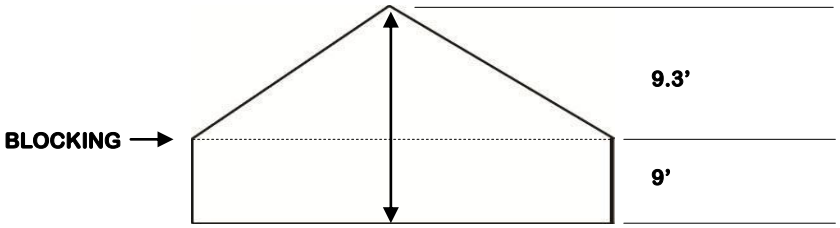
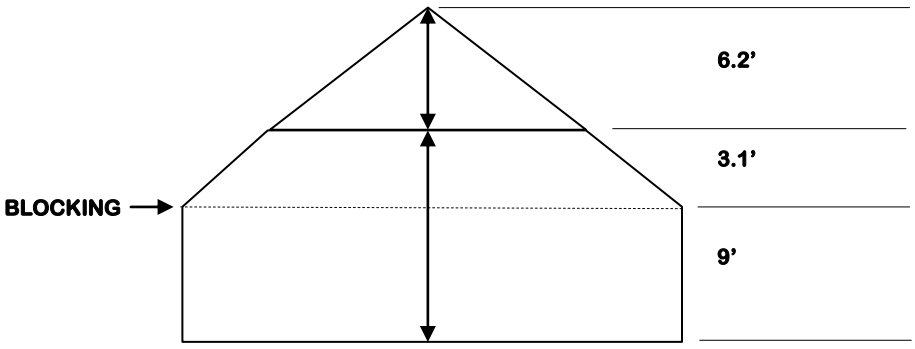


Table W4.5 Selection of Species, Grade, Size, and Spacing for Non-loadbearing Studs (Tables 3.20B1 and 3.20C)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	12" *	12" *	12" *	22" *
Grade	No. 2	No. 2	No. 2	No. 2
Size	2x6	2x6	2x6	2x6
Maximum Length (Wind)	**19'-5"** OK	**18'-0"** NC**	**18'-6"** OK	**18'-6"** OK
Maximum Length (D+L)	20'-0" OK	20'-0" OK	20'-0" OK	20'-0" OK

* Stud spacing can be increased to 16" o.c. at a distance of roughly 4-5' on either side of the ridge where stud heights drop to levels that allow greater spacing. Stud spacing of 16" o.c. at the corners also works based on Table 3.20B1 Footnote "a" since allowable stud heights at 24" o.c. are greater than 9'.
** Double studs at the ridge location.

Option 2: Wall Height:..... 12.1 (max) ft



Option 2 solution is shown in Table W5.3. Choose Option 2 to keep stud sizes at 2x6 for consistency with other framing. No.3/Stud grade 2x6 can be used for framing above the ceiling diaphragm level (3-A) based on calculations from Table W4.6.

Wall Framing – cont'd

Non-Loadbearing (3-B)

Choose Studs from Table 3.20A or 3.20B and Table 3.20C

Wall Height:..... 9.3 (max) ft

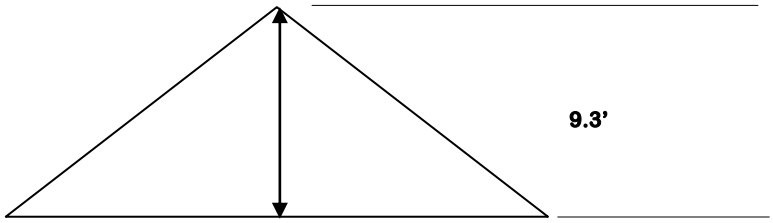


Table W4.6 Selection of Species, Grade, Size, and Spacing for Non-loadbearing Studs (Tables 3.20B1 and 3.20C)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	24" *	24" *	24" *	24" *
Grade	No. 3/Stud	No. 3/Stud	No. 3/Stud	No. 3/Stud
Size	2x6	2x6	2x6	2x6
Maximum Length (Wind)	**11'-6"** OK	**11'-3"** OK	**10'-6"** OK	**11'-3"** OK
Maximum Length (D+L)	20'-0" OK	20'-0" OK	20'-0" OK	20'-0" OK

* Decrease stud spacing to 16" o.c. per Tables 3.20B1 Footnote "a".

Connections

Lateral Framing and Shear Connections (WFCM 3.2.1)

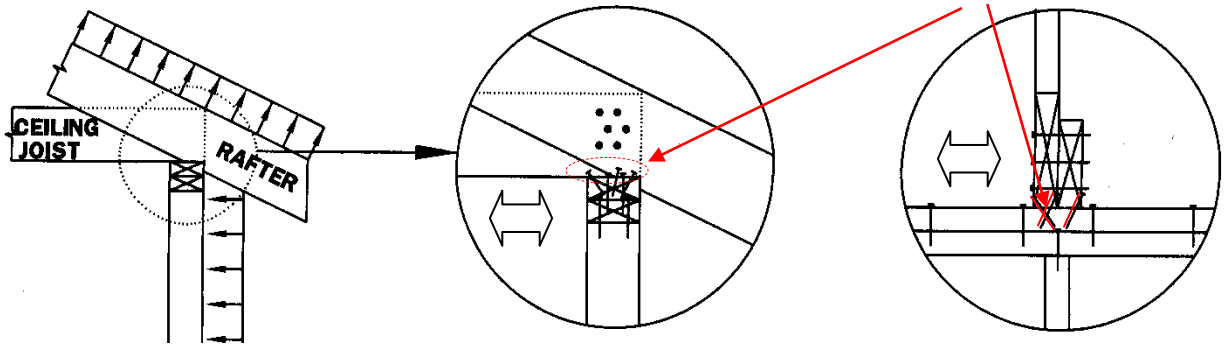
Roof Assembly to Wall Assembly (WFCM 3.2.1.2)

Choose Rafter/Ceiling Joist to Top Plate Lateral and Shear Connection from Table 3.4A

Three second gust wind speed (700 yr) and exposure category: ..... 160 mph Exp. B
Rafter/Ceiling Joist Spacing ..... 16 in.
Wall Height (2-1 and 2-2): ..... 9 ft
Top plate-to-ridge height: ..... 9.3 ft

Tabulated no. of toenails in each rafter/ceiling joist to top plate connection: ... 3
Top plate-to-ridge height adjustment (Footnote 4): 1.0
Required no. of toenails (tabulated x adjustments) 3*

* See Table W4.8 below for alternative minimum capacities for proprietary connectors.



Wall Assembly (WFCM 3.2.1.3)

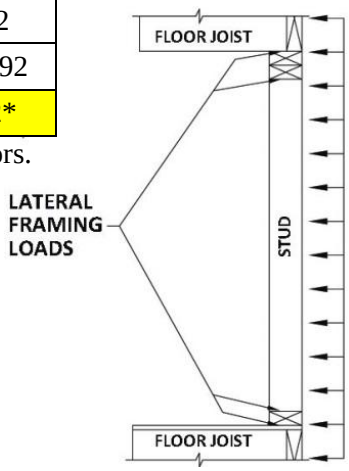
Choose Top and Bottom Plate to Stud Lateral Connection from Table 3.5A

Three second gust wind speed (700 yr) and exposure category: ..... 160 mph Exp. B
Rafter/Ceiling Joist Spacing ..... 16 in.

Table W4.7 Top and Bottom Plate to Stud Lateral Connections for Non-loadbearing Walls

Building Wall Elevation	3-B	3-A
Wall Height	9.3'**	6.2'
Tabulated no. of 16d commons per stud to plate connection	2	2
Footnote 2 adjustment for framing not within 8 feet of corners	0.92	0.92
Required no. of 16d commons per stud to plate connection	2*	2*

* See Table W4.8 for alternative minimum capacities for proprietary connectors.



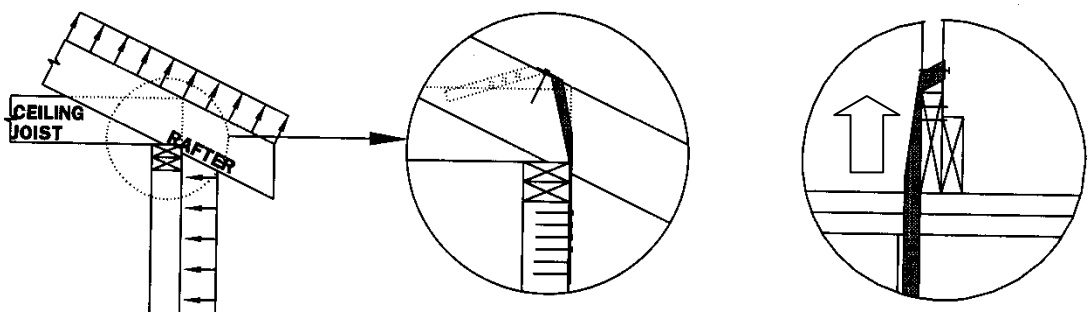
Uplift Connections (WFCM 3.2.2)

Roof Assembly to Wall Assembly (WFCM 3.2.2.1)

Table W4.8 Roof to Wall Uplift Strap Connection from Table A-3.4

Building Wall Elevation		**2-2**	**2-1**
Wind	Three second gust wind speed (700 yr) and exposure category	160 mph Exp. B	
	Framing Spacing	16 in.	
	Roof Span	32 ft	
	Minimum tabulated number of 8d Common Nails required in each end of 1-1/4" x 20 gage strap *every rafter / stud*	4	
	No Ceiling Assembly nail increase (Footnote 2)	0	
	Minimum required number of **8d Common Nails in each end of strap** *every rafter / stud* = Tabulated number of nails + Increases	4 *	

* See Table W4.9 for alternative minimum capacities for proprietary connectors.



Non-loadbearing wall assemblies in accordance with Table W4.9 below (3.2.6.3)

Connections (cont'd)

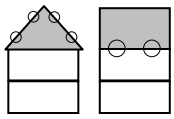
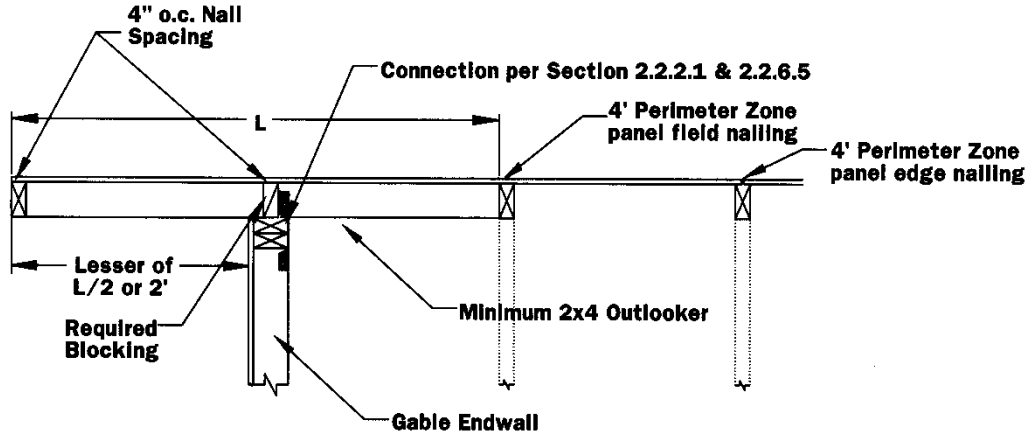


Table W4.9 Alternative proprietary connectors every rafter/stud with the following minimum capacities from Tables 3.4 and 3.4C

	Building Wall Elevation	**2-2**	**2-1**	**3-B**	**3-A**
	Wall Height	9'	9'	9.3'	6.2'
Wind	**Loadbearing Walls** - Tabulated minimum uplift connection capacity (Table 3.4)	479 lbs		n/a	
	Interior framing adjustment (Table 3.4 Footnote 1)	1.0		n/a	
	Roof dead load reduction (Table 3.4 Footnote 3)	0		n/a	
	Non-Loadbearing Walls - Tabulated minimum uplift connection capacity (Table 3.4C)	n/a		529 lbs	
	Overhang Multiplier (Table 3.4C, Footnote 1) $[(2' + OH) / 4']^2$ OH = 2 '	n/a		1.0	
	Zone 2 Multiplier (Table 3.4C, Footnote 2)	n/a		1.0	
	Required Minimum **Uplift** Capacity of proprietary connector = Tabulated minimum capacity x Adjustments - Reduction	479 lbs		529 lbs	
	Required Minimum **Lateral** Capacity – rafter/truss to wall (Table 3.4)	224 lbs		n/a	
	Required Minimum **Lateral** Capacity – top and bottom plate to stud (Table 3.5)	n/a		159 lbs*	141 lbs
	Tabulated Minimum Shear Parallel to Ridge Capacity (R=W/L=0.8) (Table 3.4)	93 lbs		n/a	
	Tabulated Minimum Shear Perpendicular to Ridge Capacity (R=L/W=1.25)	n/a		145 lbs	
	Shear connection adjustment (Table 3.4 Footnote 4)	0.92		0.92	
	Required Minimum **Shear** Capacity	77 lbs		133 lbs	

* For 3-B, maximum load based on stud length at the ridge. Loads will decrease as stud length decreases.



Connections (cont'd)

Sheathing and Cladding Attachment (WFCM 3.2.4)

Roof Sheathing (WFCM 3.2.4.1)

Choose Roof Sheathing Nail Spacing from Table 3.10

Three second gust wind speed (700 yr) and exposure category: ..... 160 mph Exp. B
Rafter/Truss Spacing:..... 16 in.
Sheathing Type: ..... WSP

Table W4.10 Roof Sheathing Nail Spacing to Resist Suction Loads	Nail Spacing 8d Common Nails	
Location	Edges	Field
4' Perimeter Edge Zone	6"	6"
Interior Zones	6"	12"
Gable Endwall Rake with Overhang	4"*	4"*

* See *2012 WFCM* Figure 2.1g for nailing details.

Special Connections (WFCM 3.2.5)

Ridge Straps (WFCM 3.2.5.1)

For a true vaulted ceiling line, rather than using collar ties to resist upward ridge separation, choose
Ridge Tension Strap Connection from Table A-3.6)

Three second gust wind speed (700 yr) and exposure category: ..... 160 mph Exp. B

Roof Pitch: 7:12
Roof Span: ..... 32 ft

Tabulated number of 8d Common Nails
required in each end of 1-1/4" x 20 gage strap: 3
Ridge Strap Spacing Adjustment (Footnote 3): 1.0

Required number of 8d Common Nails in each end of 1-1/4" x 20 gage strap:
Tabulated number of nails x Applicable adjustment factors: ..... 3 *

Connections (cont'd)

*** Alternatively, use proprietary connectors with the following minimum capacity from Table 3.6**

Tabulated minimum connection capacity: 351
Ridge Strap Spacing Adjustment (Footnote 3): 1.0
Required minimum capacity of proprietary connector:
Tabulated minimum capacity x Applicable adjustment factors:.... 351 lbs

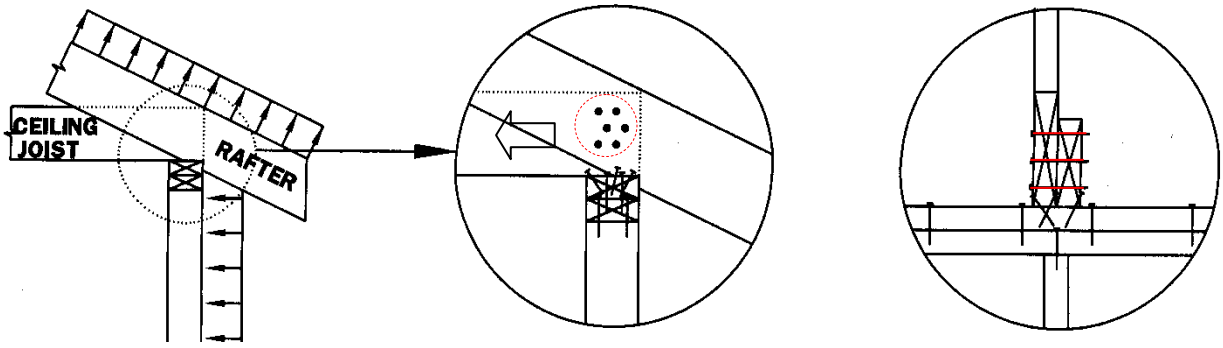
Table 3.1 Nailing Schedule

Choose Ceiling Joist to Parallel Rafter and Ceiling Joist Lap Connection from Table 3.9A

Ground Snow Load:..... 30 psf
Roof Span: ..... 32 ft
Rafter Slope: 7:12
Rafter Spacing: ..... 16 in.

Tabulated number of **16d Common Nails** required per heel joint splice:.. 5
Ceiling Height/Roof Ridge Height Adjustment (Footnote 5):..... 1.0

Required number of **16d Common Nails** per heel joint splice:
Tabulated number of nails x Applicable adjustment factors: ..... 5 *
Required number of nails at splice (Footnote 3):..... 5 *



***Alternatively, use proprietary connectors with the following minimum capacity from Table 3.9**

Tabulated minimum connection capacity: ..... 605 interpolated
Ceiling Height/Roof Ridge Height Adjustment (Footnote 5):..... 1.0

Required minimum capacity of proprietary connector:
Tabulated minimum capacity x Applicable adjustment factors:.... 605 lbs

Connections (cont'd)

Choose Ceiling Joist to Parallel Rafter and Raised Ceiling Joist Lap Connection from Table 3.9A

Ground Snow Load: ..... 30 psf
Roof Span: ..... 32 ft
Rafter Slope: 7:12
Rafter Spacing: ..... 12 in.

Tabulated number of **16d Common Nails** required per heel joint splice: .. 4
Ceiling Height/Roof Ridge Height Adjustment (Footnote 5): 1.5

Required number of **16d Common Nails** per heel joint splice:
Tabulated number of nails x Applicable adjustment factors: ..... 6 *
Required number of nails at splice (Footnote 3): ..... 6 *

***Alternatively, use proprietary connectors with the following minimum capacity from Table 3.9**

Tabulated minimum connection capacity: ..... 454 interpolated
Ceiling Height/Roof Ridge Height Adjustment (Footnote 5): 1.5

Required minimum capacity of proprietary connector:
Tabulated minimum capacity x Applicable adjustment factors: .... 681 lbs

Blocking to Rafter Connection from Table 3.1 ..... 2-8d common nails toe-nailed at each end

OR

Rim Board to Rafter Connection from Table 3.1: 2-16d common nails end-nailed at each end

Framing and Connection Summary

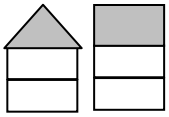


Table W4.11 Gable Wall and Roof Framing and Connection Summary

Wall	2-2	2-1	3-B	3-A
Stud Grade and Size			No. 2 2x6	No. 3/Stud 2x6
Stud Length			9.3'	6.2'
Stud Spacing			16"	16"
Roof to Wall Lateral/Shear	3-8d comm.	3-8d comm.	159 lbs	141
Roof to Wall Uplift	4-8d comm.	4-8d comm.	479 lbs	479 lbs
Plate to Stud Lateral	2-16d comm.	2-16d comm.	2-16d comm.	2-16d comm.

Table W4.12 Roof and Ceiling Framing and Connection Summary

	Attic Space	Vaulted Ceiling
Rafter Grade and Size	No. 2 2x10	No. 2 2x12*
Rafter Spacing	16"	12"
Floor/Ceiling Joist Grade & Size	No. 2 2x10	No. 2 2x8
Floor/Ceiling Joist Spacing	16"	12"
Floor/Ceiling Joist Length	16'	21'
Rafter to Ceiling Joist Nailing	5-16d comm.	6-16d comm.

* Southern Pine requires No. 1 grade.

SECOND STORY DESIGN

Wall Framing

Wall Studs (WFCM 3.4.1.1)

Loadbearing (2-1 and 2-2)

Choose Studs from Table 3.20A or 3.20B and Table 3.20C

Three second gust wind speed (700 yr) and Exposure category: ..... 160 mph Exp. B
Exterior Studs (ext. wood siding and int. gypsum bd.) Deflection: ..... L/180 in.
Wall Height: ..... 9 ft
Studs supporting (Roof, Ceiling, Floors): ..... R+C+1F
Sheathing Type (3/8" wood structural panel or minimum sheathing): ..... WSP

To show that this is an iterative approach and that other factors may drive selection of stud size, the first attempt will use 2x4 stud grade material. Start with Table 3.20B1 because shear walls will require WSP sheathing.

Table W5.1 Selection of Species, Grade, Size, and Spacing for Loadbearing Studs (Developed from WFCM Tables 3.20B1 and 3.20C)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	16"	16"	16"	16"
Grade	No. 3/Stud	No. 3/Stud	No. 3 or Stud	No. 3/Stud
Size	2x4	2x4	2x4	2x4
Maximum Length (Wind) [2]	10-1"	**9'-10"**	**9'-1"**	**9'-10"**
Maximum Length (Dead and Live Loads) [1]	**10'-0"**	10'-0"	10'-0"	10'-0"

1. Studs support roof, ceiling, and attic floor, therefore from Table 3.20C spacing is 16" o.c. The remainder of wall which supports only roof and ceiling could increase spacing to 24" o.c., however due to standard construction practice, the spacing remains at 16" o.c.
2. Footnote "a" requires the stud spacing to be multiplied by 0.80 for framing within 4 ft of the corners to address additional end zone loading requirements. Options:
    a. Space studs at 12" o.c. within 4 ft of the corners.
    b. Design for minimum sheathing materials per Table 3.20A1 and apply Footnote "a".
    c. Design for a higher grade or 2x6 studs at 24" o.c. and then space them at 16" o.c.

    Since wall W2-A will require 2x6 studs, choose Option (c). Calculations per Table W5.2.

Table W5.2 Selection of Species, Grade, Size, and Spacing for Loadbearing Studs (Developed from WFCM Tables 3.20B1 and 3.20C)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	24" *	24" *	24" *	24" *
Grade	No. 3/Stud	No. 3/Stud	No. 3 or Stud	No. 3/Stud
Size	2x6	2x6	2x6	2x6
Maximum Length (Wind) [1]	11'-6" OK	11'-3" OK	10'-6" OK	11'-3" OK
Maximum Length (Dead and Live Loads)	**10'-0"** OK	**10'-0"** OK	**10'-0"** OK	**10'-0"** OK

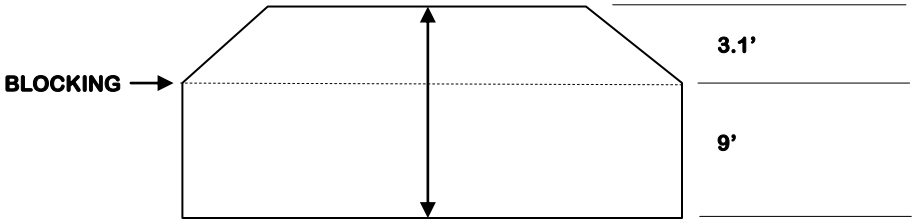
* Decrease all stud spacing to 16" o.c. to satisfy Table 3.20B Footnote "a" criteria.

Wall Framing (cont'd)

Non-Loadbearing (2-A)

Choose Studs from Table 3.20A or 3.20B and Table 3.20C

Wall studs balloon-framed to raised ceiling to avoid creating a hinge at the second floor level.



Three second gust wind speed (700 yr) and Exposure category: ..... 160 mph Exp. B
Exterior Studs (ext. wood siding and int. gypsum bd.) Deflection: ..... L/180 in.
Wall Height: ..... 12.1 (max) ft
Sheathing Type (wood structural panel or minimum sheathing): ..... WSP

Selection of Specie, Grade, Size, and Spacing for wind and gravity loads: (Table 3.20B1 and Table 3.20C). Plan for the 0.8 end zone stud spacing adjustment factor specified by footnote "a" by starting with a 24" stud spacing (See 2-1 and 2-2 wall stud designs for other options).

Table W5.3 Selection of Species, Grade, Size, and Spacing for Non-loadbearing Studs (Developed from WFCM Tables 3.20B1 and 3.20C)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	24" *	24" *	24" *	24" *
Grade	No. 2	No. 2	No. 2	No. 2
Size	2x6	2x6	2x6	2x6
Maximum Length (Wind)	**15'-2"** OK	**14'-2"** OK	**14'-1"** OK	**14'-6"** OK
Maximum Length (Dead and Live Loads)	20'-0" OK	20'-0" OK	20'-0" OK	20'-0" OK

* Decrease the specified 24" stud spacing to 16" o.c. to meet the criteria of Table 3.20B Footnote "a" for wall framing in end zones.

Wall Framing (cont'd)

Non-Loadbearing (2-B)

Choose Studs from Table 3.20A or 3.20B and Table 3.20C

Three second gust wind speed (700 yr) and Exposure category: ..... 160 mph Exp. B
Exterior Studs (ext. wood siding and int. gypsum bd.) Deflection: ..... L/180 in.
Wall Height: ..... 9 ft
Sheathing Type (wood structural panel or minimum sheathing): ..... WSP

Selection of Specie, Grade, Size, and Spacing for wind and gravity loads: (Table 3.20B1 and Table 3.20C). Plan for the 0.8 end zone stud spacing adjustment factor specified by footnote "a" by starting with a 24" stud spacing. Even though 2x4 studs might work, start with 2x6 studs based on all other walls being framed with 2x6.

Table W5.4 Selection of Species, Grade, Size, and Spacing for Non-loadbearing Studs (Tables 3.20B1 and 3.20C)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	24" *	24" *	24" *	24" *
Grade	No. 3/Stud	No. 3/Stud	No. 3 or Stud	No. 3/Stud
Size	2x6	2x6	2x6	2x6
Maximum Length (Wind)	**11'-6"** OK	**11'-3"** OK	**10'-6"** OK	**11'-3"** OK
Maximum Length (Dead and Live Loads)	20'-0" OK	20'-0" OK	20'-0" OK	20'-0" OK

* Decrease the specified 24" stud spacing to 16" o.c. to meet the criteria of Table 3.20B Footnote "a" for wall framing in end zones.

Top Plates (WFCM 3.4.1.2)

Choose Building End Wall Double Top Plate Lap Splice Length from Table 3.21

Building Dimension: ..... 32 ft

Tabulated number of nails per each side of splice ..... 13-16d nails

Minimum Splice Length (2-16d nails per 6") (14 nails/4 nails/ft): ..... 3.5 ft

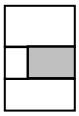
Choose Building Side Wall Double Top Plate Lap Splice Length from Table 3.21

Building Dimension: ..... 40 ft

Tabulated number of nails per each side of splice ..... 16-16d nails

Minimum Splice Length (2-16d nails per 6")(16 nails/4 nails/ft): ..... 4.0 ft

Wall Framing (cont'd)



Foyer Window

Exterior Loadbearing Wall Headers (WFCM 3.4.1.4.1)

Choose Headers in Loadbearing Walls from Tables 3.22A-E and Table 3.22F

Building Width:	32	ft
Required Span (Foyer Window):	6	ft
Ground Snow Load:	30	psf
Three second gust wind speed (700 yr) and Exposure category:	160	mph Exp. B

Header supporting roof, ceiling and attic floor

Table 3.22B1 (Dropped)

Preliminary Header Selection (Gravity Loads):	#2	3-2x12's	
Maximum Header/Girder Span (interpolated):	6'-3"	OK	

Table 3.22B2 (Raised)

Preliminary Header Selection (Gravity Loads):	**#2**	**2-2x12's**	
Maximum Header/Girder Span (interpolated):	6'-5"	OK	

Tabulated Number of Jack Studs (Table 3.22F):	3
Roof Span Adjustment (Footnote 1: (W+12)/48):	0.92
Adjusted no. of jack studs required = tabulated x roof span adjustment:	**3**

Table 3.23A – for Dropped Headers Only

Preliminary Header Selection (Wind Loads):	#2	3-2x12 (gravity loads)	OK
Maximum Header/Girder Span (Dropped)	9'-1"	OK	
Tabulated Number of Full Height (King) Studs (Table 3.23C):	3*		
Reduced Full Height Stud Requirements (Table 3.23D) x/h = 0.25:	**2**		

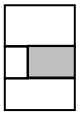
Final Selection of Header Grade and Size:

Raised Headers - gravity loads control:	#2	2-2x12's
Number of **Jack Studs** Required (gravity controlled):	3**	
Number of **Full Height (King) Studs** Required:	2	

Using identical procedures:

North bathroom headers (Dropped):	#2	2-2x8's	4'-3"	>4'	OK
North bathroom headers (Raised):	#2	2-2x8's	4'-5"	>4'	OK
Number of Jack Studs Required:	2*				
Number of Full Height (King) Studs Required:	2**				
Bedrooms 2-3 headers (Dropped):	#2	2-2x6's	3'-6"	>3'	OK
Bedrooms 2-3 headers (Raised):	#2	2-2x6's	3'-7"	>3'	OK
Number of Jack Studs Required:	2*				
Number of Full Height (King) Studs Required:	2**				
Bedroom 1 headers (Dropped):	#2	2-2x6's	4'-2"	>3'	OK
Bedroom 1 headers (Raised):	#2	2-2x6's	4'-3"	>3'	OK
Number of Jack Studs Required:	2*				
Number of Full Height (King) Studs Required:	2**				

* Full height studs could be determined based on 24" o.c. spacing from Tables W5.2-W5.4.
** WFCM 3.4.1.4.3 allows jack studs to be replaced with an equivalent number of full height (king) studs if adequate gravity connections are provided.



Exterior Non-Loadbearing Wall Headers and Window Sill Plates (WFCM 3.4.1.4.1 and 3.4.1.4.4)

Foyer Window

Choose Spans from Table 3.23B

Three second gust wind speed (700 yr) and Exposure category: 160 mph Exp. B
Wall Height: 9 ft
Required Span (Foyer Sill Plate): 6 ft

Selection of **Window Sill Plate** Specie, Grade, and Size: #2 1-2x6 (flat)
Tabulated Window Sill Plate Span: 7'-3"
Adjustment for framing not within 8' of corners (Footnote 1): 1.0
Wall Height Adjustment (Footnote 2: $(H/10)^{1/2}$): 0.95
Adjusted Maximum Sill Plate Length:
Tabulated max. Sill Plate Length ÷ wall Height Adjustment: 7'-8" >6' OK
Number of full height (king) studs determined previously.

Using identical procedures:

North bathroom sill plates: #2 1-2x6 (flat) 7'-8" >4' OK
Typical bedroom sill plates: #2 1-2x6 (flat) 7'-8" >3' OK
Non-loadbearing wall header: #2 1-2x6 (flat) 7'-8" >3' OK
Number of Full Height (King) Studs Required (Table 3.23C): 2
Reduced Full Ht. Stud Requirements (Table 3.23D) x/h = 0.25: 2
WFCM Commentary Table 3.23D: NFH=2L/s[x(1-x)]: 1

Interior Loadbearing Wall Headers (WFCM 3.4.2.4.1)

Bedroom 2 Door

Choose Headers for Interior Loadbearing Walls from Tables 3.24A-C

Building Width: 32 ft
Required Span: 3 ft

Header supporting one center bearing floor
Table 3.24A1 (Dropped)

Selection of Header Grade and Size: 2-2x6
Maximum Header/Girder Span (interpolated): 3'-10" > 3' OK

Table 3.24A2 (Raised)

Selection of Header Grade and Size: 2-2x6
Maximum Header/Girder Span (interpolated): 3'-11" > 3' OK
Number of Jack Studs Required (Table 3.24C): 1

Using identical procedures:

Foyer header (4' required): 2-2x8 4'-9" > 4' OK
Number of Jack Studs Required (Table 3.24C): 1

Interior Non-Loadbearing Wall Headers (WFCM 3.4.1.4.1)

Ends of Hallway

The *2012 International Residential Code (IRC)* section R602.7.3 allows a single flat 2x4 for interior non-loadbearing walls up to 8' spans.

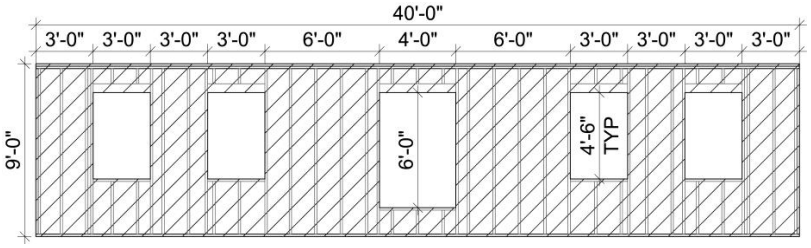
Wall Sheathing

Sheathing and Cladding (WFCM 3.4.4.1)

Choose Exterior Wall Sheathing OR Cladding from Tables 3.13A and 3.13B, respectively

Three second gust wind speed (700 yr) and Exposure category:..... 160 mph Exp. B

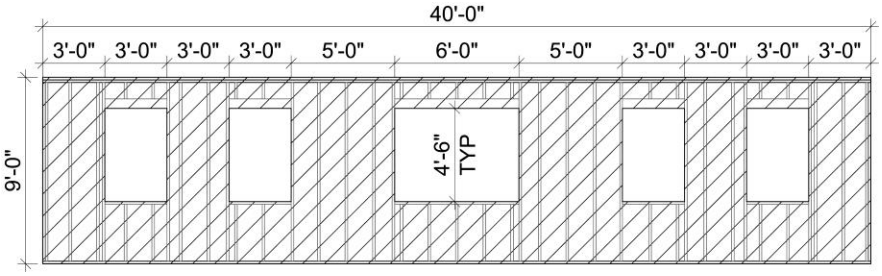
Sheathing Type (wood structural panels, fiberboard, board, hardboard):... WSP
Strength Axis to Support (Parallel or Perpendicular): ..... Parallel
Stud Spacing: ..... 16 in.
Minimum Panel Thickness to resist suction loads:..... 15/32 in.



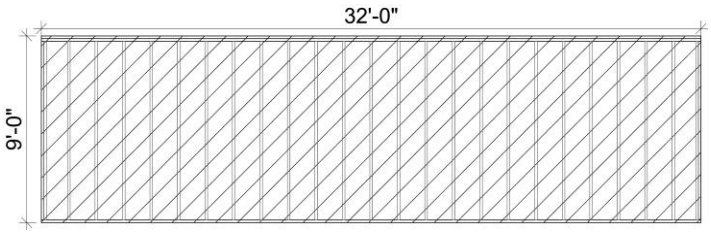
L_{FH} = 24 ft

2-2 (North) Elevation

L_{FH} = 22 ft



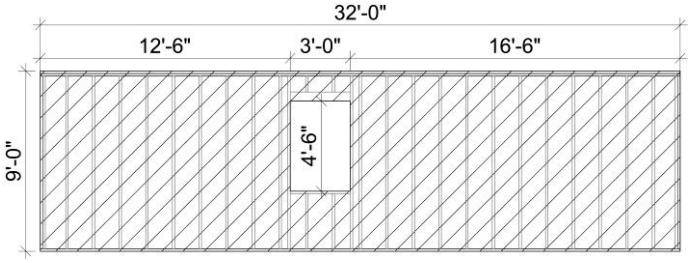
2-1 (South) Elevation



L_{FH} = 32 ft

2-B (East) Elevation

L_{FH} = 29 ft



2-A (West) Elevation

Wall Sheathing (cont'd)

Exterior Segmented Shear Walls (WFCM 3.4.4.2)

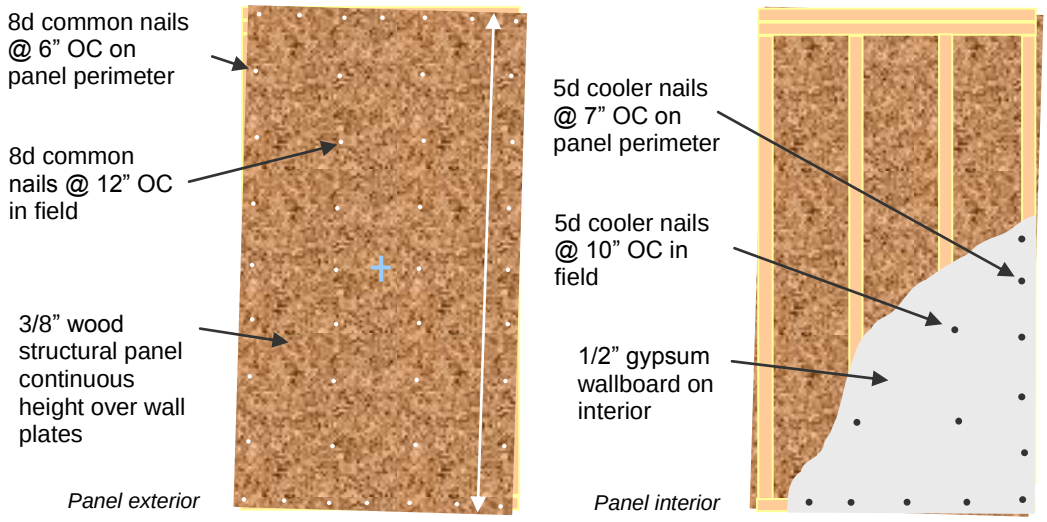
Choose Exterior Segmented Shear Wall Length from Table 3.17A-D

Wall Height:..... 9 ft
Number of Stories Braced (per 3.1.3.1 and table footnotes):..... 1

Three second gust wind speed (700 yr) and Exposure category:..... 160 mph Exp. B
Maximum shear wall aspect ratio for wind (Table 3.17D):..... 3.5:1
Minimum shear wall segment length (Wall height/aspect ratio) (9 ft/3.5): 2.6 ft

Seismic Design Category:..... D_1
Roof and Attic Dead Load..... 25 psf
NOTE: Dead load has been increase to account for partial attic.
Maximum shear wall aspect ratio for seismic (Table 3.17D):..... 2:1
Minimum shear wall segment length (Wall height/aspect ratio) (9 ft/2):... 4.5 ft

Minimum WSP sheathing thickness (per WFCM 3.4.4.2): ..... 3/8 in.
Minimum gypsum thickness (per WFCM 3.4.4.2): ..... 1/2 in.
Maximum stud spacing (per WFCM 3.4.4.2): ..... 16 in.



WFCM 3.4.4.2 "Standard" Shear Wall

Wall Sheathing (cont'd)

Exterior Segmented Shear Walls (WFCM 3.4.4.2)

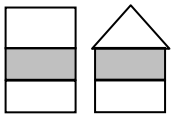
Table W5.5 Calculation of Exterior Segmented Shear Wall Lengths and Nailing Requirements

	Building Wall Elevation	**2-2**	**2-1**	**2-B**	**2-A**
	Wall Height	9'	9'	9'	9'
	Length (L) or Width (W) of Building	L=40'	L=40'	W=32'	W=32'
	Actual Length of Full Height Sheathing (L_{FH})	24'	22'	32'	29'
Seismic	Tabulated Min. Length Full Height Sheathing for **Seismic** Loads per Table 3.17C1 (R&C)** L/W = 1.25 (interpolated) (L_s)	8.8'	8.8'	8.8'	8.8'
	Vertical distribution factor adjustment per Table 3.17C Footnote 2 (C_{vd})	0.92	0.92	0.92	0.92
	Adjustment for other dead load case per Table 3.17C Footnote 4 (R&C)** (C_{dl})	1.42	1.42	1.42	1.42
	WSP Perimeter Edge Nail Spacing – **Seismic** (WFCM 3.4.4.2b + 3.4.4.2.1)	**6"**	**6"**	**6"**	**6"**
	Sheathing Type Adjustment per Table 3.17D (C_{sw})	1.0	1.0	1.0	1.0
	Aspect ratio adjustment per Table 3.17D Footnote 4 (C_{ar})*	1.5	1.5	1.0	1.0
	Min. Length Full Ht. Sheathing – Segmented **Seismic** ($L_{SSW\text{-}S} = L_s(C_{sw})(C_{dl})(C_{vd})(C_{ar})$)	**17.2'**	**17.2'**	11.5'	11.5'
	$L_{SSW\text{-}S} < L_{FH}$	**Ok**	**Ok**	**Ok**	**Ok**
Wind	Tabulated Min. Length Full Ht. Sheathing for **Wind** per Table 3.17A (R&C) (L_w)	10.3'	10.3'	12.8'	12.8'
	WSP Perimeter Edge Nail Spacing – **Wind** (WFCM 3.4.4.2a)	6"	6"	6"	6"
	Sheathing Type Adjustment per Table 3.17D (C_{sw})	1.0	1.0	1.0	1.0
	Wall and Roof Height Adjustment (Table 3.17A Footnote 4) (C_{WRH})	0.92	0.92	0.92	0.92
	Min. Length Full Ht. Sheathing–Segmented **Wind** ($L_{SSW\text{-}W} = L_w(C_{WRH})(C_{sw})$)	9.5'	9.5'	**11.8'**	**11.8'**
	$L_{SSW\text{-}W} < L_{FH}$	**Ok**	**Ok**	**Ok**	**Ok**

* SDPWS Table 4.3.4 requires the unit shear capacity to be multiplied by $2b_s/h$ if the shear wall segment aspect ratio exceeds 2:1. There are four 3' (b=3) segments in walls 2-1 and 2-2, so the aspect ratio adjustment factor for the shortest shear wall segment is $2b_s/h = 2(3)/9 = 0.67$. The sheathing type adjustment factor in the WFCM would need to be modified by the inverse of 0.67 so $C_{ar} = 1.5$.

** Since the attic only partially covers the structure and there are no additional walls or partitions, from Table 3.17C3 use Shear Wall Line Beneath category "roof and ceiling" to design the shear walls, then use the Footnote 4 adjustment to compensate for additional dead load due to attic floor framing. In this case, use roof/ceiling assembly = 25 psf.

Wall Sheathing (cont'd)



Exterior Perforated Shear Walls (WFCM 3.4.4.2)

Using Segmented Shear Wall results from Table W5.5, determine Perforated Shear Wall Lengths using Table 3.17E

Table W5.6 Calculation of Exterior Perforated Shear Wall Lengths and Nailing Requirements

Building Wall Elevation		**2-2**	**2-1**	**2-B**	**2-A**
Wall Height		9'	9'	9'	9'
Max. Unrestrained Opening Height		6'-0"	4'-6"	0	7'-6"
Max. Unrestrained Opening Heights as functions of wall height		2H/3	H/2	0	5H/6
Actual Length of Full Height Sheathing (L_{FH})		24'	22'	32'	29'
Seismic	Length of Wall (L_{Wall})	40'	40'	32'	32'
	Min. Length Full Ht. Sheathing - Segmented **Seismic** (L_{SSW-S})	17.2'	17.2'	11.5'	11.5'
	Percent Full Height Sheathing (L_{SSW-S} / L_{Wall})	43%	43%	36%	36%
	Perforated Length Increase Factor from Table 3.17E (C_L)	1.40	1.24	1.00	1.62
	Min. Length Full Ht. Sheathing - Perforated **Seismic** ($L_{PSW-S} = L_{SSW-S}$ (C_L))	**23.8'**	**21.5'**	11.5'	18.6'
$L_{PSW-S} < L_{FH}$		**Ok**	**Ok**	**Ok**	**Ok**
Wind	Actual Length of Full Height Sheathing (L_{FH-W})	24'	22'	32'	29'
	Length of Wall (L_{Wall})	40'	40'	32'	32'
	Min. Length Full Height Sheathing - Segmented **Wind** (L_{SSW-W})	9.5'	9.5'	11.8'	11.8'
	Percent Full Height Sheathing (L_{SSW-W} / L_{Wall})	24%	24%	37%	37%
	Perforated Length Increase Factor from Table 3.17E (C_L)	1.62	1.34	1.00	1.61
	Min. Length Full Ht. Sheathing - Perforated **Wind** ($L_{PSW-W} = L_{SSW-W}$ (C_L))	15.4'	12.7'	**11.8'**	**19.0'**
$L_{PSW-W} < L_{FH}$		**Ok**	**Ok**	**Ok**	**Ok**

* Includes a 2b/h reduction for exceeding 2:1 aspect ratio for seismic applied to the entire length of full-height sheathing. See Table W5.5 footnote for explanation.

Table W5.7 Top Story Shear Wall Edge Nail Spacing and Wall Length Summary

Building Elevation		**2-2**		**2-1**		**2-B**		**2-A**	
Seismic	Segmented	**6"**	**17.2'**	**6"**	**17.2'**	6"	11.5'	6"	11.5'
	Perforated	**6"**	**23.8'**	**6"**	**21.5'**	6"	11.5'	6"	18.6'
Wind	Segmented	6"	9.5'	6"	9.5'	**6"**	**11.8'**	**6"**	**11.8'**
	Perforated	6"	15.4'	6"	12.7'	**6"**	**11.8'**	**6"**	**19.0'**

See shear wall detailing summary tables at the end of this section for a final comparison of wind vs. seismic results.

Floor Framing

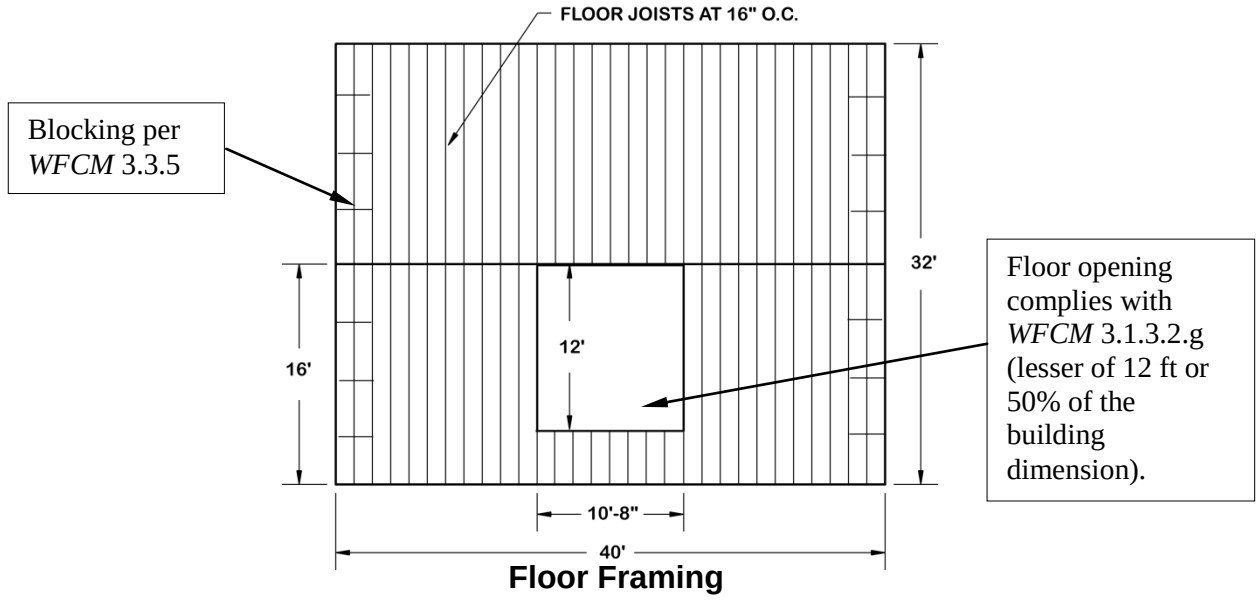
Floor Joists (WFCM 3.3.1.1)

Choose Floor Joists from Tables 3.18A-B

Live Load:..... 30 psf
Dead Load:..... 10 psf
Joist Vertical Displacement L/Δ: 360
Required Span:..... 16 ft

Table W5.8 Selection of Specie, Grade, Size, and Spacing for Floor Joists (Table 3.18A)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	16"	16"	16"	16"
Grade	#2	#2	#2	#2
Size	2x10	2x10	2x12	2x10
Maximum Span	17'-5" OK	16'-10" OK	18'-6" OK	17'-2" OK



Floor Framing

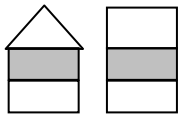
Floor Sheathing

Sheathing Spans (WFCM 3.3.4.1)

Choose Floor Sheathing from Table 3.14

Floor Joist Spacing:..... 16 in.
Sheathing Type: ..... WSP (Single Floor)
Span Rating..... 16 o.c.

Tabulated Minimum Panel Thickness: ..... 19/32 in. OK



Connections

Lateral Framing and Shear Connections (WFCM 3.2.1)

Wall Assembly (WFCM 3.2.1.3)

Top Plate to Top Plate
Table 3.1 for 6" WSP wall edge nail spacing..... 2-16d Commons per foot

Top Plate Intersection (Table 3.1): ..... 4-16d Commons each joint side

Stud to Stud (Table 3.1):..... 2-16d Commons 24" o.c.

Header to Header (Table 3.1):..... 16d Commons 16" o.c. - edges

Top or Bottom Plate to Stud (Table 3.1 & 3.5A):..... 2-16d Commons per stud*
* See header design for any additional nailing required for king studs. Also note that W2-A has a 12.1 foot wall height, however, 2-16d commons are sufficient.

Wall Assembly to Floor Assembly (WFCM 3.2.1.4)

Bottom Plate to Floor Joist, Bandjoist, Endjoist, or Blocking
Table 3.1 for 6" WSP wall edge nail spacing..... 2-16d Commons per foot

Floor Assembly (WFCM 3.2.1.5)

Bridging to Floor Joist (Table 3.1): ..... 2-8d Commons each end

Blocking to Floor Joist (Table 3.1): ..... 2-8d Commons each end

Band Joist to Floor Joist (Table 3.1): ..... 3-16d Commons per joist

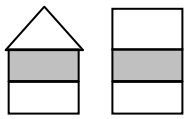
Floor Assembly to Wall Assembly (WFCM 3.2.1.6)

Floor Joist to Top Plate (Table 3.1):..... 4-8d Commons per joist

Blocking to Sill or Top Plate (Table 3.1):..... 3-16d Commons each block

Band Joist to Sill or Top Plate
Table 3.1 for 6" WSP wall edge nail spacing..... 2-16d Commons per foot

Connections (cont'd)



Uplift Connections (WFCM 3.2.2)

Wall Assembly to Wall Assembly (WFCM 3.2.2.2)

Table W5.9 Wall to Wall Uplift Strap Connection from Table A-3.4

Building Wall Elevation		**2-1**	**2-2**
Wind	Three second gust wind speed (700 yr) and Exposure category:	160 mph Exp. B	
	Framing Spacing	16 in.	
	Roof Span	32 ft	
	Minimum tabulated number of 8d Common Nails required in each end of 1-1/4" x 20 gage strap *every stud*	4	
	No Ceiling Assembly nail increase Table A-3.4 Footnote 2	0	
	Minimum required number of 8d Common Nails in each end of strap *every stud* = Tabulated number of nails - Reductions + Increases	4*	

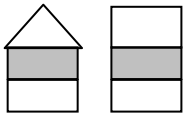
*Non-loadbearing wall assemblies (2-A and 2-B) in accordance with Table W5.10 below (3.2.6.3)

Table W5.10 Alternative proprietary connectors every stud with the following minimum capacities

Building Wall Elevation		**2-1**	**2-2**	**2-A**	**2-B**
Wind	**Loadbearing Walls** - Tabulated minimum uplift connection capacity (Table 3.4)	479 lbs		n/a	
	Interior framing adjustment (The 75% uplift factor reduction allowed by Table 3.4 Footnote 1 was not applied)	1.0		n/a	
	Roof dead load reduction (Table 3.4 Footnote 2) = 0 since the attic floor does not cover the entire second floor	-0 lbs		n/a	
	Wall-to-Wall and Wall-to-Foundation reduction (Table 3.4 Footnote 3) = [73 plf x (16" / 12"/ ft) = 97 lbs]	-97 lbs		n/a	
	Non-Loadbearing Walls - Tabulated minimum uplift connection capacity (Table 3.4C)	n/a		529 lbs	
	Roof Overhang (OH) = 2' Overhang Multiplier (Table 3.4C Footnote 1) $[(2' + OH) / 4']^2$	n/a		1.0	
	Zone 2 Multiplier (The 65% uplift factor reduction allowed by Table 3.4C Footnote 2 was not applied)	n/a		1.0	
	Required minimum capacity of proprietary connector = Tabulated minimum capacity x Adjustments - Reduction	**382 lbs**		**529 lbs**	

Check Perforated Shear Wall plate anchorage between wall ends

The assumption is that wall plate nailing to floor framing (*WFCM* 3.2.1.6 and Table 3.1) in addition to the wind uplift straps (determined above), are sufficient to resist uplift requirements on the plate using the Perforated Shear Wall Method.



Connections (cont'd)

Uplift Connections (WFCM 3.2.3)

Wall Assembly to Wall Assembly (WFCM 3.2.2.2 and 3.2.3)

Table W5.11 Alternative to metal straps on every stud - wood structural panels to resist wall plate to wall stud uplift and shear from Table 3.4B

Building Wall Elevation		**2-1**	**2-2**	**2-A**	**2-B**
Wind	Three second gust wind speed (700 yr) and Exposure category	160 mph Exp. B		160 mph Exp. B	
	Roof Span	32 ft		28 ft *	
	Shear Wall Sheathing Thickness (see shear wall design above)	15/32 in.		15/32 in.	
	Shear Wall Nailing: size and spacing (panel edges and field)	8d common @ 6"/12"		8d common @ 6"/12"	
	Number of Rows Required	2		2	
	Panel Edge Nail spacing	4"		4"	

* A conservative approach to design gable end wall (2-A & 2-B) WSPs to resist combined uplift and shear is as follows:

1. Determine the uplift in plf from Table 3.4C, which in this case equals 397 plf @ 12" o.c. outlooker spacing. Reduce wall dead load of 73plf which gives 324 plf.
2. Determine an "effective" roof span from Table 3.4 for equivalent rafter/truss spacing @ 12" o.c., which in this case is 28' where U=323 lbs.
3. Use Table 3.4B in a similar fashion to the load bearing walls to determine the nail spacing requirements to handle uplift combined with shear.
4. An alternative in Step 1 is to reduce the tabulated uplift load by a factor of 0.65 per Table 3.4C Footnote 2 and use straps at the Zone 3 corners and ridge.

See Figure 3.2f for appropriate panel edge nail spacing (3.2.3.5).

See Special Connections for connections around openings (3.2.3.4).

WFCM 3.2.3.7a requires that nail spacing not be less than 6" o.c. for a double row of fasteners to avoid tension perpendicular to grain stresses in common framing members such as band joists. An alternative to splicing panels at the band joist is to splice panels at mid-stud height. Detailing shall be in accordance with WFCM 3.2.3.7b.

Connections (cont'd)

Overturning Resistance (WFCM 3.2.4)

Hold-downs (WFCM 3.2.4.1)

Table W5.12 Calculate Hold-downs from Table 3.17F for Segmented and Perforated Shear Walls

Building Wall Elevation		**2-1**	**2-2**	**2-A**	**2-B**
Wall Height		9'	9'	9'	9'
Seismic	WSP Perimeter Edge Nail Spacing - **seismic**	6"	6"	6"	6"
	Tabulated hold-down connection capacity required – **seismic** (T_s)	2151 lbs	2151 lbs	2151 lbs	2151 lbs
	Hold-down adjustment per Table 3.17F footnotes (Table 3.17D) (C_{sw})	1.0	1.0	1.0	1.0
	Adjusted hold-down capacity ($T_{as} = (T_s) / (C_{sw})$)	2151 lbs	2151 lbs	2151 lbs	2151 lbs
Wind	WSP Perimeter Edge Nail Spacing - **wind**	6"	6"	6"	6"
	Tabulated hold-down connection capacity required – **wind** (T_w)	3924 lbs	3924 lbs	3924 lbs	3924 lbs
	Hold-down adjustment per Table 3.17F Footnotes (Table 3.17D) (C_{sw})	1.0	1.0	1.0	1.0
	Adjusted hold-down capacity ($T_{wa} = (T_w) / (C_{sw})$) – **wind**	**3924 lbs**	**3924 lbs**	**3924 lbs**	**3924 lbs**

Figure 3.8a Corner Stud Holddown Detail - 3 Studs With Blocking

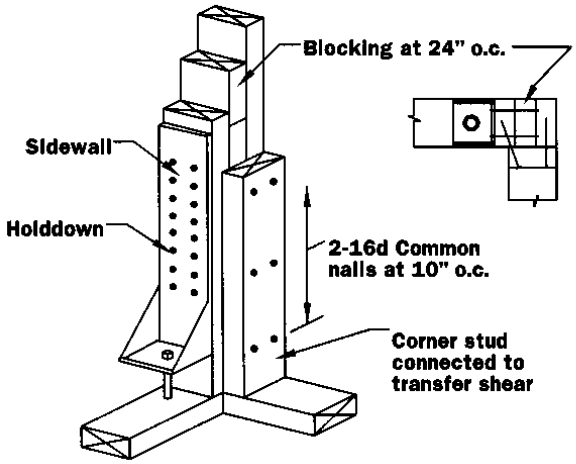
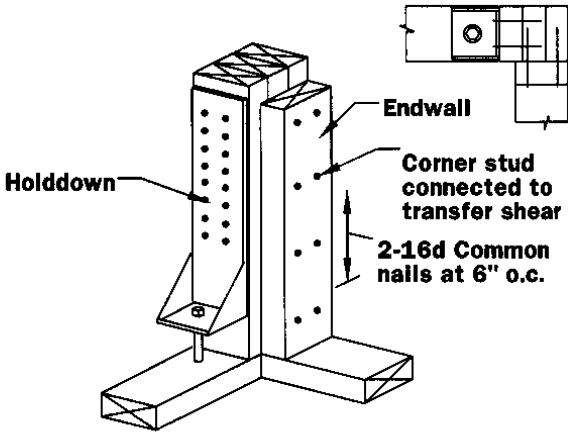
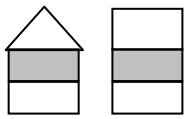


Figure 3.8b Corner Stud Holddown Detail - 4 Studs



Connections (cont'd)



Sheathing and Cladding Attachment – Resisting Suction Loads (WFCM 3.2.5)

Wall Sheathing (WFCM 3.2.5.2)

Choose Wall Sheathing Nail Spacing from Table 3.11

Three second gust wind speed (700 yr) and Exposure category: ..... 160 mph Exp. B
Stud Spacing: ..... 16 in.
Sheathing Type (wood structural panels, board or lap siding): ..... WSP

Table W5.13 Wall Sheathing Nail Spacing to Resist Suction Loads

Location	Edges	Field
4' Edge Zone	6"	12"
Interior Zones	6"	12"

Wall sheathing nailing requirement for shear walls (8d common nails required) **control.**

Special Connections (WFCM 3.2.6)

Connections around Wall Openings (WFCM 3.2.6.4)

Foyer Window

Choose Header/Girder Connections based on loads from Table 3.7

Three second gust wind speed (700 yr) and Exposure category: ..... 160 mph Exp. B
Roof Span: ..... 32 ft
Header Span (Foyer Window): ..... 6 ft

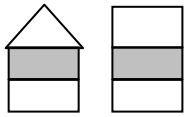
Required Connection Capacity at Each End of Header:
Tabulated Uplift Capacity (interpolated): ..... 1091 lbs
Tabulated Lateral Capacity: ..... 504 lbs

Top/bottom plate to full height stud connection (3.4.1.4.2 Exception) = w*(L/2)/NFH
w = 155 plf (Table 3.5); Z' = 125 lbs (Table 3.5A Commentary)
Required capacity = 232 lbs; Dividing by Z' yields:..... 2-16d Commons
All shorter headers would require lower capacity.

Using identical procedures:
North Bathroom (4' header) Tabulated Uplift Capacity (interpolated): ..... 727 lbs
North Bathroom (4' header) Tabulated Lateral Capacity: ..... 336 lbs

Typical Bedroom (3' header) Tabulated Uplift Capacity (interpolated): .... 545 lbs
Typical Bedroom (3' header) Tabulated Lateral Capacity (interpolated): .. 252 lbs

Connections (cont'd)



Choose Window Sill Plate Connections based on loads from Table 3.8

Three second gust wind speed (700 yr) and Exposure category:..... 160 mph Exp. B
Window Sill Plate Span:..... 6 ft
Tabulated Lateral Connection Capacity at Each End of Window Sill Plate:..... 504 lbs

Using identical procedures:

North Bathroom (4' sill) Tabulated Lateral Connection Capacity at Each End..... 336 lbs
Typical Bedroom (3' sill) Tabulated Lateral Connection Capacity at Each End..... 252 lbs

Wall Detailing Summary

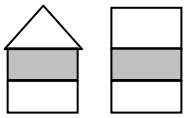


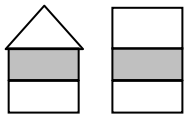
Table W5.15 Shear Wall Detailing Requirements for Seismic Loads

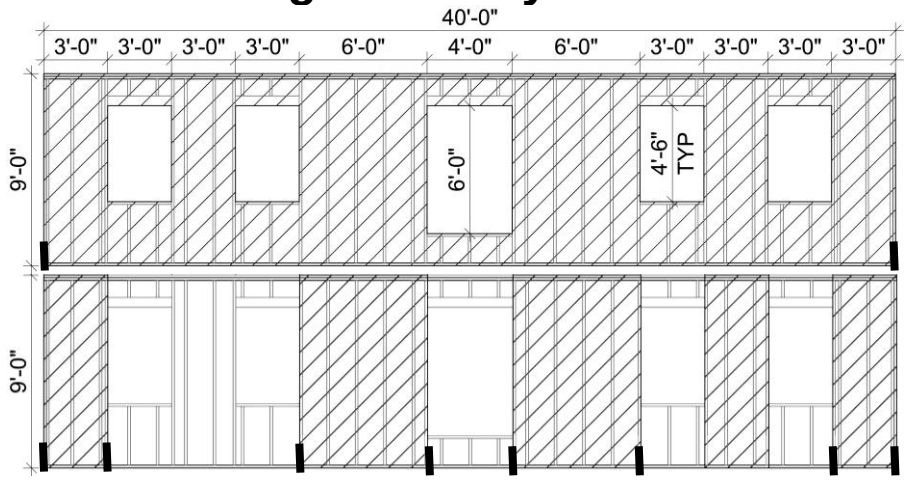
Wall	2-2		2-1		2-B		2-A	
Stud Size	2x4		2x4		2x4		2x4	
Stud Spacing	16"		16"		16"		16"	
Interior Sheathing Type	Gyp		Gyp		Gyp		Gyp	
Thickness	1/2"		1/2"		1/2"		1/2"	
Nail Type	5d cooler		5d cooler		5d cooler		5d cooler	
Edge/Field Nailing	7"/10"		7"/10"		7"/10"		7"/10"	
Exterior Sheathing Type	WSP		WSP		WSP		WSP	
Thickness	15/32"		15/32"		15/32"		15/32"	
Nail Type	8d comm.		8d comm.		8d comm.		8d comm.	
Edge/Field Nailing	12"		12"		12"		12"	
Shear Wall Type	SSW	PSW	SSW	PSW	SSW	PSW	SSW	PSW
Edge Nailing	6"	6"	6"	6"	6"	6"	6"	6"
Segment Length	**17.2'**	Full	**17.2'**	Full	11.5'	Full	11.5'	Full
Hold-downs, lbs	2151	2151	2151	2151	2151	2151	2151	2151
Shear nailing (per foot)	2-16d		2-16d		2-16d		2-16d	

Table W5.16 Shear Wall Detailing Requirements for Wind Loads

Wall	2-2		2-1		2-B		2-A	
Stud Grade and Size	**No. 3/Stud 2x6**		**No. 3/Stud 2x6**		**No. 3/Stud 2x6**		**No. 2 2x6**	
Stud Length	9'		9'		9'		13'	
Stud Spacing	16"		16"		16"		16"	
Interior Sheathing Type	Gyp		Gyp		Gyp		Gyp	
Thickness	1/2"		1/2"		1/2"		1/2"	
Nail Type	5d cooler		5d cooler		5d cooler		5d cooler	
Edge/Field Nailing	7"/10"		7"/10"		7"/10"		7"/10"	
Exterior Sheathing Type	WSP		WSP		WSP		WSP	
Thickness	15/32"		15/32"		15/32"		15/32"	
Nail Type	8d comm.		8d comm.		8d comm.		8d comm.	
Field Nailing	12"		12"		12"		12"	
Shear Wall Type	SSW	PSW	SSW	PSW	SSW	PSW	SSW	PSW
Edge Nailing	6"	6"	6"	6"	6"	6"	6"	6"
No. 8d comm. each strap/stud	4	4	4	4	4	4	4	4
Segment Length	9.5'	Full	9.5'	Full	**11.8'**	Full	**11.8'**	Full
Hold-downs, lbs	**3924**	**3924**	**3924**	**3924**	**3924**	**3924**	**3924**	**3924**
Shear nailing (per foot)	2-16d		2-16d		2-16d		2-16d	

Wall Detailing Summary

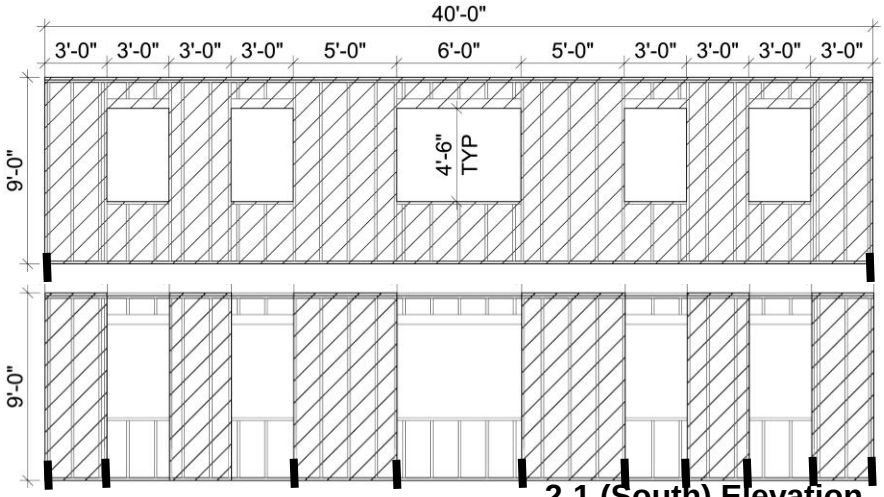




Perforated Shear Wall
3924 lb hold-downs
6/12 nailing

Segmented Shear Wall
17.2' required
3924 lb hold-downs
6/12 nailing

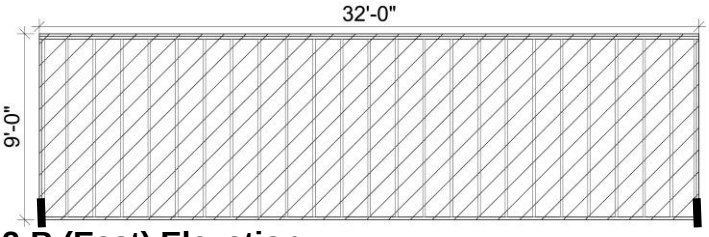
2-2 (North) Elevation



Perforated Shear Wall
3924 lb hold-downs
6/12 nailing

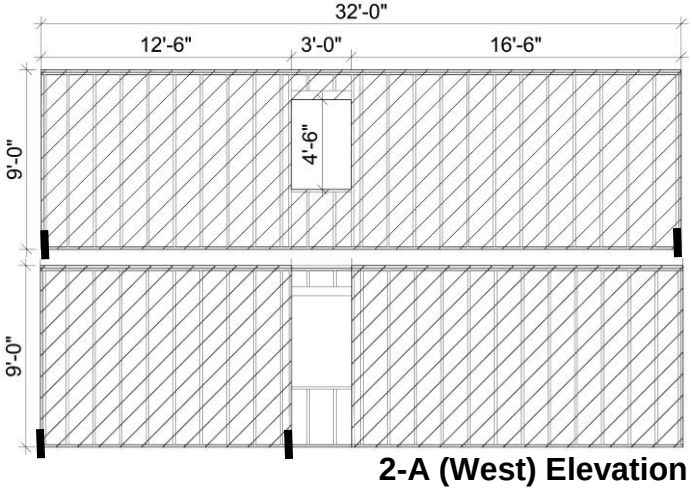
Segmented Shear Wall
17.2' required
3924 lb hold-downs
6/12 nailing

2-1 (South) Elevation



Segmented Shear Wall
11.8' required
3924 lb hold-downs
6/12 nailing

2-B (East) Elevation



Perforated Shear Wall
3924 lb hold-downs
6/12 nailing

Segmented Shear Wall
11.8' required
3924 lb hold-downs
6/12 nailing

2-A (West) Elevation

Wall Detailing Summary (cont'd)

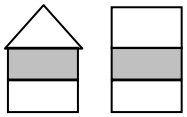


Table W5.17 Header Detailing Requirements for Wind and Gravity Loads

Header Span and Details		Ext. Loadbearing (2-1&2-2)	Ext. Non-loadbearing Headers & Sill Plates (2-A&2-B)	Int. Loadbearing
6'	Type	Raised	Dropped	-
	Size/Plies	2-2x12	1-2x6 flat	-
	Uplift load	1091	n/a	-
	Lateral load	504	504	-
	No. Jack studs	3	n/a	-
	No. King studs	**2**	1	-
	King to plate nails	2-16d comm.	2-16d comm.	-
4'	Type	Dropped or Raised	Dropped	Dropped or Raised
	Size/Plies	2-2x8	1-2x6 flat	2-2x8
	Uplift load	727	n/a	n/a
	Lateral load	336	336	n/a
	No. Jack studs	2	n/a	1
	No. King studs	**2**	1	1
	King to plate nails	2-16d comm.	2-16d comm.	n/a
3'	Type	Dropped or Raised	Dropped	Dropped or Raised
	Size/Plies	2-2x6	1-2x6 flat	2-2x6
	Uplift load	545	n/a	n/a
	Lateral load	252	252	n/a
	No. Jack studs	2	n/a	1
	No. King studs	**2**	1	1
	King to plate nails	2-16d comm.	2-16d comm.	n/a

Table W5.18 Header Detailing Requirements for Gravity Loads Only

Header Span and Details		Ext. Loadbearing (2-1 & 2-2)	Ext. Non-loadbearing Headers & Sill Plates (2-A & 2-B)	Int. Loadbearing
6'	Type	Raised	Dropped or Raised	-
	Size/Plies	2-2x12	1-2x6 flat	-
	No. Jack studs	3	n/a	-
	No. King studs	1	1	-
4'	Type	Dropped or Raised	Dropped or Raised	Dropped or Raised
	Size/Plies	2-2x8	1-2x6 flat	2-2x8
	No. Jack studs	2	n/a	1
	No. King studs	1	1	1
3'	Type	Dropped or Raised	Dropped or Raised	Dropped or Raised
	Size/Plies	2-2x6	1-2x6 flat	2-2x6
	No. Jack studs	2	n/a	1
	No. King studs	1	1	1

FIRST STORY DESIGN

Wall Framing

Wall Studs (WFCM 3.4.1.1)

Loadbearing (1-1 and 1-2)

Choose Studs from Table 3.20A or 3.20B and Footnotes

Three second gust wind speed (700 yr.) and Exposure category: ..... 160 mph Exp. B
Exterior Studs (ext. wood siding and int. gypsum bd.) Deflection: ..... L/180 in.
Wall Height: ..... 9 ft
Studs supporting (Roof, Ceiling, Floors): ..... R+C+2F
Sheathing Type (wood structural panel or minimum sheathing): ..... WSP

Based on second floor wall designs, start with 2x6 studs @ 24" o.c.

Table W6.1 Selection of Species, Grade, Size, and Spacing for Loadbearing Studs (Developed from WFCM Tables 3.20B1 and 3.20C)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	24" *	24" *	24" *	24" *
Grade	No. 3/Stud	No. 3/Stud	No. 3 or Stud	No. 3/Stud
Size	2x6	2x6	2x6	2x6
Maximum Length (Wind) [1]	11'-6" OK	11'-3" OK	10'-6" OK	11'-3" OK
Maximum Length (Dead and Live Loads)	**10'-0"** OK	**10'-0"** OK	**10'-0"** OK	**10'-0"** OK

* Decrease all stud spacing to 16" o.c. to satisfy Table 3.20B Footnote "a" criteria.

Non-Loadbearing (1-A and 1-B)

Choose Studs from Table 3.20A or 3.20B and Table 3.20C

Three second gust wind speed (700 yr) and Exposure category: ..... 160 mph Exp. B
Exterior Studs (ext. wood siding and int. gypsum bd.) Deflection: ..... L/180 in.
Wall Height: ..... 9 ft
Sheathing Type (wood structural panel or minimum sheathing): ..... WSP

Plan for Footnote "a" stud spacing adjustment factor of 0.8 by starting with 24" stud spacing. Even though 2x4 studs might work, start with 2x6 studs based on all other walls being framed with 2x6.

Table W6.2 Selection of Species, Grade, Size, and Spacing for Non-loadbearing Studs (Developed from WFCM Tables 3.20B1 and 3.20C)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	24" *	24" *	24" *	24" *
Grade	No.3/Stud	No.3/Stud	No. 3 or Stud	No.3/Stud
Size	2x6	2x6	2x6	2x6
Maximum Length (Wind)	**11'-6" OK**	**11'-3" OK**	**10'-6" OK**	**11'-3" OK**
Maximum Length (Dead and Live Loads)	20'-0" OK	20'-0" OK	20'-0" OK	20'-0" OK

* Decrease all stud spacing to 16" o.c. per Table 3.20B Footnote "a".

Top Plates (WFCM 3.4.1.2)

Choose Building End Wall Double Top Plate Lap Splice Length from Table 3.21

Building Dimension: ..... 32 ft

Tabulated number of nails per each side of splice: ..... 13-16d nails

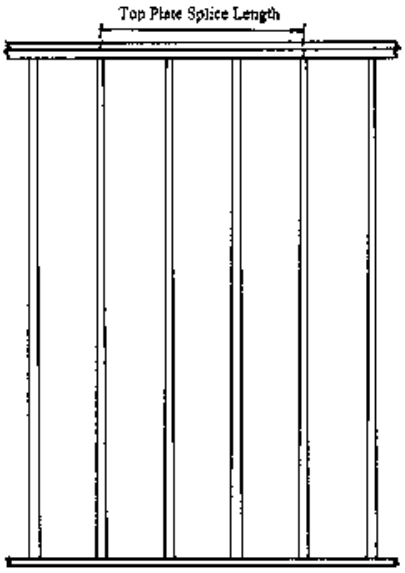
Minimum Splice Length (2-16d nails per 6") (13 nails/4 nails/ft): ..... 3.5 ft

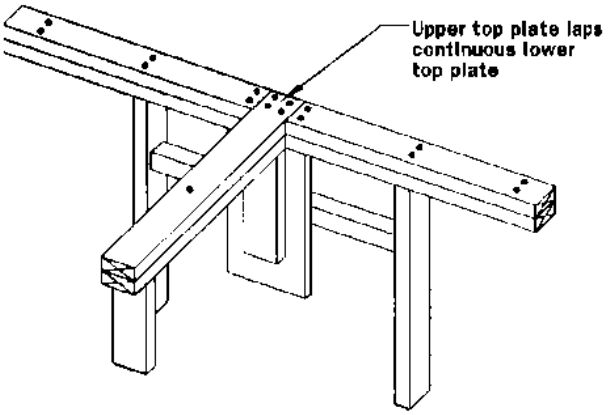
Choose Building Side Wall Double Top Plate Lap Splice Length from Table 3.21

Building Dimension: ..... 40 ft

Tabulated number of nails per each side of splice: ..... 16-16d nails

Minimum Splice Length (2-16d nails per 6") (16 nails/4 nails/ft): ..... 4.0 ft





Wall Framing (cont'd)

Exterior Loadbearing Wall Headers (WFCM 3.4.1.4.1)

Family Room Door

Choose Headers in Loadbearing Walls from Tables 3.22A-E and Table 3.22F

Building Width: ..... 32 ft
Required Span: ..... 9 ft
Ground Snow Load: ..... 30 psf
Three second gust wind speed (700 yr.) and Exposure category: ..... 160 mph Exp. B

Headers supporting roof, ceiling, and two center bearing floors

Table 3.22D1 (Dropped)

Preliminary Header Selection (Gravity Loads): ..... 20F Glulam 3-1/8x13-3/4
Maximum Header/Girder Span (interpolated): ..... 9'-4"

Table 3.22D2 (Raised)

Preliminary Header Selection (Gravity Loads): ..... 20F Glulam 3-1/8x13-3/4
Maximum Header/Girder Span (interpolated): ..... 9'-9"

Table 3.22F

Tabulated Number of Jack Studs Required (R+C+2CBF): 5
Roof Span Adjustment (Footnote 1: (W+12)/48): 0.92
Adjusted no. of jack studs required = tabulated x roof span adjustment: ... **5**

Table 3.23A (Dropped)

Dropped Header Wind Load Check: ..... 20F Glulam 3-1/8x13-3/4
Maximum Header/Girder Span ..... 11'-6" OK

Table 3.23C

Tabulated Number of Full Height (King) Studs: 4*
Reduced Full Height Stud Requirements (Table 3.23D) x/h = 0.15: **3**

Final Selection of Header Grade and Size:

Gravity Loads Control: ..... 20F Glulam 3-1/8x13-3/4
Number of **Jack Studs** Required (gravity controlled): 5**
Number of **Full Height (King) Studs** Required (wind controlled): 3*
(same species / grade as Loadbearing Studs (WFCM 3.4.1.4.2))

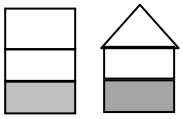
Using identical procedures:

Foyer header (6' required): ..... 20F Glulam 3-1/8x9-5/8 6'-9" >6' OK
Number of Jack Studs Required: 3**
Number of Full Height (King) Studs Required: 2*

Typical Window headers (3' required): ..... Dropped 2-2x8's 3'-8" >3' OK
Typical Window headers (3' required): ..... Raised 2-2x6's 3'-0" >3' OK
Number of Jack Studs Required: 2**
Number of Full Height (King) Studs Required: 1

* Full height studs could be determined based on 24" o.c. spacing from Tables W6.1-W6.2.
** WFCM 3.4.1.4.3 allows jack studs to be replaced with an equivalent number of full height (king) studs if adequate gravity connections are provided.

If all first floor headers align vertically with second floor headers, only one floor is being carried and headers could be designed for more efficiency (Table 3.24A1/A2 adjusted by 1.4 for half the tributary area). However, jack studs still need to be designed for roof, ceiling, and two floors.



Exterior Non-Loadbearing Wall Headers and Window Sill Plates (WFCM 3.4.1.4.1 and 3.4.1.4.4)

Choose Window Sill Plates from Table 3.23B

Three second gust wind speed (700 yr) and Exposure category: 160 mph Exp. B
Required Span: 3 and 4 ft

Selection of **Window Sill Plate** Grade, and Size: **1-2x6 (flat)**
Tabulated Window Sill Plate Span: 7'-3"
Wall Height Adjustment (Footnote 3: $(H/10)^{1/2}$): 0.95

Adjusted Maximum Sill Plate Length:
Tabulated maximum sill plate Length ÷ Wall Height Adjustment: **7'-8"** > 4' OK

Table 3.23C
Number of Full Height (King) Studs Required: 2
Reduced Full Height Stud Requirements (Table 3.23D) x/h = 0.25: **2**

Interior Loadbearing Wall Headers (WFCM 3.4.2.4.1)

Living Room Door

Choose Headers for Interior Loadbearing Walls from Tables 3.24A-C
Building Width: 32 ft
Required Span: 6 ft

Header supporting two center bearing floors
Table 3.24B1 (Dropped)
Selection of Header Grade and Size: 20F Glulam 3-1/8x9-5/8
Maximum Header/Girder Span (interpolated): 6'-1" ft. > 6' OK

Table 3.24B2 (Raised)
Selection of Header Grade and Size: 20F Glulam 3-1/8x9-5/8
Maximum Header/Girder Span (interpolated): 6'-1" ft. > 6' OK
Number of Jack Studs Required (Table 3.24C): 4

Using identical procedures:
Foyer header (4' required): 2-2x10 4'-0" > 4' OK
Number of Jack Studs Required (Table 3.24C): 3

Interior Non-Loadbearing Wall Headers (WFCM 3.4.1.4.1)

Ends of Hallway

The *2012 International Residential Code (IRC)* section R602.7.3 allows a single flat 2x4 for interior non-loadbearing walls up to 8' spans.

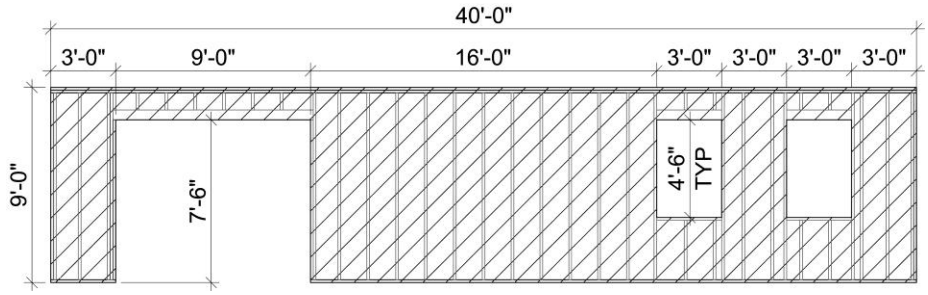
Wall Sheathing

Sheathing and Cladding (WFCM 3.4.4.1)

Choose Exterior Wall Sheathing OR Cladding from Tables 3.13A and 3.13B respectively

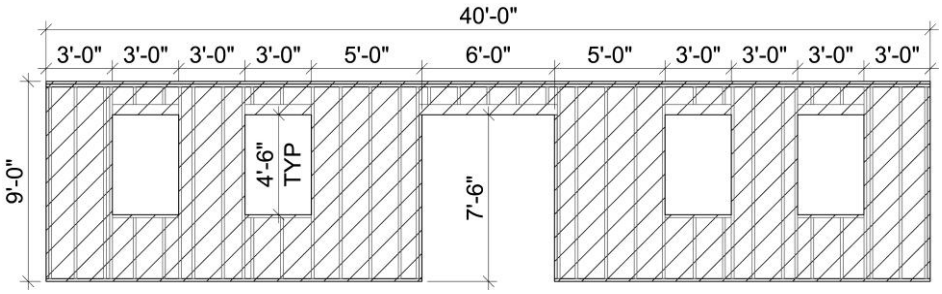
Three second gust wind speed (700 yr) and Exposure category:..... 160 mph Exp. B

Sheathing Type (wood structural panels, fiberboard, board, hardboard):... WSP
Strength Axis to Support (Parallel or Perpendicular): ..... Parallel
Stud Spacing: ..... 16 in.
Minimum Panel Thickness to resist suction loads: ..... 15/32 in.



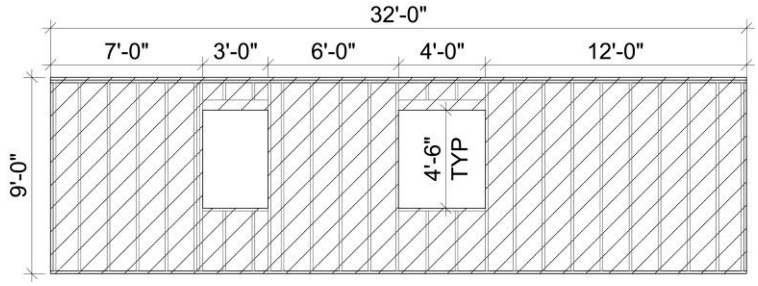
L_{FH} = 25 ft

1-2 North Elevation



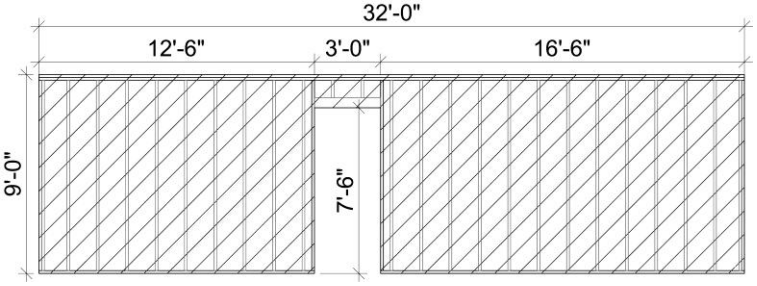
L_{FH} = 22 ft

1-1 South Elevation



L_{FH} = 25 ft

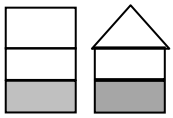
1-B East Elevation



L_{FH} = 29 ft

1-A West Elevation

Wall Sheathing (cont'd)



Exterior Segmented Shear Walls (WFCM 3.4.4.2)

Choose Exterior Segmented Shear Wall Length from Table 3.17A-D

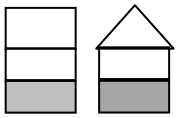
Wall Height: 9 ft
Number of Stories Braced (per 3.1.3.1 and table footnotes): 2
Three second gust wind speed (700 yr) and Exposure category: 160 mph Exp. B
Maximum shear wall aspect ratio for wind (Table 3.17D): 3.5:1
Minimum shear wall segment length (Wall height/aspect ratio) (9 ft/3.5): 2.6 ft
Seismic Design Category: D_1
Maximum shear wall aspect ratio for seismic (Table 3.17D): 2:1
Minimum shear wall segment length (Wall height/aspect ratio): (9 ft/2): 4.5 ft
Minimum WSP sheathing thickness (per WFCM 3.4.4.2): 3/8 in.
Minimum gypsum thickness (per WFCM 3.4.4.2): 1/2 in.
Maximum stud spacing (per WFCM 3.4.4.2): 16 in.

Table W6.3 Calculation of Exterior Segmented Shear Wall Lengths and Nailing Requirements

Building Wall Elevation		**1-2**	**1-1**	**1-B**	**1-A**
Wall Height		9'	9'	9'	9'
Length (L) or Width (W) of Building		L=40'	L=40'	W=32'	W=32'
Actual Length of Full Height Sheathing (L_{FH})		25'	22'	25'	29'
Seismic	Effective Length of Full Height Sheathing for **Seismic** ($L_{FH\text{-}S}$)	22'*	18'*	25'	29'
	Tabulated Minimum Length Full Height Sheathing for **Seismic** Loads per Table 3.17C1 (R + C + 1F)** L/W = 1.25 (L_s)	18.1'	18.1'	18.1'	18.1
	Vertical distribution adjustment per Table 3.17C Footnote 2 (C_{vd})	0.92	0.92	0.92	0.92
	WSP Perimeter Edge Nail Spacing – **Seismic** (WFCM 3.4.4.2 + 3.4.4.2.1) Note: nail spacing for elevation 1-1 reduced to provide increased unit shear capacity for seismic.	6"	4"	6"	6"
	Sheathing Type Adjustment per Table 3.17D (C_{sw})	1.0	0.68	1.0	1.0
	Adjustment for other dead load case Table 3.17C Footnote 4 (C_{dl})**	1.2	1.2	1.2	1.2
	Min. Length Full Ht. Sheathing – Segmented **Seismic** ($L_{SSW\text{-}S} = L_s(C_{vd})(C_{sw})(C_{dl})(C_{ar})$)	20.0'	13.6'	20.0'	20.0'
$L_{SSW\text{-}S} < L_{FH\text{-}S}$		**Ok**	**Ok**	**Ok**	**Ok**
Wind	Tabulated Min. Length Full Ht. Sheathing for **Wind** per Table 3.17A (L_w)	19.9'	19.9'	24.8'	24.8'
	WSP Perimeter Edge Nail Spacing - **Wind** (WFCM 3.4.4.2) Note: nail spacing for elevation 1-B reduced to provide increased unit shear capacity for wind.	**6"**	**6"**	**4"**	**6"**
	Wall and Roof Ht. Adjustment (Table 3.17A Footnote 4) (C_{WRH})	1.1	1.1	1.1	1.1
	Sheathing Type Adjustment per Table 3.17D (C_{swa})	1.0	1.0	0.74	1.0
	Min. Length Full Ht. Sheathing - Segmented **Wind** ($L_{SSW\text{-}W} = L_w(C_{WRH})(C_{swa})$)	**21.9'**	**21.9'**	**20.2'**	**27.3'**
$L_{SSW\text{-}W} < L_{FH}$		**Ok**	**Ok**	**Ok**	**Ok**

* Includes a $2b_s/h$ reduction for exceeding 2:1 aspect ratio for seismic. Effective lengths can be recalculated as follows to minimize the number of hold-downs:
1-1: 2(5) + 2(0.67)(3) = 14 ft thus eliminating two 3 ft segments and related hold-downs
1-2: 16 + 2(0.67)(3) = 20 ft thus eliminating one 3 ft segment and related hold-downs.

** See Table W5.5 footnotes for explanation.



Wall Sheathing (cont'd)

Exterior Perforated Shear Walls (WFCM 3.4.4.2)

Using Segmented Shear Wall results from Table W6.3, determine Perforated Shear Wall Lengths using Table 3.17E

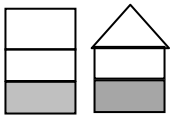
Table W6.4 Calculation of Exterior Perforated Shear Wall Lengths and Nailing Requirements

	Building Wall Elevation	**1-2**	**1-1**	**1-B**	**1-A**
	Wall Height	9'	9'	9'	9'
	Max. Unrestrained Opening Height	7'-6"	7'-6"	4'-6"	7'-6"
	Actual Length of Full Height Sheathing (L_{FH})	25'	22'	25'	29'
Seismic	Length of Wall (L_{Wall})	40'	40'	32'	32'
	Min. Length Full Ht. Sheathing - Segmented **Seismic** (L_{SSW-S})	20.0'	13.6'	20.0'	20.0'
	Percent Full Height Sheathing (L_{SSW-S} / L_{Wall})	50%	34%	63%	63%
	Perforated Length Increase Factor from Table 3.17E (C_L)	1.43	1.66	1.14	1.29
	Aspect ratio adjustment per Table 3.17D Footnote 4 (C_{ar})*	1.5	1.5	1.0	1.0
	Min. Length Full Ht. Sheathing - Perforated **Seismic** ($L_{PSW-S} = L_{SSW-S} (C_L) (C_{ar})$)	42.9'	33.9'	22.8'	25.8'
	$L_{PSW-S} < L_{FH}$	**NG****	**NG****	**OK**	**OK**
Wind	Length of Wall (L_{Wall})	40'	40'	32'	32'
	Min. Length Full Height Sheathing - Segmented **Wind** (L_{SSW-W})	21.9'	21.9'	20.2'	27.3'
	Percent Full Height Sheathing (L_{SSW-W} / L_{Wall})	55%	55%	63%	85%
	Perforated Length Increase Factor from Table 3.17E (C_L)	1.38	1.38	1.14	1.10
	Min. Length Full Ht. Sheathing - Perforated **Wind** ($L_{PSW-W} = L_{SSW-W} (C_L)$)	30.2'	30.2'	**23.0'**	30.0'
	$L_{PSW-W} < L_{FH}$	NG**	NG**	**OK**	NG*

* Includes a $2b_s/h$ adjustment for exceeding 2:1 aspect ratio for seismic. See Table W5.6 for explanation.

** See Table W6.5 and W6.6 for modifications to nailing patterns and sheathing lengths to allow the perforated shear wall method to work.

Wall Sheathing (cont'd)



Since walls 1-1, 1-2, and 1-A do not have enough capacity using the PSW method, they can either be designed as segmented shear walls with hold-downs around wall openings, or sheathing edge nail spacing can be reduced. Modified results are as follows:

Table W6.5 Calculation of Modified Edge Nailing and Sheathing Length Requirements for Seismic Design of Perforated Shear Walls 1-1 and 1-2.

Modified Shear Wall Calculations from Tables W6.3 and W6.4	**1-2**	**1-1**
Wall Height	9'	9'
Max. Unrestrained Opening Height	7'-6"	7'-6"
Max. Unrestrained Opening Heights as functions of wall height	5H/6	5H/6
Tabulated Minimum Length Full Height Sheathing for **Seismic** Loads per Table 3.17C1 (L_s) L/W = 1.25 (interpolated)	18.1'	18.1'
Vertical distribution factor adjustment per Table 3.17C Footnote 2 (C_{vd})	0.92	0.92
WSP Perimeter Edge Nail Spacing – **Seismic** (WFCM 3.4.4.2b + 3.4.4.2.1) Note: nail spacing for elevations 1-2 and 1-1 reduced to provide increased unit shear capacity for seismic.	**3"**	**3"**
Sheathing Type Adjustment per Table 3.17D (C_{sw})	0.53	0.53
Adjustment for other dead load case (C_{dl}) per Table 3.17C Footnote 4	1.2	1.2
Min. Length Full Ht. Sheathing – Segmented **Seismic** ($L_{SSW\text{-}S} = L_s\,(C_{vd})\,(C_{sw})\,(C_{ar})\,(C_{dl})$)	10.6'	10.6'
Length of Full Height Sheathing (L_{FH})	25'	22'
Length of Wall (L_{Wall})	40'	40'
Min. Length Full Ht. Sheathing – Segmented **Seismic** ($L_{SSW\text{-}S}$)	10.6'	10.6'
Percent Full Height Sheathing ($L_{SSW\text{-}S} / L_{Wall}$)	40%	40%
Perforated Length Increase Factor from Table 3.17E (C_L)	1.56	1.56
Aspect ratio adjustment per Table 3.17D Footnote 4 (C_{ar})*	1.5	1.5
Min. Length Full Ht. Sheathing - Perforated **Seismic** ($L_{PSW\text{-}S} = L_{SSW\text{-}S}\,(C_L)$)	**24.8'**	**24.8'**
$L_{PSW\text{-}S} < L_{FH}$	**OK**	**NG****

* Includes a $2b_s/h$ adjustment for exceeding 2:1 aspect ratio for seismic. See Table W5.6 for explanation.
**See Table W6.7 for perforated shear wall analysis based on SDPWS.

Wall Sheathing (cont'd)

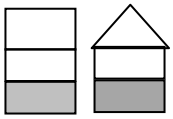


Table W6.6 Calculation of Modified Edge Nailing and Sheathing Length Requirements for Wind Design of Perforated Shear Walls 1-1, 1-2, and 1-A.

Modified Shear Wall Calculations from Tables W6.3 and W6.4	**1-2**	**1-1**	**1-A**
Effective Length of Full Height Sheathing (L_{FH-W})	25'	22'	29'
Max. Unrestrained Opening Height	7'-6"	7'-6"	7'-6"
Max. Unrestrained Opening Heights as functions of wall height	5H/6	5H/6	5H/6
Tabulated Min. Length Full Ht. Sheathing for **Wind** per Table 3.17A (L_w)	19.9'	19.9'	24.8'
WSP Perimeter Edge Nail Spacing - **Wind** (WFCM 3.4.4.2) Note: nail spacing for elevations 1-2, 1-1, and 1-A reduced to provide increased unit shear capacity for wind.	4"	3"	**4"**
Wall and Roof Ht. Adjustment (Table 3.17A Footnote 4) (C_{WRH})	1.1	1.1	1.1
Sheathing Type Adjustment per Table 3.17D (C_{swa})	0.74	0.60	0.74
Min. Length Full Ht. Sheathing - Segmented **Wind** ($L_{SSW-W}=L_w(C_{WRH})(C_{swa})$	16.2'	13.1'	20.2'
Length of Wall (L_{Wall})	40'	40'	32'
Min. Length Full Height Sheathing - Segmented **Wind** (L_{SSW-W})	16.2'	13.1'	20.2'
Percent Full Height Sheathing (L_{SSW-W} / L_{Wall})	41%	33%	63%
Perforated Length Increase Factor from Table 3.17E (C_L)	1.55	1.67	1.29
Min. Length Full Ht. Sheathing - Perforated **Wind** ($L_{PSW-W} = L_{SSW-W}$ (C_L))	25.1'	21.9'	**26.1'**
$L_{PSW-W} < L_{FH-W}$	**OK**	**OK**	**OK**

Wall Sheathing (cont'd)

Since wall 1-1 does not have enough capacity for seismic using the Perforated Shear Wall (PSW) method, it will be designed per *2008 Special Design Provisions for Wind and Seismic (SDPWS)*.

To calculate the seismic shear load on wall 1-1, select the ASD unit shear capacity of the wall from Table 3.17D for 3" panel edge spacing as shown in Table W6.5: v = 451 plf. Per SDPWS Table 4.3.4, the capacity must be adjusted based on aspect ratios exceeding 2:1, so use the previously calculated 2b/h = 0.67. Multiply by the minimum length of full height sheathing, L_{SSW-S} = 15.9', also calculated from Table W6.5: Load = (v) (2b/h)(L_{SSW-S}) = 4,805 lbs. Modified results are as follows:

Table W6.7 Calculation of Sheathing Length Requirements for Seismic Design of Wall 1-1 using the Perforated Shear Wall Method from 2008 SDPWS Section 4.3.3.5.

Modified Perforated Shear Wall Calculations from Table W6.4	**1-1**
Wall Height	9'
Total length of wall (L_{tot})	40'
Total area of openings (A_o = 6(7.5)+4(3)(4.5)) (ft^2)	99
Length of full-height sheathing (ΣL_i)	22'
Aspect ratio adjustment per SDPWS 4.3.4.1 ($2b_s/h$)	0.67
Sheathing area ratio (r) per SDPWS Equation 4.3-6	0.67
Shear capacity adjustment factor (C_o) per SDPWS Equation 4.3-5	0.73
Nominal unit shear capacity per SDPWS Table 4.3A (plf)	450
PSW capacity per SDPWS 4.3.3.5 = (v)($2b_s/h$)(ΣL_i)(C_o) (lbs)	4,842
Load (lbs)	4,805
Load ≤ Capacity	**OK**

Table W6.8 Bottom Story Shear Wall Edge Nail Spacing and Wall Length Summary

Building Elevation		**1-2**		**1-1**		**1-B**		**1-A**	
Seismic	**Segmented**	6"	20.0'	**4"**	**13.6'**	6"	20.0'	6"	20.0'
	Perforated	**3"**	**24.8'**	**3"**	**22.0'**	6"	22.8'	6"	25.8'
Wind	**Segmented**	**6"**	**21.9'**	6"	21.9'	**4"**	**20.2'**	**6"**	**27.3'**
	Perforated	4"	25.1'	3"	21.9'	**4"**	**23.0'**	**4"**	**26.1'**

See shear wall detailing summary tables at the end of this section for a final comparison of wind vs. seismic results.

Floor Framing

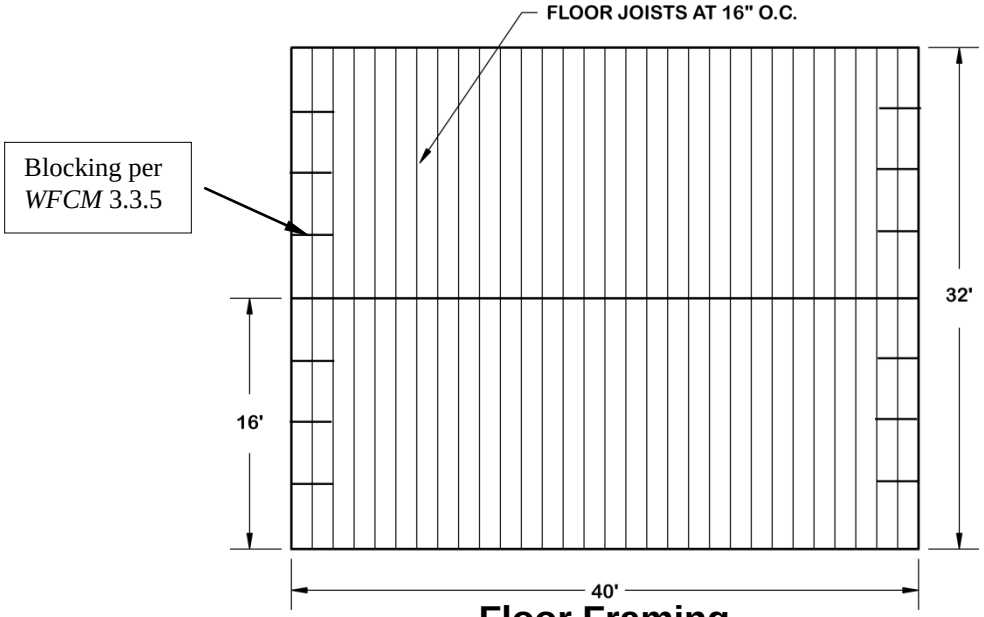
Floor Joists (WFCM 3.3.1.1)

Choose Floor Joists from Tables 3.18A-B

Live Load:..... 40 psf
Dead Load:..... 10 psf
Joist Vertical Displacement L/Δ: 360
Required Span:..... 16 ft

Table W6.9 Selection of Specie, Grade, Size, and Spacing for Floor Joists (Table 3.18B)

Specie	Douglas Fir-Larch	Hem-Fir	Southern Pine	Spruce-Pine-Fir
Spacing	**16**	**16**	**16**	**16**
Grade	**#1**	**#1**	**#1**	**SS**
Size	**2x10**	**2x10**	**2x10**	**2x10**
Maximum Span	16'-5"	16'-0"	16'-1"	16'-0"



Floor Framing

Floor Sheathing

Sheathing Spans (WFCM 3.3.4.1)

Choose Floor Sheathing from Table 3.14

Floor Joist Spacing:..... 16 in.
Sheathing Type (wood structural panels or boards): ..... WSP (Single Floor)
Span Rating..... 16 o.c.

Tabulated Minimum Panel Thickness: ..... **19/32** in.

Connections

Lateral Framing and Shear Connections (WFCM 3.2.1)

Wall Assembly (WFCM 3.2.1.3)

Top Plate to Top Plate
Table 3.1 Footnote 1 for WSP wall edge nailing spacing < 6"
4" nail spacing: 1.67 x 2 nails ..... 4-16d Commons per foot
3" nail spacing: 2.0 x 2 nails ..... 4-16d Commons per foot

Top Plate Intersection (Table 3.1): ..... 4-16d Commons each side joint

Stud to Stud (Table 3.1): ..... 2-16d Commons 24" o.c.

Header to Header (Table 3.1): ..... 16d Commons 16" o.c. - edges

Top or Bottom Plate to Stud (Table 3.1 & 3.5A): ..... 2-16d Commons per stud*
* See header design for any additional nailing required for king studs

Wall Assembly to Floor Assembly (WFCM 3.2.1.4)

Bottom Plate to Floor Joist, Bandjoist, Endjoist, or Blocking
Table 3.1 Footnote 1 for WSP wall edge nailing spacing < 6"
4" nail spacing: 1.67 x 2 nails ..... 4-16d Commons per foot
3" nail spacing: 2.0 x 2 nails ..... 4-16d Commons per foot

Floor Assembly (WFCM 3.2.1.5)

Bridging to Floor Joist (Table 3.1): ..... 2-8d Commons each end

Blocking to Floor Joist (Table 3.1): ..... 2-8d Commons each end

Band Joist to Floor Joist (Table 3.1): ..... 3-16d Commons per joist

Floor Assembly to Wall Assembly (WFCM 3.2.1.6)

Floor Joist to Top Plate (Table 3.1): ..... 4-8d Commons per joist

Blocking to Sill or Top Plate (Table 3.1): ..... 3-16d Commons each block

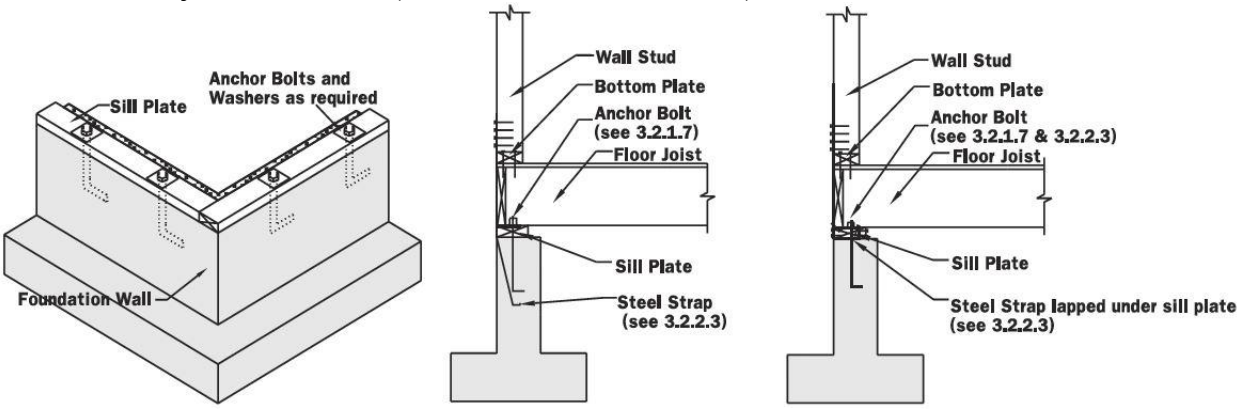
Band Joist to Sill or Top Plate
Table 3.1 Footnote 1 for WSP wall edge nailing spacing < 6"
4" nail spacing: 1.67 x 2 nails ..... 4-16d Commons per foot
3" nail spacing: 2.0 x 2 nails ..... 4-16d Commons per foot

Note that nailing requirements are increased in many cases to maintain load path since shear wall sheathing nailing is less than 6" o.c. at panel edges.

Connections (cont'd)

Lateral, Shear, and Uplift Connections (WFCM 3.2.1 and 3.2.2)

Wall Assembly to Foundation (WFCM 3.2.1.7 and 3.2.2.3)



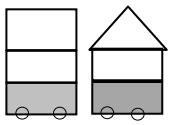
Choose Sill Plate to Foundation Connection Requirements for Anchor Bolts Resisting Lateral, Shear, and Uplift Loads from Table 3.2A for Wind and 3.3A for Seismic

Three second gust wind speed (700 yr) and Exposure category:..... 160 mph Exp. B
Stories supported by Foundation: 2
Anchor Bolt Diameter:..... 5/8 in.

Table W6.10 Assuming Crawl Space or Basement, determine maximum Anchor Bolt Spacing.

Building Wall Elevation		**1-2**	**1-1**	**1-B**	**1-A**
Sill plate line dimension (L_{sw})		40'	40'	32'	32'
Building dimension perpendicular to sill plate (Table 3.2A)		32'	32'	40'	40'
Seismic	Tabulated number of anchor bolts to resist seismic shear loads (s_s) (Table 3.3A4) (R+C+2F) (interpolated)	4	4	4	4
	Dead load adjustment per Table 3.3A Footnote 5 (C_{dl})	1.14	1.14	1.14	1.14
	Adjusted number of bolts s_{sa} == (s_s)(C_{dl})	5	5	5	5
	Bolt spacing for **seismic shear** loads (bolts placed 1' from end of sill) s_{ss} = 12 (L_{sw}-2) / (#bolts-1)	114"	114"	90"	90"
Wind	Tabulated number of bolts to resist shear loads from wind (Table 3.2A)(R+2F)	9	9	12	12
	Wall and Roof Height Adjustment (Table 3.2A Footnote 4) (C_{WRH})	0.91	0.91	0.91	0.91
	Minimum number of bolts to resist shear loads = Tabulated x C_{WRH}	9	9	12	12
	Bolt spacing for **wind shear** loads (bolts placed 1' from end of sill) s_{ws} = 12 (L_{sw}-2) / (#bolts-1)	57"	57"	**32"**	**32"**
	Max. bolt spacing to resist **wind uplift** loads (s_{wu}) (Table 3.2C (end zones) & 3.4C)	**31"**	**31"**	36"**	36"**
Max. anchor bolt spacing (lesser of s_{ws}, s_{wu}, and s_{ss})		31"	31"	32"	32"

**Calculated from *WFCM* Table 3.4C based on 16" o.c. outlooker spacing (horizontal projection) with 2 wall dead loads subtracted (0.6x121plf) and bottom/sill plate capacity from *WFCM Commentary* Table 3.2C. Table 3.4C = 529 lbs x 12"/ft / 16" – 146 plf (walls) = 397 plf – 146 plf = 251 plf. WFCM Commentary Table 3.2C calculations = 36".



Connections (cont'd)

Alternatively, use proprietary connectors with the following minimum capacities from Table 3.2, Table 3.3, and Table 3.4C.

Three second gust wind speed (700 yr) and Exposure category:..... 160 mph Exp. B
Stories supported by Foundation: 2

Table W6.11 Assuming Crawl Space or Basement, determine required loads for proprietary connectors.

Building Wall Elevation		**1-2**	**1-1**	**1-B**	**1-A**
Building dimension W or L		L=40'	L=40'	W=32'	W=32'
R=L/W or W/L for Table 3.3 (see Footnote 1)		1.0	1.0	1.25	1.25
Seismic	Tabulated **seismic shear load** (Table 3.3) R+C+2F (interpolated)	174 plf	174 plf	174 plf	174 plf
	Adjustment for other dead load case Footnote 3 (C_{dl})	1.14	1.14	1.14	1.14
	Adjusted seismic shear load = tabulated seismic shear load (C_{dl})	198 plf	198plf	198plf	198plf
Wind	Number of stories receiving lateral wind load (Table 3.2)	2	2	2	2
	Outlooker Spacing	n/a	n/a	16"	16"
	Wind uplift (Table 3.4C)	n/a	n/a	529 lbs	529 lbs
	Wind uplift - plf basis (Tabulated x 12 / spacing)	n/a	n/a	397 plf	397 plf
	Overhang Reduction (Table 3.4C Footnote 1) [(2' - OH / 4']	n/a	n/a	1.0	1.0
	Zone 2 Multiplier (Table 3.4C, Footnote 2)	n/a	n/a	1.0	1.0
	Adjusted Wind uplift (Table 3.4C)	n/a	n/a	397 plf	397 plf
	Wind uplift (Table 3.2(U))	218 plf	218 plf		
	Wind lateral load (Table 3.2(L))	*	*	*	*
	Tabulated Wind shear load (Table 3.2(S)) 427R	342 plf	342 plf	534 plf	534 plf
	Footnote 3: Sheathing Type Adjustment per Table 3.17D (C_{swa}) – assuming PSW	0.74	0.60	0.74	0.74
	Footnote 4: Wall and Roof Height Adjustment (C_{WRH})	0.91	0.91	0.91	0.91
	Adjusted shear load = Tabulated (C_{WRH}) / (C_{swa})	**421 plf**	**519 plf**	**657 plf**	**657 plf**

*Table 3.2 Footnote: Determine anchorage for Lateral Loads in foundation design per Section 1.1.4 (might include soil loads).

Connections (cont'd)

Uplift Connections (WFCM 3.2.2)

Wall Assembly to Foundation (WFCM 3.2.2.3)

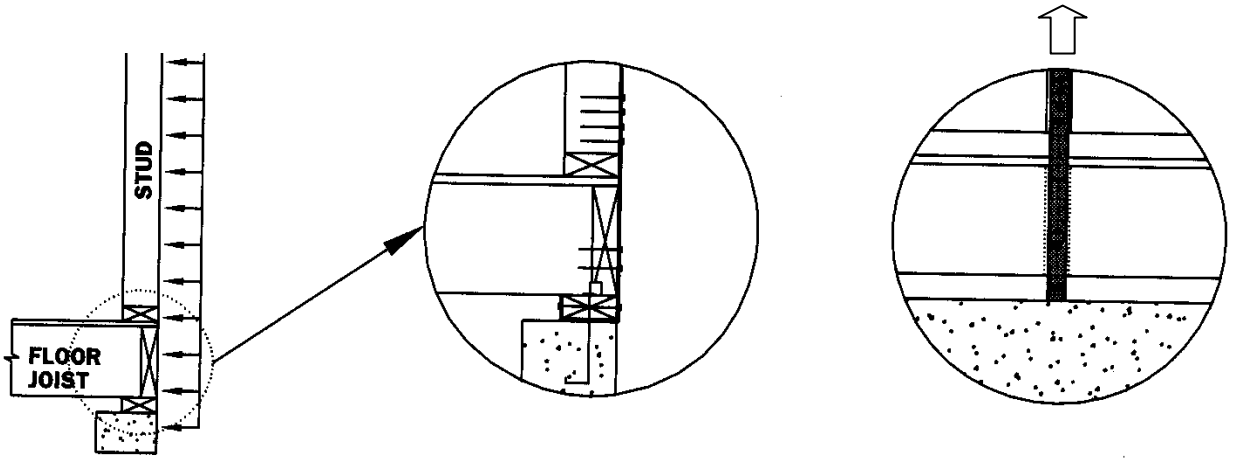
Table W6.12 Wall to Foundation Uplift Strap Connection from Table A-3.4

Building Wall Elevation		**1-2**	**1-1**
Wind	Three second gust wind speed (700 yr) and Exposure category:	160 mph Exp. B	
	Framing Spacing	16 in.	
	Roof Span	32 ft	
	Tabulated number of 8d Common Nails required in each end of 1-1/4" x 20 gage strap *every stud*	4	
	No Ceiling Assembly nail increase (Footnote 3)	0	
	Required number of **8d Common Nails in each end of strap** *every stud* = Tabulated number of nails - Reductions + Increases	**4 ***	

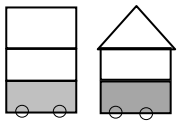
*Non-loadbearing wall assemblies in accordance with Table W6.13 (3.2.6.3)

Table W6.13 Alternative proprietary connectors with the following minimum capacities

Building Wall Elevation		**1-2**	**1-1**	**1-B**	**1-A**
Wind	**Loadbearing Walls** - Tabulated minimum uplift connection capacity (Table 3.4)	479 lbs		n/a	
	Interior framing adjustment (Footnote 1)	1.0		n/a	
	Roof dead load reduction (Table 3.4, Footnote 2) = 0 since the attic floor does not cover the entire second floor	0 lbs		n/a	
	Wall-to-Wall and Wall-to-Foundation reduction (Table 3.4, Footnote 3) = [73 plf x 2 walls (16" / 12"/ ft) = 194 lbs]	-194 lbs		n/a	
	Non-Loadbearing Walls - Tabulated minimum uplift connection capacity (Table 3.4C)	n/a		529 lbs	
	Overhang Multiplier (Table 3.4C, Footnote 1) $[(2' + OH) / 4']^2$ OH = 2'	n/a		1.0	
	Zone 2 Multiplier (Table 3.4C, Footnote 2)	n/a		1.0	
	Required minimum capacity of proprietary connector = Tabulated minimum capacity x Adjustments - Reduction	**285 lbs**		**529 lbs**	



Connections (cont'd)



Uplift Connections (WFCM 3.2.3)

Wall Assembly to Foundation (WFCM 3.2.2.2 and 3.2.3)

Table W6.14 Alternative to metal straps on every stud - wood structural panels to resist wall plate to wall stud uplift and shear from Table 3.4B

Building Wall Elevation		**1-2**	**1-1**	**1-B**	**1-A**
Wind	Three sec. gust wind speed (700 yr) and exp. category	160 mph Exp. B		160 mph Exp. B	
	Roof Span	32 ft		20 ft**	
	Shear Wall Sheathing Thickness (see Table W6.4)	15/32 in.	15/32 in.	15/32 in.	15/32 in.
	Shear Wall Type and Nailing: size and spacing (panel edges and field) (see Table W6.8) - **SSW**	8d comm. @ 6"/12"	8d comm. @ 6"/12"	8d comm. @4"/12"	8d comm. @ 6"/12"
	Number of Rows Required- **SSW**	2	2	2	2
	Top & Bottom of Panel Nail spacing- **SSW**	4"	**4"**	4"	4"
	Shear Wall Type and Nailing: size and spacing (panel edges and field) (see Table W6.8) - **PSW**	8d comm. @ 4"/12"	8d comm. @ 3"/12"	8d comm. @4"/12"	8d comm. @ 4"/12"
	Number of Rows Required- **PSW**	2		2	2
	Top & Bottom of Panel Nail spacing- **PSW**	**3"**	NP[1]	4"	4"

1. Wall 1-1 requires metal straps on every stud to resist uplift loads or using the Segmented Shear Wall nailing requirements.

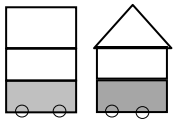
** A conservative approach to design gable end wall (1-A & 1-B) WSPs to resist combined uplift and shear is as follows:

1. Determine the uplift in plf from Table 3.4C, which in this case equals 397 plf @ 12" o.c. outlooker spacing. Reduce 2 wall dead loads of 73plf each which gives 251 plf.
2. Determine an "effective" roof span from Table 3.4 for equivalent rafter/truss spacing @ 12" o.c., which in this case is 20' where U=249 lbs.
3. Use Table 3.4B in a similar fashion to the load bearing walls to determine the nail spacing requirements to handle uplift combined with shear.
4. An alternative in Step 1 is to reduce the tabulated uplift load by a factor of 0.65 per Table 3.4C Footnote 2 and use straps at the Zone 3 corners and ridge.

Additional detailing

- See Figure 3.2f for appropriate panel edge nail spacing (3.2.3.5).
- See Special Connections for connections around openings (3.2.3.4).
- Anchor bolts with 3"x3" steel plate washers at 16" o.c. are required (3.2.3.6).
- Determine sheathing splice requirements over common horizontal framing members or at mid-stud height (3.2.3.7).

Connections (cont'd)



Overturning Resistance (WFCM 3.2.4)

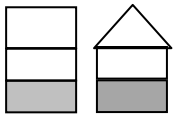
Hold-downs (WFCM 3.2.4.1)

Table W6.15 Calculate Hold-downs from Table 3.17F for Segmented and Perforated Shear Walls

Building Wall Elevation		**1-2**		**1-1**		**1-B**		**1-A**	
Wall Height		9'		9'		9'		9'	
Seismic	Tabulated hold down connection capacity required – **seismic** (T_s)	2151 lbs		2151 lbs		2151 lbs		2151 lbs	
	WSP Perimeter Edge Nail Spacing – **seismic – SSW** & Hold-down adjustment per Footnote 1 (C_{swa})	6"	1.0	4"	0.68	6"	1.0	6"	1.0
	Adjusted hold-down capacity to account for increased shear capacity ($T_{sa\text{-}ssw} = (T_s) / (C_{swa})$) – **seismic - SSW**	2151 lbs		3163 lbs		2151 lbs		2151 lbs	
	Additional story hold-down requirements – **seismic - SSW** (see Table W5.12)	2151 lbs		2151 lbs		2151 lbs		2151 lbs	
	Total hold-down requirement for floor to foundation ($\Sigma T_{sa\text{-}ssw}$) – **seismic - SSW**	4302 lbs		5314 lbs		4302 lbs		4302 lbs	
	WSP Perimeter Edge Nail Spacing – **seismic – PSW** & Hold-down adjustment per Footnote 1 (C_{swa})	3"	0.53	3"	0.53	6"	1.0	6"	1.0
	Adjusted hold-down capacity ($T_{sa\text{-}psw} = (T_s) / (C_{swa})$) – **seismic - PSW**	4058 lbs		4058 lbs		2151 lbs		2151 lbs	
	Additional story hold-down requirements – **seismic - PSW** (see Table W5.12)	2151 lbs		2151 lbs		2151 lbs		2151 lbs	
	Total hold-down requirement for floor to foundation ($\Sigma T_{sa\text{-}psw}$) – **seismic - PSW**	6209 lbs		6209 lbs		4302 lbs		4302 lbs	
Wind	Tabulated hold-down connection capacity required – **wind** (T_w)	3924 lbs		3924 lbs		3924 lbs		3924 lbs	
	WSP Perimeter Edge Nail Spacing – **wind** – **SSW** & Hold-down adjustment per Footnote 1 (C_{swa})	6"	1.0	6"	1.0	4"	0.74	6"	1.0
	Adjusted hold-down capacity to account for increased shear capacity ($T_{wa\text{-}ssw} = (T_w) / (C_{swa})$) - **wind**	3924 lbs		3924 lbs		5303 lbs		3924 lbs	
	Additional story hold-down requirements – **wind – SSW** (Table W5.12)	3924 lbs		3924 lbs		3924 lbs		3924 lbs	
	Total hold-down requirement for floor to foundation – **wind – SSW** ($\Sigma T_{wa\text{-}ssw}$)	7848 lbs		7848 lbs		9227 lbs		7848 lbs	
	WSP Perimeter Edge Nail Spacing – **wind** – **PSW** & Hold-down adjustment per Footnote 1 (C_{swa})	4"	0.74	3"	0.60	4"	0.74	4"	0.74
	Adjusted hold-down capacity ($T_{wa\text{-}psw} = (T_w) / (C_{swa})$) - **wind**	5303 lbs		6540 lbs		5303 lbs		5303 lbs	
	Additional story hold-down requirements – **wind – PSW** (Table W5.12)	3924 lbs		3924 lbs		3924 lbs		3924 lbs	
	Total hold-down requirement for floor to foundation – **wind – PSW** ($\Sigma T_{wa\text{-}psw}$)	**9227 lbs**		**10464 lbs**		**9227 lbs**		**9227 lbs**	

One hold-down can be used on each corner with corner studs connected to transfer shear as shown in WFCM Figures 3.8a or 3.8b.

Connections (cont'd)



Sheathing and Cladding Attachment (WFCM 3.2.5)

Wall Sheathing (WFCM 3.2.5.2)

Choose Wall Sheathing Nail Spacing from Table 3.11

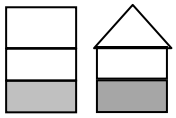
Three second gust wind speed (700 yr) and Exposure category:..... 160 mph Exp. B
Stud Spacing: ..... 16 in.
Sheathing Type (wood structural panels, board or lap siding): ..... WSP

Table W6.16 Wall Sheathing Nail Spacing to Resist Suction Loads

Location	Edges	Field
4' Edge Zone	6"	12"
Interior Zones	6"	12"

Shear wall sheathing nail spacing requirements control.

Connections (cont'd)



Special Connections (WFCM 3.2.6)

Connections around Wall Openings (WFCM 3.2.6.4)

Typical Window

Choose Header/Girder Connections based on loads from Table 3.7

Three second gust wind speed (700 yr) and Exposure category: 160 mph Exp. B
Roof Span: 32 ft
Header Span (Typical Window): 9 ft

Required Connection Capacity at Each End of Header:

Tabulated Uplift Capacity (interpolated): 1636 lbs
Floor load adjustment (per footnote 3: 36plf x header span): -324 lbs
Adjusted **Uplift** Capacity **1312** lbs
Tabulated **Lateral** Capacity: **756** lbs

Top/bottom plate to FHS Connection (3.4.1.4.2 Exception) = w*(L/2)/NFH
w = 155 plf (Table 3.5); Z' = 125 lbs (Table 3.5A Commentary)
Required capacity = 232 lbs. Dividing by Z' yields: 2-16d Commons
All shorter headers will require lower capacity.

Using identical procedures:

Window (6' header) Adjusted Uplift Capacity (interpolated): 1091 lbs
Window (6' header) Tabulated Lateral Capacity: 504 lbs

Window (4' header) Adjusted Uplift Capacity (interpolated): 583 lbs
Window (4' header) Tabulated Lateral Capacity: 336 lbs

Window (3' header) Adjusted Uplift Capacity (interpolated): 437 lbs
Window (3' header) Tabulated Lateral Capacity: 252 lbs

Choose Window Sill Plate Connections based on loads from Table 3.8

Three second gust wind speed (700 yr) and Exposure category: 160 mph Exp. B
Window Sill Plate Span: 3 ft

Tabulated **Lateral** Connection Capacity - Each End of Window Sill: **252** lbs

Wall Detailing Summary

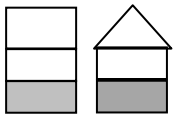


Table W6.17 Shear Wall Detailing Requirements for Seismic Loads

Wall	1-2		1-1		1-B		1-A	
Stud Grade and Size	2x6 No.3/Stud		2x6 No.3/Stud		2x6 No.3/Stud		2x6 No.3/Stud	
Stud Length	9'		9'		9'		9'	
Stud Spacing	16"		16"		16"		16"	
Interior Sheathing Type	Gyp		Gyp		Gyp		Gyp	
Thickness	1/2"		1/2"		1/2"		1/2"	
Nail Type	5d cooler		5d cooler		5d cooler		5d cooler	
Edge/Field Nailing	7"/10"		7"/10"		7"/10"		7"/10"	
Exterior Sheathing Type	WSP		WSP		WSP		WSP	
Thickness	15/32"		15/32"		15/32"		15/32"	
Nail Type	8d comm.		8d comm.		8d comm.		8d comm.	
Field Nailing	12"		12"		12"		12"	
Shear Wall Type	SSW	PSW	SSW	PSW	SSW	PSW	SSW	PSW
Edge Nailing**	6"	3"	4"	3"	6"	6"	6"	6"
Segment Length	20.0'	Full	13.6'	Full	20.0'	Full	20.0'	Full
Hold-downs (2-stories), lbs	4302	6209	6326	6209	4302	4302	4302	4302
Anchor bolt spacing	114"		114"		90"		90"	
Shear nailing (per foot)	2-16d	4-16d	4-16d	4-16d	2-16d	2-16d	2-16d	2-16d

Table W6.18 Shear Wall Detailing Requirements for Wind Loads

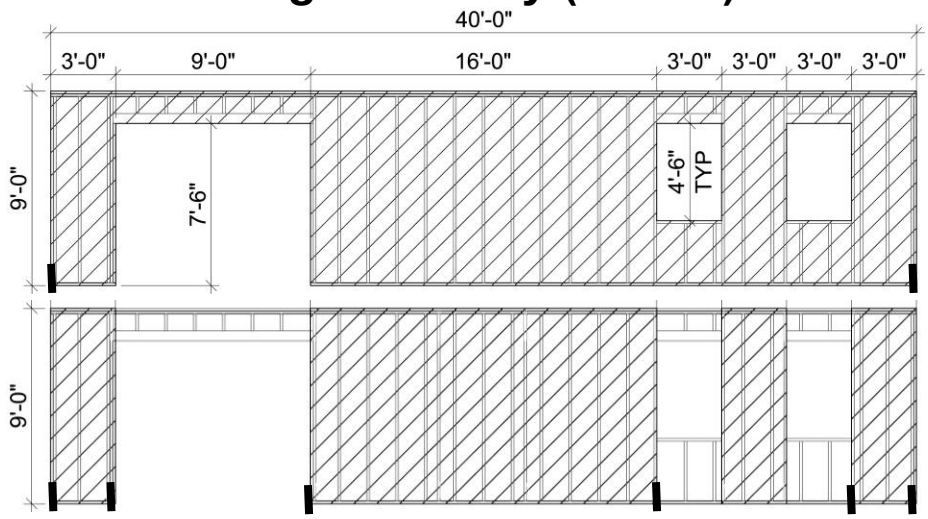
Wall	1-2		1-1		1-B		1-A	
Stud Grade and Size	**No. 3/Stud** 2x6		**No. 3/Stud** 2x6		**No. 3/Stud** 2x6		**No. 3/Stud** 2x6	
Stud Length	9'		9'		9'		9'	
Stud Spacing	16"		16"		16"		16"	
Interior Sheathing Type	Gyp		Gyp		Gyp		Gyp	
Thickness	1/2"		1/2"		1/2"		1/2"	
Nail Type	5d cooler		5d cooler		5d cooler		5d cooler	
Edge/Field Nailing	7"/10"		7"/10"		7"/10"		7"/10"	
Exterior Sheathing Type	WSP		WSP		WSP		WSP	
Thickness	15/32"		15/32"		15/32"		15/32"	
Nail Type	8d comm.		8d comm.		8d comm.		8d comm.	
Field Nailing	12"		12"		12"		12"	
Shear Wall Type	SSW	PSW	SSW	PSW	SSW	PSW	SSW	PSW
Edge Nailing*	**4"**	**3"**	**4"**	**3"****	**4"**	**4"**	**4"**	**4"**
No. Rows Required	**2**	**2**	**2**	**NP**	**2**	**2**	**2**	**2**
Segment Length	**21.9'**	**Full**	**21.9'**	**Full**	**20.2'**	**Full**	**27.3'**	**Full**
Hold-downs (2-stories), lbs	**7848**	**9227**	**7848**	**10464**	**9227**	**9227**	**7848**	**9227**
Anchor bolt spacing with 3"x3" steel plate washers	**16"**		**16"*****		**16"**		**16"**	
Shear nailing (per foot)	**4-16d**	**4-16d**	**4-16d**	**4-16d**	**4-16d**	**4-16d**	**4-16d**	**4-16d**

* WSP resist combined uplift and shear – no straps.

** Using WSP to resist combined uplift and shear not permitted. Either use Segmented Shear Wall details or use metal straps every stud.

*** Required for Segmented Shear Wall used to resist combined uplift and shear. For Perforated Shear Wall, use 31" as calculated in Table W6.10.

Wall Detailing Summary (cont'd)



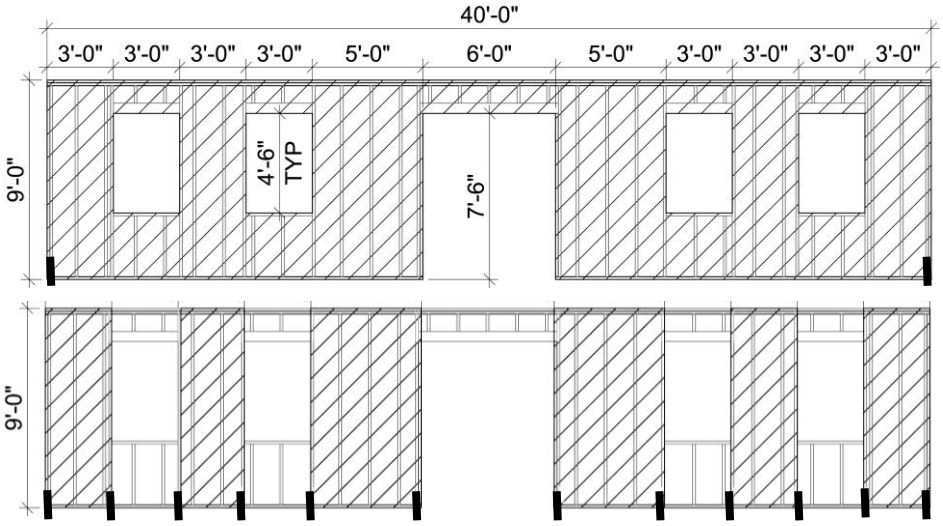
Perforated Shear Wall
9227 lb hold-downs
3/12 nailing

Segmented Shear Wall
21.9' required
7848 lb hold-downs
4/12 nailing

1-2 North Elevation

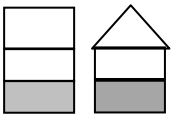
Perforated Shear Wall
10464 lb hold-downs
3/12 nailing

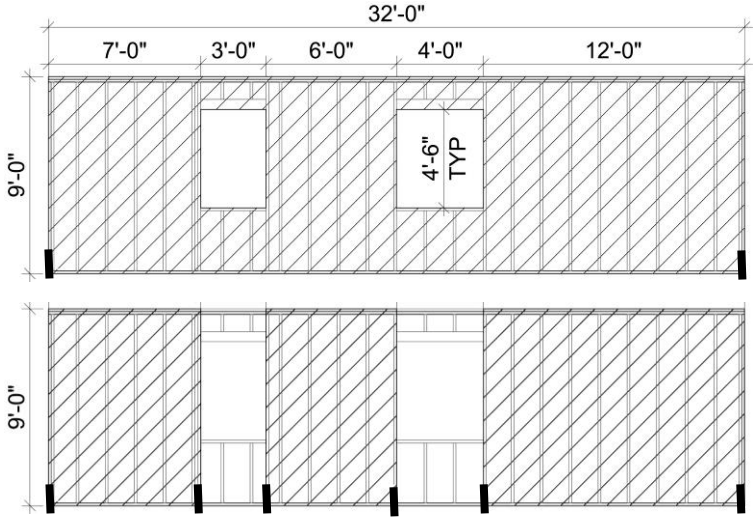
Segmented Shear Wall
21.9' required
7848 lb hold-downs
4/12 nailing



1-1 South Elevation

Wall Detailing Summary (cont'd)





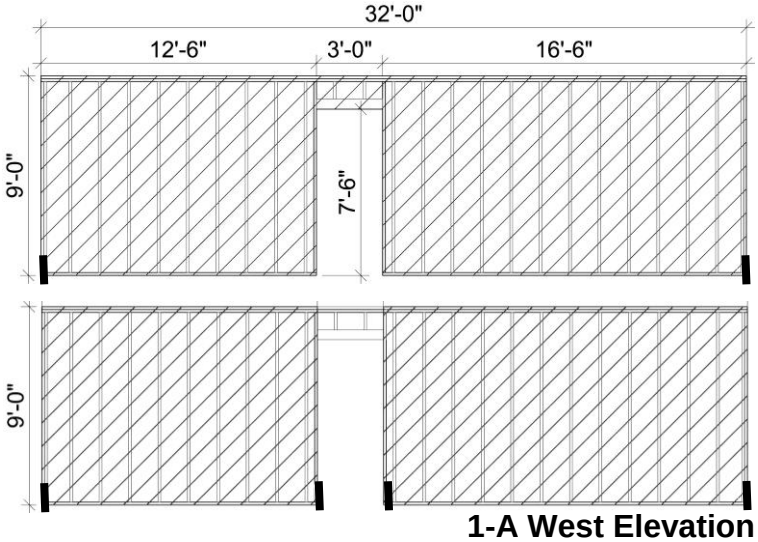
Perforated Shear Wall
9227 lb hold-downs
4/12 nailing

Segmented Shear Wall
20.2' required
9227 lb hold-downs
4/12 nailing

1-B East Elevation

Perforated Shear Wall
9227 lb hold-downs
4/12 nailing

Segmented Shear Wall
27.3' required
7848 lb hold-downs
4/12 nailing



1-A West Elevation

Wall Detailing Summary (cont'd)

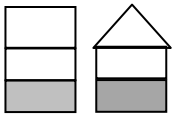


Table W6.19 Header Detailing Requirements for Wind and Gravity Loads

Header Span and Details		Ext. Loadbearing (1-1&1-2)	Ext. Non-loadbearing Headers & Sill Plates (1-A&1-B)	Int. Loadbearing
9'	Type	Dropped or Raised	-	-
	Size/Plies	20F Glulam 3-1/8x13-3/4	-	-
	Uplift load	1312	-	-
	Lateral load	756	-	-
	No. Jack studs	5	-	-
	No. King studs	3	-	-
	King to plate nails	2-16d comm.	-	-
6'	Type	Dropped or Raised	-	Dropped or Raised
	Size/Plies	20F Glulam 3-1/8x9-5/8	-	20F Glulam 3-1/8x9-5/8
	Uplift load	1091	-	n/a
	Lateral load	504	-	n/a
	No. Jack studs	3	-	4
	No. King studs	2	-	1
	King to plate nails	2-16d comm.	-	n/a
4'	Type	-	Dropped	Dropped or Raised
	Size/Plies	-	1-2x6 flat	2-2x10
	Uplift load	-	n/a	n/a
	Lateral load	-	336	n/a
	No. Jack studs	-	n/a	3
	No. King studs	-	2	1
	King to plate nails	-	2-16d comm.	n/a
3'	Type	Dropped or Raised	Dropped	-
	Size/Plies	2-2x8	1-2x6 flat	-
	Uplift load	437	n/a	-
	Lateral load	252	252	-
	No. Jack studs	2	n/a	-
	No. King studs	1	2	-
	King to plate nails	2-16d comm.	2-16d comm.	-

Wall Detailing Summary (cont'd)

Table W6.20 Header Detailing Requirements for Gravity Loads Only

Header Span and Details		Ext. Loadbearing (1-1 & 1-2)	Ext. Non-loadbearing Headers & Sill Plates (1-A & 1-B)	Int. Loadbearing
9'	Type	Dropped or Raised	-	-
	Size/Plies	20F Glulam 3-1/8x13-3/4	-	-
	No. Jack studs	5	-	-
	No. King studs	1	-	-
6'	Type	Dropped or Raised	Dropped or Raised	-
	Size/Plies	20F Glulam 3-1/8x9-5/8	1-2x6 flat	-
	No. Jack studs	3	n/a	-
	No. King studs	1	1	-
4'	Type	-	Dropped or Raised	Dropped or Raised
	Size/Plies	-	1-2x6 flat	2-2x10
	No. Jack studs	-	n/a	3
	No. King studs	-	1	1
3'	Type	Dropped or Raised	Dropped or Raised	-
	Size/Plies	2-2x8	1-2x6 flat	-
	No. Jack studs	2	n/a	-
	No. King studs	1	1	-

NOTES

APPENDIX
SUPPLEMENTAL CHECKLISTS AND WORKSHEETS

LOADS ON THE BUILDING

Structural systems in the *WFCM 2012Edition* have been sized using dead, live, snow, seismic and wind loads in accordance with *ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures*.

Lateral Loads:

Wind:

3-second gust wind speed in Exposure Category ___ (700 yr. return) = _____ mph

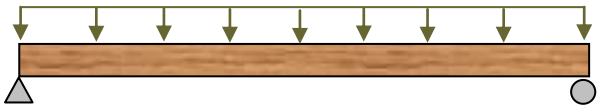
Seismic:

Simplified Procedure (ASCE 7-10 Section 12.14)

Seismic Design Category (SDC) – (ASCE 7-10 Section 11.4.2 and IRC Subcategory) = _____

Vertical force distribution factor (F) - (ASCE 7-10 Section 12.14.8.1) = _____

Gravity Loads:



Roof:

Roof Dead Load = ____ psf

Ground Snow Load, P_g = ____ psf

Ceiling:

Roof Ceiling Load = ____ psf

Floors:

First Floor Live Load = _____ psf

Second Floor Live Load = _____ psf

Third Floor Live Load = _____ psf

Attic Floor Live Load = _____ psf

Floor Dead Load = _____ psf

Walls:

Wall Dead Load = _____ psf

Deflection limits per 2012 IRC Table R301.7:

Roof Rafters with Ceiling Attached L/Δ = _____
Roof Rafters with no Ceiling Attached L/Δ = _____
Floor Joists L/Δ = _____
Exterior Studs L/Δ = _____

WFCM APPLICABILITY LIMITATIONS

The following table is used to determine whether the building geometry is within the applicability limitations of the *WFCM*. Conditions not complying with the limitations shall be designed in accordance with accepted engineer practice (see *WFCM* 1.1.3).

Table W1.1 Applicability Limitations

Attribute		Limitation	Design Case	√
BUILDING DIMENSIONS				
Mean Roof Height (MRH)	maximum	33'		
Number of Stories	maximum	3		
Building Dimension (L or W)	maximum	80'		

*Building designed as a 3-story structure for purposes of determining gravity and seismic loads since the building contains a habitable attic (see WFCM 3.1.3.1).

PRESCRIPTIVE DESIGN LIMITATIONS

The following table is used to determine whether the building geometry is within the applicability limitations of the *WFCM* Chapter 3 prescriptive provisions. Conditions not complying with the limitations shall be designed in accordance with *WFCM* Chapter 2 (see *WFCM* 3.1.3).

Table W1.2 Prescriptive Design Limitations

Element	Attribute	Limitation	Design Case	√
FLOOR SYSTEMS				
Lumber Joists	Joist Span	26'		
	Joist Spacing	24"		
	Cantilevers/Setback - Supporting loadbearing walls	d		
	Cantilevers - Supporting non-loadbearing walls	L/4		
Floor Diaphragms	Vertical Floor Offset	d_f		
	Floor Diaphragm Aspect Ratio	Table 3.16B L_{min}=_____' and L_{max}=_____'; Table 3.16C1 L_{max}=_____'		
	Floor Diaphragm Openings	Lesser of 12' or 50% of Diaphragm Dimension		
WALL SYSTEMS				
Wall Studs	Loadbearing Wall Height	10'		
	Non-Loadbearing Wall Height	20'		
	Wall Stud Spacing	24"		
Shear Walls	Shear Wall Line Offset	4'		
	Shear Wall Story Offset	No offset unless per Exception		
	Shear Wall Segment Aspect Ratio	3½:1		
ROOF SYSTEMS				
Lumber Rafters	Rafter Span (Horizontal Projection)	26'		
	Rafter Spacing	24"		
	Eave Overhang Length	Lesser of 2' or rafter length/3		
	Rake Overhang Length	Lesser of 2' or purlin span/2		
	Roof Slope	Flat - 12:12		
Roof Diaphragms	Roof Diaphragm Aspect Ratio	Table 3.16A1 L_{min}=_____' and L_{max}=_____'; Table 3.16C1 L_{max}=_____'		

CHECKLIST

The following checklist is used to assist with the evaluation of a structure in accordance with *WFCM* Chapter 3 prescriptive provisions. Items are keyed to sections of the *WFCM* Chapter 3 to allow a systematic evaluation of the structure. Blank checklists are reproduced in the Appendix of the workbook.

WFCM 3.2 CONNECTIONS CHECKLIST

3.2.1 Lateral Framing and Shear Connections

3.2.1.1 Roof Assembly ..... Ok?

3.2.1.2 Roof Assembly to Wall Assembly ..... Ok?

3.2.1.3 Wall Assembly ..... Ok?

3.2.1.4 Wall Assembly to Floor Assembly ..... Ok?

3.2.1.5 Floor Assembly ..... Ok?

3.2.1.6 Floor Assembly to Wall Assembly or Sill Plate ..... Ok?

3.2.1.7 Wall Assembly or Sill Plate to Foundation ..... Ok?

3.2.2 Uplift Connections

3.2.2.1 Roof Assembly to Wall Assembly ..... Ok?

3.2.2.2 Wall Assembly to Wall Assembly ..... Ok?

3.2.2.3 Wall Assembly to Foundation ..... Ok?

3.2.3 Overturning Resistance

3.2.3.1 Hold-downs ..... Ok?

3.2.4 Sheathing and Cladding Attachment

3.2.4.1 Roof Sheathing ..... Ok?

3.2.4.2 Wall Sheathing ..... Ok?

3.2.4.3 Floor Sheathing ..... Ok?

3.2.4.4 Roof Cladding ..... Ok?

3.2.4.5 Wall Cladding ..... Ok?

3.2.5 Special Connections

3.2.5.1 Ridge Straps ..... Ok?

3.2.5.2 Jack Rafters ..... Ok?

3.2.5.3 Non-Loadbearing Wall Assemblies ..... Ok?

3.2.5.4 Connections around Wall Openings ..... Ok?

WFCM 3.3 FLOOR SYSTEMS CHECKLIST

3.3.1 Wood Joist Systems

3.3.1.1 Floor Joists ..... Ok?

3.3.1.1.1 Notching and Boring ..... Ok?

3.3.1.2 Bearing ..... Ok?

3.3.1.3 End Restraint ..... Ok?

3.3.1.4 Lateral Stability ..... Ok?

3.3.1.5 Single or Continuous Floor Joists

3.3.1.5.1 Supporting Loadbearing Walls ..... Ok?

3.3.1.5.2 Supporting Non-Loadbearing Walls ..... Ok?

3.3.1.5.3 Supporting Concentrated Loads ..... Ok?

3.3.1.6 Cantilevered Floor Joists

3.3.1.6.1 Supporting Loadbearing Walls ..... Ok?

3.3.1.6.2 Supporting Non-Loadbearing Walls ..... Ok?

3.3.1.7 Floor Diaphragm Openings ..... Ok?

3.3.2 Wood I-Joist Systems ..... Ok?

3.3.3 Wood Floor Truss Systems ..... Ok?

3.3.4 Floor Sheathing

3.3.4.1 Sheathing Spans ..... Ok?

3.3.4.2 Sheathing Edge Support ..... Ok?

3.3.5 Floor Diaphragm Bracing ..... Ok?

WFCM 3.4 WALL SYSTEMS CHECKLIST

3.4.1 Exterior Walls

3.4.1.1 Wood Studs ..... Ok?

3.4.1.1.1 Notching and Boring ..... Ok?

3.4.1.1.2 Stud Continuity ..... Ok?

3.4.1.1.3 Corners ..... Ok?

3.4.1.2 Top Plates ..... Ok?

3.4.1.3 Bottom Plates ..... Ok?

3.4.1.4 Wall Openings

3.4.1.4.1 Headers ..... Ok?

3.4.1.4.2 Full Height Studs ..... Ok?

3.4.1.4.3 Jack Studs ..... Ok?

3.4.1.4.4 Window Sill Plates ..... Ok?

3.4.2 Interior Loadbearing Partitions

3.4.2.1 Wood Studs ..... Ok?

3.4.2.1.1 Notching and Boring ..... Ok?

3.4.2.1.2 Stud Continuity ..... Ok?

3.4.2.2 Top Plates ..... Ok?

3.4.2.3 Bottom Plates ..... Ok?

3.4.2.4 Wall Openings

3.4.2.4.1 Headers ..... Ok?

3.4.2.4.2 Studs Supporting Header Beams ..... Ok?

3.4.3 Interior Non-Loadbearing Partitions

3.4.3.1 Wood Studs ..... Ok?

3.4.3.1.1 Notching and Boring ..... Ok?

3.4.3.2 Top Plates ..... Ok?

3.4.3.3 Bottom Plates ..... Ok?

3.4.4 Wall Sheathing

3.4.4.1 Sheathing and Cladding ..... Ok?

3.4.4.2 Exterior Shear Walls ..... Ok?

3.4.4.2.1 Sheathing Type Adjustments ..... Ok?

3.4.4.2.2 Perforated Shear Wall Adjustments ..... Ok?

3.4.4.2.3 Hold-downs ..... Ok?

WFCM 3.5 ROOF SYSTEMS CHECKLIST

3.5.1 Wood Rafter Systems

3.5.1.1 Rafters ..... Ok?

3.5.1.1.1 Jack Rafters ..... Ok?

3.5.1.1.2 Rafter Overhangs ..... Ok?

3.5.1.1.3 Rake Overhangs ..... Ok?

3.5.1.1.4 Notching and Boring ..... Ok?

3.5.1.2 Bearing ..... Ok?

3.5.1.3 End Restraint ..... Ok?

3.5.1.4 Ridge Beams ..... Ok?

3.5.1.5 Hip and Valley Beams ..... Ok?

3.5.1.6 Ceiling Joists ..... Ok?

3.5.1.7 Open Ceilings ..... Ok?

3.5.1.8 Roof Openings ..... Ok?

3.5.2 Wood I-Joist Roof Systems ..... Ok?

3.5.3 Wood Roof Truss Systems ..... Ok?

3.5.4 Roof Sheathing

3.5.4.1 Sheathing ..... Ok?

3.5.4.2 Sheathing Edge Support ..... Ok?

3.5.5 Roof Diaphragm Bracing ..... Ok?

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