GRAVITY CALCULATIONS

RANKIN
RESIDENCE

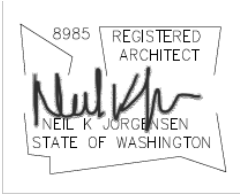
DESIGN LOADS

FLOOR:
LIVE: 40 PSF
DEAD: 10 PSF

ROOF:
LIVE: 25 PSF
DEAD: 15 PSF

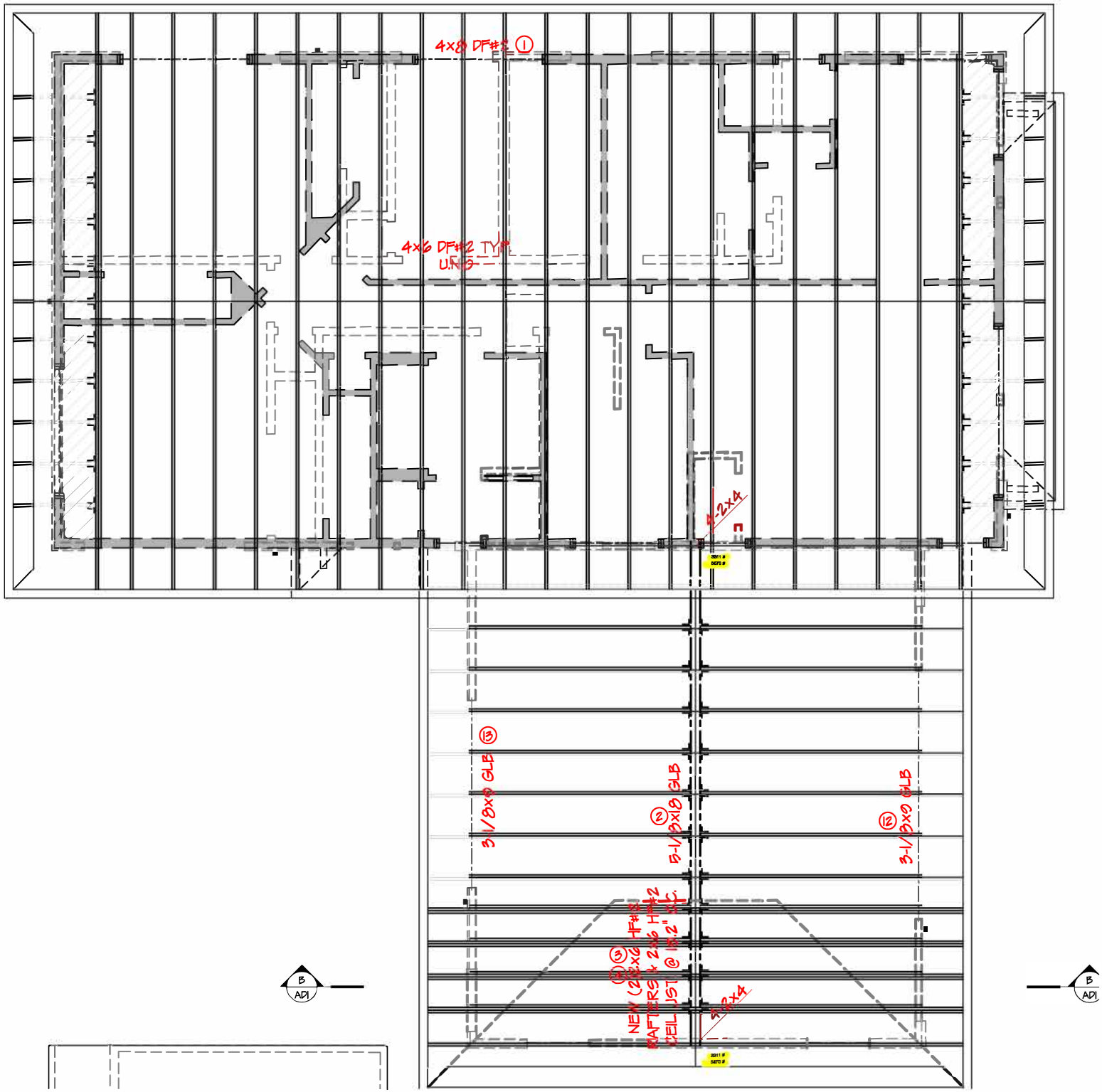
DECK:
LIVE: 60PSF
DEAD: 10 PSF

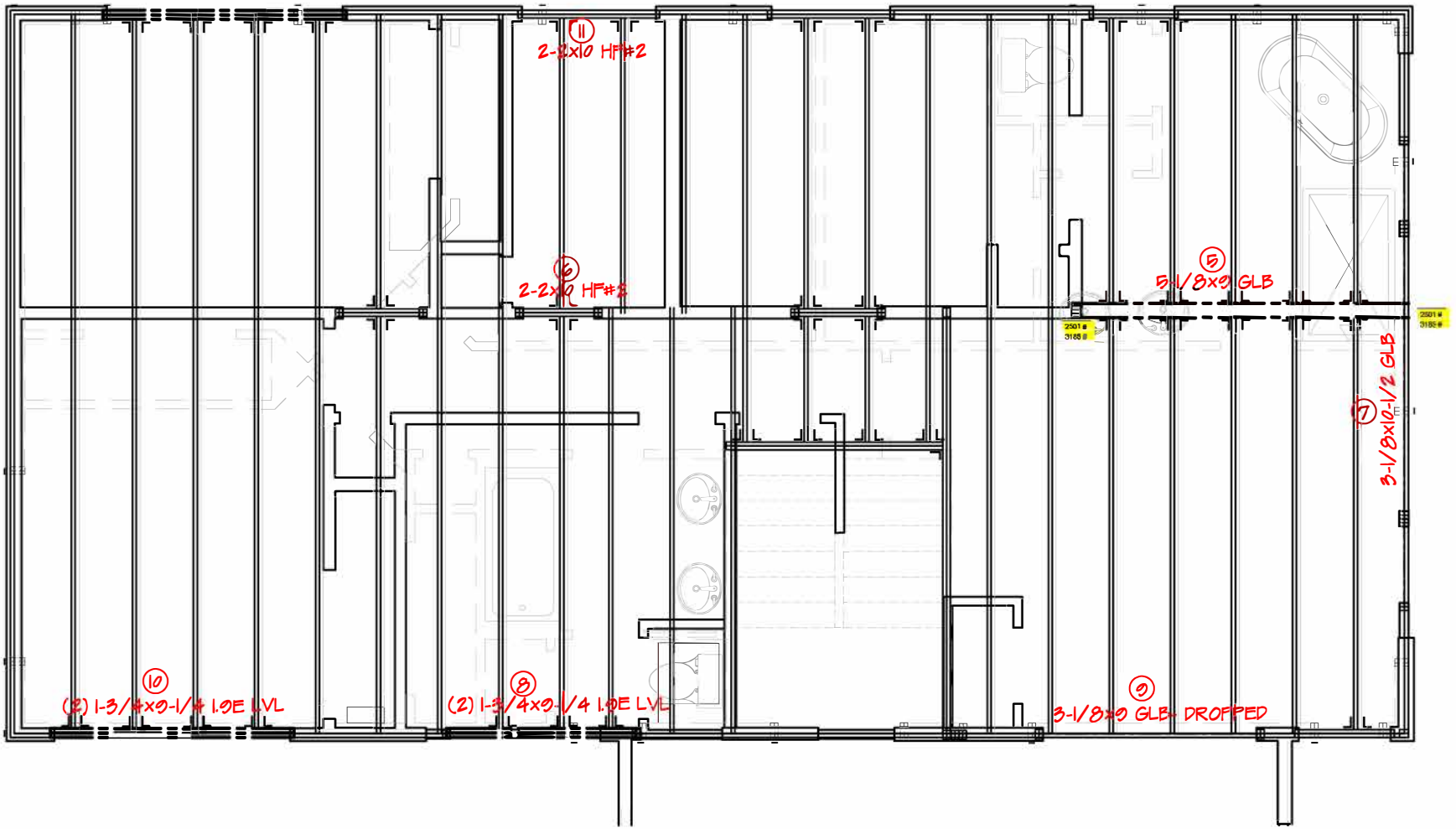
SOIL BEARING:
1500 PSF

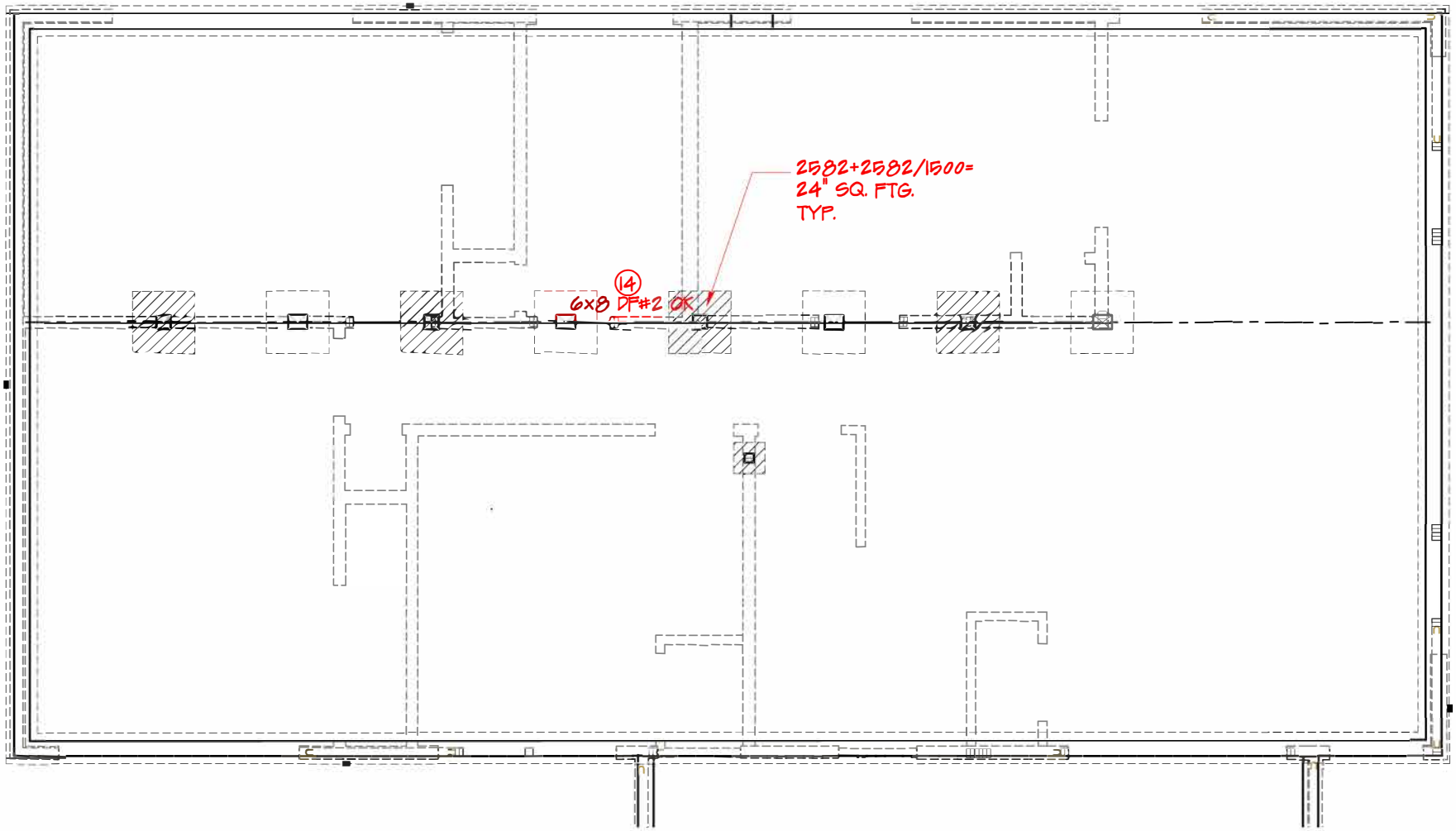


PREPARED BY:
J3 ARCHITECTS LLC
206-412-9296

11-13-24


4x8 DF#2 ①
4x6 DF#2 TYP. U.N.O.
5-2x4
⑮ 3-1/8x9 GLB
② 3-1/8x9 GLB
⑫ 3-1/8x9 GLB
NEW (26)2x6 HF#2 RAFTERS @ 2'-0" O.C. CEIL. JST @ 16.2" O.C.
5-2x4
B ADI
B ADI


(11)
2-2x10 HF#2
(6)
2-2x10 HF#2
(5)
5-1/8x9 GLB
(7)
3-1/8x12-1/2 GLB
(10)
(2) 1-3/4x9-1/4 1.9E LVL
(8)
(2) 1-3/4x9-1/4 1.9E LVL
(9)
3-1/8x9 GLB- DROPPED


2582+2582/1500=
24" SQ. FTG.
TYP.
(14)
6x8 DF#2 OK

RANKIN

BDRM 2 WIN Date: 11/08/24

Selection **4x 8 DF-L #2** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 2.8 in² R2= 2.8 in² (1.5) DL Defl= 0.06 in

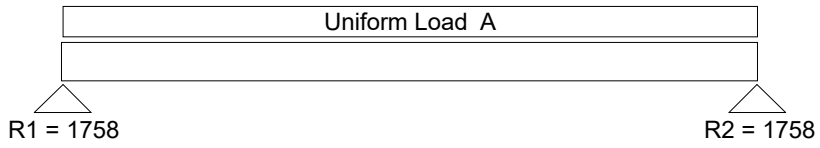
Data

Beam Span	6.25 ft	Reaction 1 LL	1087 #	Reaction 2 LL	1087 #
Beam Wt per ft	6.17 #	Reaction 1 TL	1758 #	Reaction 2 TL	1758 #
Bm Wt Included	39 #	Maximum V	1758 #		
Max Moment	2747 '#	Max V (Reduced)	1418 #		
TL Max Defl	L / 240	TL Actual Defl	L / 581		
LL Max Defl	L / 360	LL Actual Defl	L / >1000		

Attributes	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	30.66	25.38	0.13	0.07
Critical	28.17	11.82	0.31	0.21
Status	OK	OK	OK	OK
Ratio	92%	47%	41%	32%

Values		Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
	Reference Values	900	180	1.6	625
	Adjusted Values	1170	180	1.6	625
Adjustments	CF Size Factor	1.300			
	Cd Duration	1.00	1.00		
	Cr Repetitive	1.00			
	Ch Shear Stress		N/A		
	Cm Wet Use	1.00	1.00	1.00	1.00
	Cl Stability	1.0000	Rb = 0.00	Le = 0.00 Ft	

Loads Uniform LL: 348 Uniform TL: 556 = A



SPAN = 6.25 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

GREAT RM RIDGE Date: 11/08/24

Selection **5-1/8x 18 GLB 24F-V4 DF/DF** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 8.6 in² R2= 8.6 in² (1.5) DL Defl= 0.49 in Recom Camber= 0.73 in

Data

Beam Span	24.3 ft	Reaction 1 LL	3311 #	Reaction 2 LL	3311 #
Beam Wt per ft	22.42 #	Reaction 1 TL	5570 #	Reaction 2 TL	5570 #
Bm Wt Included	545 #	Maximum V	5570 #		
Max Moment	33836 '#	Max V (Reduced)	4882 #		
TL Max Defl	L / 240	TL Actual Defl	L / 303		
LL Max Defl	L / 360	LL Actual Defl	L / 613		

Attributes

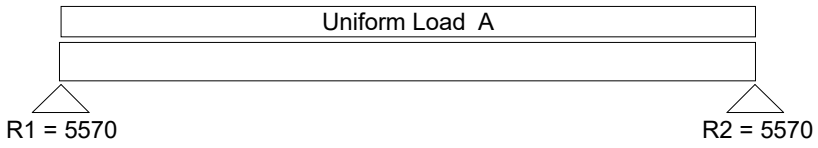
	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	276.75	92.25	0.96	0.48
Critical	178.77	30.51	1.22	0.81
Status	OK	OK	OK	OK
Ratio	65%	33%	79%	59%

Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	2400	240	1.8	650
Adjusted Values	2271	240	1.8	650
Cv Volume	0.946			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 273 Uniform TL: 436 = A



SPAN = 24.3 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

RAFTERS

Date: 11/08/24

Selection **(2) 2x 6 HF #2 @ 19.2 in oc** Lu = 0.0 Ft

Conditions NDS 2018, Repetitive Use

Min Bearing Area R1= 0.9 in² R2= 0.9 in² (1.5) DL Defl= 0.21 in

Data

Beam Span	10.9 ft	Reaction 1 LL	218 #	Reaction 2 LL	218 #
Beam Wt per ft	0 #	Reaction 1 TL	349 #	Reaction 2 TL	349 #
Bm Wt Included	0 #	Maximum V	349 #		
Max Moment	950 '#	Max V (Reduced)	319 #		
TL Max Defl	L / 240	TL Actual Defl	L / 293		
LL Max Defl	L / 360	LL Actual Defl	L / 558		

Attributes

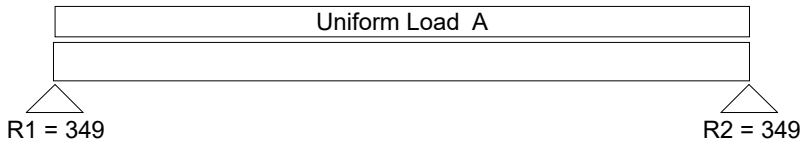
	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	15.13	16.50	0.45	0.23
Critical	8.98	3.19	0.55	0.36
Status	OK	OK	OK	OK
Ratio	59%	19%	82%	65%

Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	850	150	1.3	405
Adjusted Values	1271	150	1.3	405
CF Size Factor	1.300			
Cd Duration	1.00	1.00		
Cr Repetitive	1.15			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 40 Uniform TL: 64 = A



SPAN = 10.9 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

CEIL JST

Date: 11/08/24

Selection **2x 6 HF #2 @ 19.2 in oc** Lu = 0.0 Ft

Conditions NDS 2018, Repetitive Use

Min Bearing Area R1= 0.3 in² R2= 0.3 in² (1.5) DL Defl= 0.14 in

Data

Beam Span	10.9 ft	Reaction 1 LL	87 #	Reaction 2 LL	87 #
Beam Wt per ft	0 #	Reaction 1 TL	131 #	Reaction 2 TL	131 #
Bm Wt Included	0 #	Maximum V	131 #		
Max Moment	356 '#	Max V (Reduced)	120 #		
TL Max Defl	L / 240	TL Actual Defl	L / 398		
LL Max Defl	L / 360	LL Actual Defl	L / 697		

Attributes

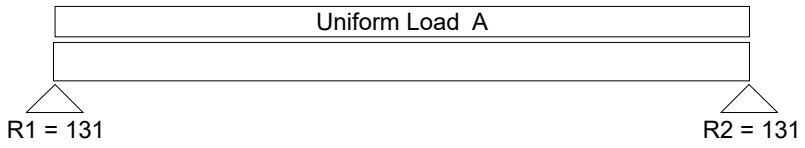
	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	7.56	8.25	0.33	0.19
Critical	3.37	1.20	0.55	0.36
Status	OK	OK	OK	OK
Ratio	45%	15%	60%	52%

Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	850	150	1.3	405
Adjusted Values	1271	150	1.3	405
CF Size Factor	1.300			
Cd Duration	1.00	1.00		
Cr Repetitive	1.15			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 16 Uniform TL: 24 = A



SPAN = 10.9 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

UFF BM

Date: 11/08/24

Selection **5-1/8x 9 GLB 24F-V4 DF/DF** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 4.9 in² R2= 4.9 in² (1.5) DL Defl= 0.10 in Recom Camber= 0.14 in

Data

Beam Span	10.5 ft	Reaction 1 LL	2501 #	Reaction 2 LL	2501 #
Beam Wt per ft	11.21 #	Reaction 1 TL	3185 #	Reaction 2 TL	3185 #
Bm Wt Included	118 #	Maximum V	3185 #		
Max Moment	8361 '#	Max V (Reduced)	2730 #		
TL Max Defl	L / 240	TL Actual Defl	L / 385		
LL Max Defl	L / 360	LL Actual Defl	L / 543		

Attributes

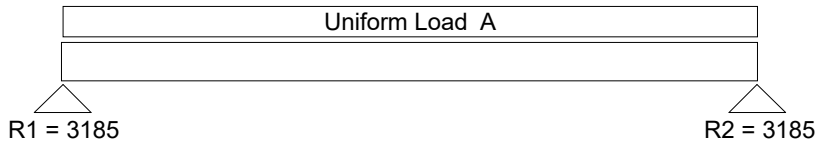
	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	69.19	46.13	0.33	0.23
Critical	41.81	17.06	0.53	0.35
Status	OK	OK	OK	OK
Ratio	60%	37%	62%	66%

Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	2400	240	1.8	650
Adjusted Values	2400	240	1.8	650
Cv Volume	1.000			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 476 Uniform TL: 596 = A



SPAN = 10.5 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

UFF- DBL JST USE 2-2x10 HF#2 Date: 11/13/24

Selection **2x 10 HF #2** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 2.1 in² R2= 2.1 in² (1.5) DL Defl= <0.01 in.

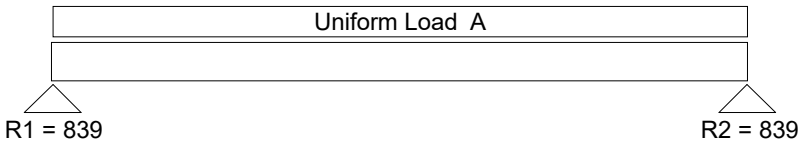
Data

Beam Span	2.8 ft	Reaction 1 LL	666 #	Reaction 2 LL	666 #
Beam Wt per ft	3.37 #	Reaction 1 TL	839 #	Reaction 2 TL	839 #
Bm Wt Included	9 #	Maximum V	839 #		
Max Moment	587 '#	Max V (Reduced)	377 #		
TL Max Defl	L / 240	TL Actual Defl	L / >1000		
LL Max Defl	L / 360	LL Actual Defl	L / >1000		

Attributes	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	21.39	13.88	0.01	<0.01
Critical	7.54	3.77	0.14	0.09
Status	OK	OK	OK	OK
Ratio	35%	27%	5%	5%

Values		Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
	Reference Values	850	150	1.3	405
	Adjusted Values	935	150	1.3	405
Adjustments	CF Size Factor	1.100			
	Cd Duration	1.00	1.00		
	Cr Repetitive	1.00			
	Ch Shear Stress		N/A		
	Cm Wet Use	1.00	1.00	1.00	1.00
	Cl Stability	1.0000	Rb = 0.00	Le = 0.00 Ft	

Loads Uniform LL: 476 Uniform TL: 596 = A



SPAN = 2.8 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

DINING WIN

Date: 11/08/24

Selection **3-1/8x 10-1/2 GLB 24F-V4 DF/DF** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 3.1 in² R2= 5.2 in² (1.5) DL Defl= 0.08 in Recom Camber= 0.13 in

Data

Beam Span	9.25 ft	Reaction 1 LL	1406 #	Reaction 2 LL	2506 #
Beam Wt per ft	7.97 #	Reaction 1 TL	1992 #	Reaction 2 TL	3394 #
Bm Wt Included	74 #	Maximum V	3394 #		
Max Moment	8008 '#	Max V (Reduced)	3186 #		
TL Max Defl	L / 240	TL Actual Defl	L / 469		
LL Max Defl	L / 360	LL Actual Defl	L / 725		

Attributes

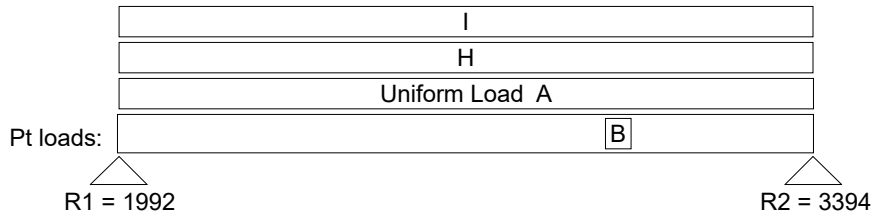
	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	57.42	32.81	0.24	0.15
Critical	40.04	19.91	0.46	0.31
Status	OK	OK	OK	OK
Ratio	70%	61%	51%	50%

Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	2400	240	1.8	650
Adjusted Values	2400	240	1.8	650
Cv Volume	1.000			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00
Cl Stability	1.0000	Rb = 0.00	Le = 0.00 Ft	

Loads Uniform LL: 40 Uniform TL: 50 = A

Point LL	Point TL	Distance	Par Unif LL	Par Unif TL	Start	End
2501	B = 3185	6.66	75	H = 120	0	9.25
			38	I = 60	0	9.25



SPAN = 9.25 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

ENTRY DR

Date: 11/13/24

Selection **(2) 1-3/4x 9-1/4 1.9E TJ Microllam LVL** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 5.2 in² R2= 4.5 in² (1.5) DL Defl= 0.04 in

Data

Beam Span	6.2 ft	Reaction 1 LL	2817 #	Reaction 2 LL	2484 #
Beam Wt per ft	8.32 #	Reaction 1 TL	3930 #	Reaction 2 TL	3399 #
Bm Wt Included	52 #	Maximum V	3930 #		
Max Moment	6128 '#	Max V (Reduced)	2959 #		
TL Max Defl	L / 240	TL Actual Defl	L / 667		
LL Max Defl	L / 360	LL Actual Defl	L / >1000		

Attributes

	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	49.91	32.38	0.11	0.07
Critical	27.30	15.57	0.31	0.21
Status	OK	OK	OK	OK
Ratio	55%	48%	36%	34%

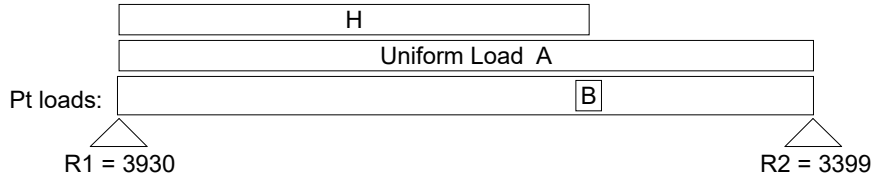
Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	2600	285	1.9	750
Adjusted Values	2694	285	1.9	750
CF Size Factor	1.036			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 556 Uniform TL: 696 = A

Point LL	Point TL	Distance	Par Unif LL	Par Unif TL	Start	End
391	B = 629	4.2	348	H = 556	0	4.2



SPAN = 6.2 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

DINING ENTRY OPEN Date: 11/08/24

Selection **3-1/8x 9 GLB 24F-V4 DF/DF** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 5.1 in² R2= 5.1 in² (1.5) DL Defl= 0.08 in Recom Camber= 0.12 in

Data

Beam Span	7.25 ft	Reaction 1 LL	2261 #	Reaction 2 LL	2261 #
Beam Wt per ft	6.83 #	Reaction 1 TL	3292 #	Reaction 2 TL	3292 #
Bm Wt Included	50 #	Maximum V	3292 #		
Max Moment	5967 '#	Max V (Reduced)	2611 #		
TL Max Defl	L / 240	TL Actual Defl	L / 440		
LL Max Defl	L / 360	LL Actual Defl	L / 744		

Attributes

	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	42.19	28.13	0.20	0.12
Critical	29.84	16.32	0.36	0.24
Status	OK	OK	OK	OK
Ratio	71%	58%	55%	48%

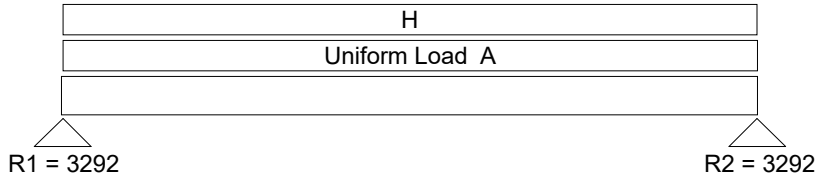
Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	2400	240	1.8	650
Adjusted Values	2400	240	1.8	650
Cv Volume	1.000			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 276 Uniform TL: 345 = A

Par Unif LL	Par Unif TL	Start	End
348	H = 556	0	7.25



SPAN = 7.25 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

EX. OFFICE WIN Date: 11/13/24

Selection	**(2) 1-3/4x 9-1/4 1.9E TJ Microllam LVL**	Lu = 0.0 Ft
Conditions	NDS 2018	
	Min Bearing Area R1= 4.8 in² R2= 4.8 in² (1.5) DL Defl= 0.09 in	

Data

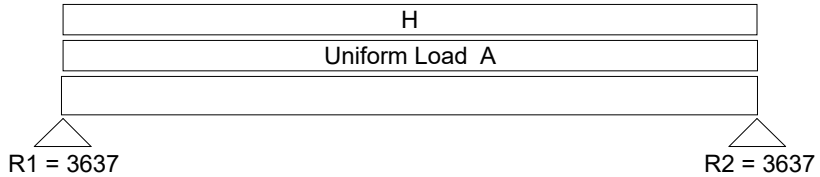
Beam Span	8.0 ft	Reaction 1 LL	2496 #	Reaction 2 LL	2496 #
Beam Wt per ft	8.32 #	Reaction 1 TL	3637 #	Reaction 2 TL	3637 #
Bm Wt Included	67 #	Maximum V	3637 #		
Max Moment	7275 '#	Max V (Reduced)	2936 #		
TL Max Defl	L / 240	TL Actual Defl	L / 420		
LL Max Defl	L / 360	LL Actual Defl	L / 710		

Attributes	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	49.91	32.38	0.23	0.14
Critical	32.41	15.45	0.40	0.27
Status	OK	OK	OK	OK
Ratio	65%	48%	57%	51%

		Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Values	Reference Values	2600	285	1.9	750
	Adjusted Values	2694	285	1.9	750
Adjustments	CF Size Factor	1.036			
	Cd Duration	1.00	1.00		
	Cr Repetitive	1.00			
	Ch Shear Stress		N/A		
	Cm Wet Use	1.00	1.00	1.00	1.00
	Cl Stability	1.0000	Rb = 0.00	Le = 0.00 Ft	

Loads Uniform LL: 276 Uniform TL: 345 = A

Par Unif LL	Par Unif TL	Start	End
348	H = 556	0	8.0



SPAN = 8 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

EX BATH WIN

Date: 11/13/24

Selection **(2) 2x 10 HF #2** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 4.7 in² R2= 4.7 in² (1.5) DL Defl= 0.02 in

Data

Beam Span	4.7 ft	Reaction 1 LL	1278 #	Reaction 2 LL	1278 #
Beam Wt per ft	6.74 #	Reaction 1 TL	1898 #	Reaction 2 TL	1898 #
Bm Wt Included	32 #	Maximum V	1898 #		
Max Moment	2230 '#	Max V (Reduced)	1276 #		
TL Max Defl	L / 240	TL Actual Defl	L / >1000		
LL Max Defl	L / 360	LL Actual Defl	L / >1000		

Attributes

	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	42.78	27.75	0.04	0.02
Critical	28.63	12.76	0.24	0.16
Status	OK	OK	OK	OK
Ratio	67%	46%	18%	15%

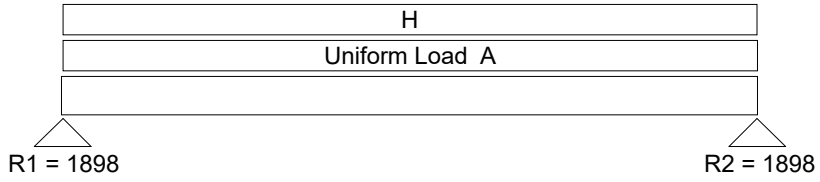
Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	850	150	1.3	405
Adjusted Values	935	150	1.3	405
CF Size Factor	1.100			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 196 Uniform TL: 245 = A

Par Unif LL	Par Unif TL	Start	End
348	H = 556	0	4.7



SPAN = 4.7 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

GREAT RM WIN Date: 11/08/24

Selection **3-1/8x 9 GLB 24F-V4 DF/DF** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 2.9 in² R2= 2.9 in² (1.5) DL Defl= 0.26 in Recom Camber= 0.39 in

Data

Beam Span	12.25 ft	Reaction 1 LL	1133 #	Reaction 2 LL	1133 #
Beam Wt per ft	6.83 #	Reaction 1 TL	1855 #	Reaction 2 TL	1855 #
Bm Wt Included	84 #	Maximum V	1855 #		
Max Moment	5681 '#	Max V (Reduced)	1628 #		
TL Max Defl	L / 240	TL Actual Defl	L / 275		
LL Max Defl	L / 360	LL Actual Defl	L / 537		

Attributes

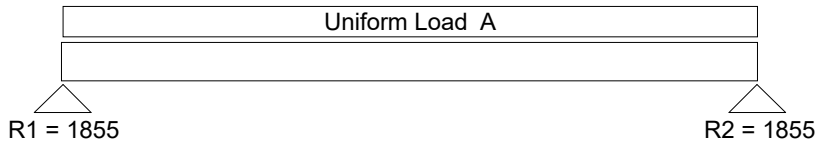
	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	42.19	28.13	0.54	0.27
Critical	28.40	10.17	0.61	0.41
Status	OK	OK	OK	OK
Ratio	67%	36%	87%	67%

Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	2400	240	1.8	650
Adjusted Values	2400	240	1.8	650
Cv Volume	1.000			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 185 Uniform TL: 296 = A



SPAN = 12.25 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

GREAT RM WIN 2 Date: 11/13/24

Selection **3-1/8x 9 GLB 24F-V4 DF/DF** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 2.2 in² R2= 2.2 in² (1.5) DL Defl= 0.09 in Recom Camber= 0.13 in

Data

Beam Span	9.25 ft	Reaction 1 LL	856 #	Reaction 2 LL	856 #
Beam Wt per ft	6.83 #	Reaction 1 TL	1401 #	Reaction 2 TL	1401 #
Bm Wt Included	63 #	Maximum V	1401 #		
Max Moment	3239 '#	Max V (Reduced)	1173 #		
TL Max Defl	L / 240	TL Actual Defl	L / 638		
LL Max Defl	L / 360	LL Actual Defl	L / >1000		

Attributes

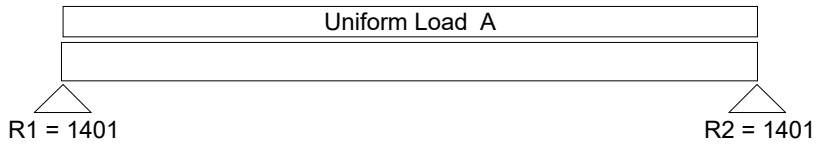
	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	42.19	28.13	0.17	0.09
Critical	16.19	7.33	0.46	0.31
Status	OK	OK	OK	OK
Ratio	38%	26%	38%	29%

Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	2400	240	1.8	650
Adjusted Values	2400	240	1.8	650
Cv Volume	1.000			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00

Cl Stability 1.0000 Rb = 0.00 Le = 0.00 Ft

Loads Uniform LL: 185 Uniform TL: 296 = A



SPAN = 9.25 FT

Uniform and partial uniform loads are lbs per lineal ft.

RANKIN

FN BM

Date: 11/13/24

Selection **6x 8 DF-L #2** Lu = 0.0 Ft

Conditions NDS 2018

Min Bearing Area R1= 4.1 in² R2= 4.1 in² (1.5) DL Defl= 0.01 in

Data

Beam Span	4.3 ft	Reaction 1 LL	2049 #	Reaction 2 LL	2049 #
Beam Wt per ft	10.02 #	Reaction 1 TL	2582 #	Reaction 2 TL	2582 #
Bm Wt Included	43 #	Maximum V	2582 #		
Max Moment	2776 '#	Max V (Reduced)	1832 #		
TL Max Defl	L / 240	TL Actual Defl	L / >1000		
LL Max Defl	L / 360	LL Actual Defl	L / >1000		

Attributes

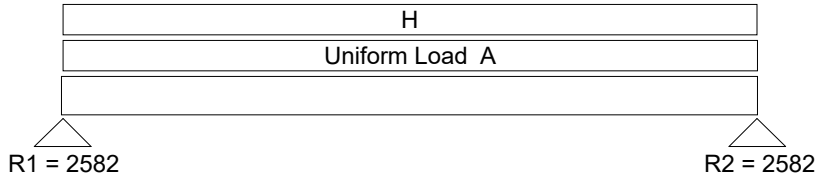
	Section (in³)	Shear (in²)	TL Defl (in)	LL Defl
Actual	51.56	41.25	0.04	0.03
Critical	44.41	16.16	0.22	0.14
Status	OK	OK	OK	OK
Ratio	86%	39%	19%	21%

Values / *Adjustments*

	Fb (psi)	Fv (psi)	E (psi x mil)	Fc⊥ (psi)
Reference Values	750	170	1.3	625
Adjusted Values	750	170	1.3	625
CF Size Factor	1.000			
Cd Duration	1.00	1.00		
Cr Repetitive	1.00			
Ch Shear Stress		N/A		
Cm Wet Use	1.00	1.00	1.00	1.00
Cl Stability	1.0000	Rb = 0.00	Le = 0.00 Ft	

Loads Uniform LL: 476 Uniform TL: 596 = A

Par Unif LL	Par Unif TL	Start	End
476	H = 596	0	4.3

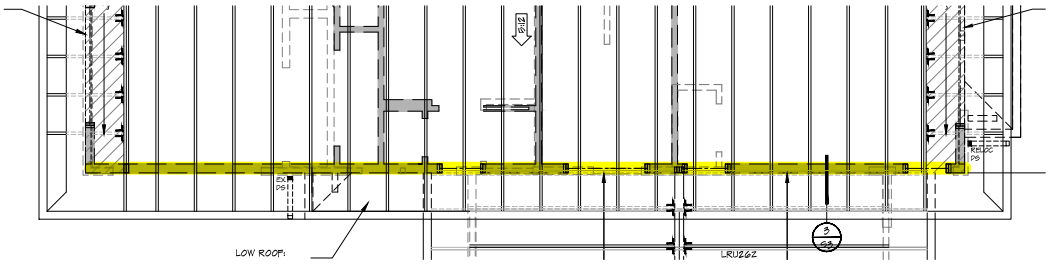


SPAN = 4.3 FT

Uniform and partial uniform loads are lbs per lineal ft.

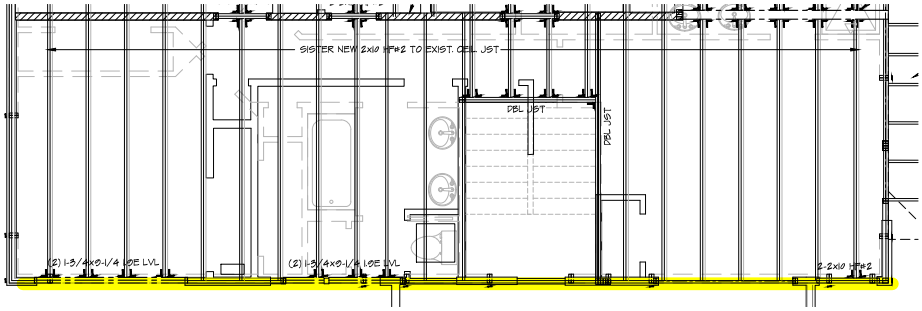
LOADING ON SOUTH HOUSE WALLS:

NEW ROOF LOAD:



DEAD LOAD = 15 PSF x 13.5ft = 203 PLF
SNOW LOAD = 25 PSF x 13.5ft = 338 PLF

NEW FLOOR LOAD:



DEAD LOAD = 15 PSF x 7ft = 105 PLF
LIVE LOAD = 40 PSF x 7ft = 280 PLF

EXISTING FLOOR LOAD:

DEAD LOAD = 15 PSF x 7ft = 105 PLF
LIVE LOAD = 40 PSF x 7ft = 280 PLF

NEW & EXISTING WALL DEAD LOAD:

DEAD LOAD = 10 PSF x 16ft = 160 PLF

TOTAL LOADS:

DEAD LOAD = 203 + 105 + 105 + 160 = **573 PLF**
LIVE LOAD = 280 +280 = **560 PLF**
SNOW LOAD = **338 PLF**

==> REQ MIN FOOTING: 1'-0" WIDE x 6" DEEP (SEE ENERCALC PRINTOUT)

Project Title: Rankin Addition
Engineer: NKH
Project ID: 24-123
Project Descr:

Wall Footing

Project File: (E) Foundation.ec6

DESCRIPTION: Existing Foundation

Code References

Calculations per ACI 318-19, IBC 2021
Load Combinations Used : ASCE 7-22 / IBC 2024 (L<=100psf)

General Information

Material Properties

f'c : Concrete 28 day strength	=	3.0 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
AutoCalc Footing Weight as DL :		Yes

Soil Design Values

Allowable Soil Bearing	=	2.0 ksf
Increase Bearing By Footing Weight	=	Yes
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing Depth

Reference Depth below Surface	=	ft
Allow. Pressure Increase per foot of depth	=	ksf
when base footing is below	=	ft

Increases based on footing Width

Allow. Pressure Increase per foot of width	=	ksf
when footing is wider than	=	ft

Adjusted Allowable Bearing Pressure = 2.073 ksf

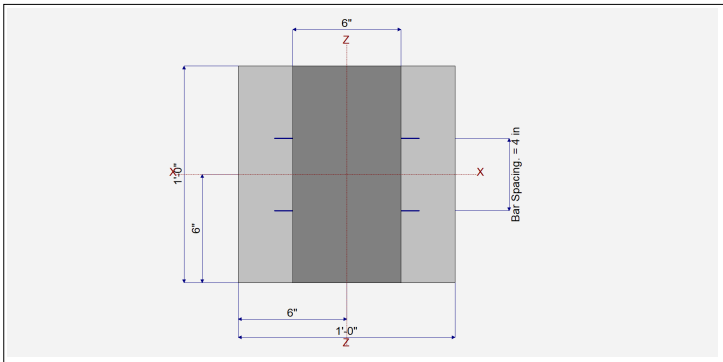
Dimensions

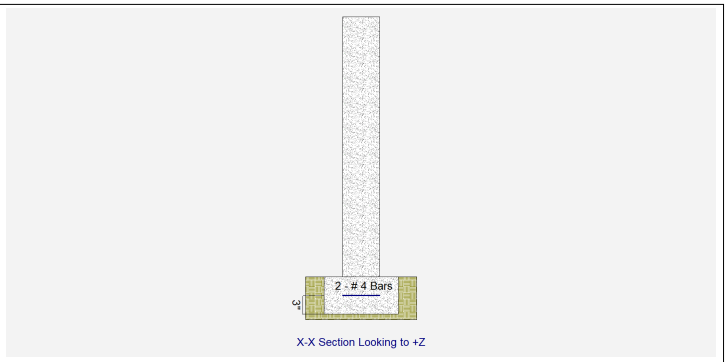
Footing Width	=	1.0 ft	Footing Thickness	=	6.0 in		
Wall Thickness	=	4 in	Rebar Centerline to Edge of Concrete...				
Wall center offset from center of footing	=	0 in	at Bottom of footing	=	3.0 in		

Reinforcing

Bars along X-X Axis

# of Bars in 12" Width	=	2			
Reinforcing Bar Size	=	#	4		





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=								k
OB : Overburden	=	0.5730		0.560	0.3380				ksf
V-x	=								k
M-zz	=								k-ft

Vx applied = in above top of footing

Project Title: Rankin Addition
Engineer: NKH
Project ID: 24-123
Project Descr:

Wall Footing

Project File: (E) Foundation.ec6

DESCRIPTION: Existing Foundation

DESIGN SUMMARY

Design OK

	Factor of Safety	Item	Applied	Capacity	Governing Load Combination
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift

	Utilization Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.3174	Soil Bearing	0.6577 ksf	2.073 ksf	+D+0.750L+0.5250S
PASS	0.008250	Z Flexure (+X)	0.03873 k-ft	4.694 k-ft	+1.20D+1.60L+0.30S
PASS	0.001593	Z Flexure (-X)	0.007477 k-ft	4.694 k-ft	+1.20D+0.50L+0.150S
PASS	N/A	1-way Shear (+X)	N/A psi	73.333 psi	N/A
PASS	N/A	1-way Shear (-X)	N/A psi	73.333 psi	N/A

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc	Actual Soil Bearing Stress -X	Actual Soil Bearing Stress +X	Actual / Allowable Ratio
D Only	2.073 ksf	0.0 in	0.3590 ksf	0.3590 ksf	0.173
+D+L	2.073 ksf	0.0 in	0.6390 ksf	0.6390 ksf	0.308
+D+0.70S	2.073 ksf	0.0 in	0.4773 ksf	0.4773 ksf	0.230
+D+0.750L	2.073 ksf	0.0 in	0.5690 ksf	0.5690 ksf	0.275
+D+0.750L+0.5250S	2.073 ksf	0.0 in	0.6577 ksf	0.6577 ksf	0.317
+0.60D	2.073 ksf	0.0 in	0.2154 ksf	0.2154 ksf	0.104
+D+0.750L+0.10S	2.073 ksf	0.0 in	0.5859 ksf	0.5859 ksf	0.283

Overturning Stability

Units : k-ft

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Sliding Safety Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot. or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
+1.40D	0.009363	-X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.40D	0.009363	+X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+1.60L	0.03398	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+1.60L	0.03398	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+1.60L+0.30S	0.03873	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+1.60L+0.30S	0.03873	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L	0.0051	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L	0.0051	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D	0.008025	-X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.20D	0.008025	+X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+S	0.02094	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+S	0.02094	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+S	0.007819	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+S	0.007819	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+0.30S	0.009853	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+0.30S	0.009853	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+0.90D	0.006019	-X	Top	0.1296	Min Temp %	0.4	4.694	OK
+0.90D	0.006019	+X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+0.150S	0.007477	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+0.150S	0.007477	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK

One Way Shear

Units : k

Load Combination...	vu @ -X	vu @ +X	vu:Max	Φ vn	vu / Φ vn	Status
+1.40D	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+1.60L	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK

Project Title: Rankin Addition
Engineer: NKH
Project ID: 24-123
Project Descr:

Wall Footing

Project File: (E) Foundation.ec6

DESCRIPTION: Existing Foundation

One Way Shear

Units : k

Load Combination...	vu @ -X	vu @ +X	vu:Max	Φ vn	vu / Φ vn	Status
+1.20D+1.60L+0.30S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+0.50L	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+0.50L+S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+0.50L+0.30S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+0.90D	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+0.50L+0.150S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK

Rankin Addition

Project Number: 24-123

3633 Island Crest Way

Mercer Island, WA 98040

Structural Calculations

(Lateral Only)

12/26/24

Reviewed by:

Nabil Kausal-Hayes, PE

206-601-9728

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Prepared By:

Allen Rishel, EIT

December 26th, 2024

PROJECT: Rankin Addition

DESIGNER: NKH and AKR

DATE: December 26th, 2024

JOB #: 24-123

PROJECT SUMMARY AND DESIGN CRITERIA

Background
Project Summary:
This is an upper floor addition on an existing single story, wood framed house for the Rankin Family on Mercer Island, WA. The structure consists of wood roof and floor trusses/joists bearing on wood framed walls, posts, and beams. The house is supported by existing concrete stem walls and shallow spread footings. This project is designed in accordance with the 2021 International Building Code along with the codes listed below and corresponding state and city/county amendments.

Notes:
All input variables are highlighted in yellow, resources bolded, and links to resources bolded and underlined. Areas highlighted in blue are code/design checks and green - unity checks.

Resources:
- American Wood Council (AWC). (2018). "National Design Specifications for Wood Construction (NDS)."
- American Wood Council (AWC). (2021). "Special Design Provisions for Wind and Seismic (SDWS)."
- American Concrete Institute (ACI). (2019). "Building Code Requirements for Structural Concrete (ACI 318-19)."
- American Institute of Steel Construction (AISC). (2016). "Steel Construction Manual." 15th Ed.
- American Society of Civil Engineers (ASCE). (2022). "Minimum Design Loads for Buildings and Other Structures."
- State of Washington (2021). "International Building Code (IBC)."
- American Society of Civil Engineering (ASCE). "ASCE Hazard Tool"https://asce7hazardtool.online/

Material Properties

Soil:
-Soil Bearing Pressure (min per IBC1806.2) $p_{brg} := 2000\ psf$
-Frost Depth $FD := 12\ in$
- Active and Passive Soil Pressure $q_a := 35 \cdot pcf$ $q_p := 250 \cdot pcf$

Concrete:
-Compressive Strength $f'_c := 2500\ psi$
-Density, Normal Weight $\gamma_{conc} := 150 \cdot pcf$
-Density, Light Weight $\gamma_{conc\ LW} := 115 \cdot pcf$
-Reinforcing Steel, ASTM A615 $f_{yr} := 60\ ksi$

Steel:
- Modulus of Elasticity $E_c := 29000\ ksi$
-Anchor Rods/Bolts, ASTM A307 Shear and Tension Yield Strength $F_{nv} := 24\ ks$ $F_{nt} := 45\ ksi$

Wood:
-Solid Sawn Joists, Beams, Headers, and Studs DF-L #1 6x and Larger, DF-L #2 All Other (UNO)
-Glulam Beams 24F-V4 (Simple Span), 24F-V8 (Cont/Cantilever)

Gravity Loading

Roof Dead Load

Roofing $R := 1.5\ psf$

Insulation $I := 2.0\ psf$

Ceiling $C := 2\ psf$

Sheathing $t := 0.5\ in$ $SH := t \cdot \left(\frac{3.25\ psf}{1\ in} \right) = 1.625\ psf$

Structural Members $S := 2.5\ psf$

Lights $L := 1\ psf$

Mechanical $M := 1.5\ psf$

Misc. $MISC := 2.9\ psf$

$DL_{rf} := R + I + C + SH + S + L + M + MISC$ $DL_{rf} = 15\ psf$ $DL_{pv} := 0\ psf$

Seismic Roof Dead Load

$SDL_{rf} := DL_{rf} - MISC + DL_{pv} \cdot (75\ \%) = 12.1\ psf$ $SDL_{rf} = 12\ psf$

Floor Dead Load

Flooring $F := 1.5\ psf$

Insulation $I := 2.0\ psf$

Ceiling $C := 0\ psf$

Sheathing $t := 0.75\ in$ $SH := t \cdot \left(\frac{3.25\ psf}{1\ in} \right) = 2.4375\ psf$

Structural Members $S := 3.4\ psf$

Lights $L := 1\ psf$

Mechanical $M := 1.5\ psf$

Misc. $MISC := 3.2\ psf$

$DL_{flr} := F + I + C + SH + S + L + M + MISC$ $DL_{flr} = 15\ psf$

Seismic Floor Dead Load

$SDL_{flr} := DL_{flr} = 719.9994\ Pa$ $SDL_{flr} = 15\ psf$

Wall Dead Loads

Exterior Wood $p_{ext\_w} := 10\ psf$

Interior Wood $p_{int} := 9\ psf$

Live Loads

Roof $LL_{rf} := 20\ psf$ Roof Snow Load $SL := 25\ psf$

Floor Live Load $LL_{flr} := 40\ psf$

Deck Live Load $LL_{deck} := 1.5 \cdot LL_{flr} = 60\ psf$

Deflection Criteria

$\Delta_{rf\_TL} := \frac{L}{240}$ $\Delta_{rf\_LL} := \frac{L}{360}$ $\Delta_{flr\_TL} := \frac{L}{360}$ $\Delta_{flr\_LL} := \frac{L}{480}$

NKH ENGINEERING

PROJECT: Rankin Addition

DESIGNER: NKH and AKR

DATE: December 26th, 2024

JOB #: 24-123

LATERAL ANALYSIS

General

Input *Output* *Verify*

LRFD

Risk Cat.: II (ref. 1.5-1)

$L := 48\ ft$	Building Length	$SDL_{rf} := 12\ psf$	Roof Seismic Dead Load
$B := 48\ ft$	Building Width	$SDL_{flr} := 15\ psf$	Floor Seismic Dead Load
$h_{rf} := 20\ ft$	Avg Roof Height Upper	$LL := 25\ psf$	Roof Snow/Live Load
$h_p := 0\ ft$	Parapet Height	$p_{ext} := 12\ psf$	Exterior Wall Load
$h_{wall} := 9\ ft$	Wall Height	$p_{int} := 10\ psf$	Interior Wall Load

$a := \min\left(\begin{bmatrix} 10\ \%\cdot B \\ 0.4\cdot h_{rf} \end{bmatrix}\right) = 4.8\ ft$ Width of Pressure Coefficient Zone

MWFRS (per ASCE 7 - 22, Chapter 26 and 27)

$theta := \operatorname{atan}\left(\frac{5}{12}\right) = 22.62\ deg$ Roof Slope

Design Velocity Pressure - Enclosed/Partially Enlosed Buildings

$V_w := 110$ mph — Basic Wind Speed (ref. figure 26.5-1A and city/county design criteria)

$K_d := 0.85$ — Directionality Factor (ref. section 26.6 and table 26.6 - 1)

$exposure := "B"$ — Exposure Category (ref. section 26.7)

$K_{zt} := 1.3$ — Topographic Factor (ref. section 26.8)

$K_z = 0.62$ — Velocity Pressure Exposure Coefficient (ref. table 26.10-1)

$q_z := 0.00256\cdot K_z\cdot K_{zt}\cdot K_d\cdot V_w^{\ 2}\cdot(psf)$ Velocity pressure (eq 27.3-1) $q_z = 21.2\ psf$

Design Wind Pressure

$p_{w\_min} := 16\ psf$ — Minimum Design Pressure

$G_e := 0.85$ — Gust Effect Factor (ref. section 26.9)

Walls

$GC_{pi} := 0.18$ — Internal Pressure Coefficient (ref. table 26.11-1)

Veolcity Pressure Evaluated at Mean Roof Height, h

$q_h := q_z = 21.22\ psf$

Design Wind Pressure (cont'd)

External Pressure Coefficients for Walls (ref. figure 26.4-1)

$\frac{L}{B} = 1$ $C_{pww} := 0.8$ Windward Wall $C_{plw} := -0.25$ Leeward Wall

$C_p := C_{pww} - C_{plw} = 1.05$

Design MWFRS Wind Pressures (eq 26.4-1)

$$p_w := \max\left(\begin{bmatrix} p_{w\_min} \\ q_h \cdot \left(G_e \cdot C_p + GC_{pi}\right) \\ q_h \cdot \left(G_e \cdot C_p - GC_{pi}\right) \end{bmatrix}\right) \qquad p_w = 22.76\ \text{psf}$$

Parapet (ref. section 27.4.5) $q_h \cdot \left(G_e \cdot C_p - GC_{pi}\right) = 15.12\ \text{psf}$

$GC_{pnw} := 1.5$ Windward Combined Net Pressure Coefficient

$GC_{pnL} := -1.0$ Leeward Combined Net Pressure Coefficient

$p_p := \text{if } h_p \le 0$ Combined Net Pressure on Parapet $p_p = 0\ \text{psf}$

$0\ \text{psf}$

else

$q_z \cdot \left(GC_{pnw} - GC_{pnL}\right)$

Roof (fig. 27.4-1) $\frac{h_{rf}}{L} = 0.4167$

$GC_{pi} = 0.18$ Internal pressure coefficient (ref. table 26.11-1)

External pressure coefficients for roofs (ref. figure 27.4-1)

$\frac{h_{rf}}{L} = 0.4167$ $C_{prf1} := -0.6$ $C_{prf2} := 0.2$

Veolcity pressure evaluated at mean roof height, h

$q_h = 21.22\ \text{psf}$

Design MWFRS wind pressure (ref. eq 27.4-1)

$p_{rf\_pos1} := q_h \cdot \left(G_e \cdot C_{prf1} + GC_{pi}\right) = -7\ \text{psf}$ $p_{rf\_pos2} := q_h \cdot \left(G_e \cdot C_{prf2} + GC_{pi}\right) = 7.43\ \text{psf}$

$p_{rf\_neg1} := q_h \cdot \left(G_e \cdot C_{prf1} - GC_{pi}\right) = -14.64\ \text{psf}$ $p_{rf\_neg2} := q_h \cdot \left(G_e \cdot C_{prf2} - GC_{pi}\right) = -0.21\ \text{psf}$

$p_{rf} := \left|p_{rf\_neg1}\right| = 14.6429\ \text{psf}$ $p_{rf\_horiz} := p_{rf} \cdot \sin\left(theta\right) = 5.6319\ \text{psf}$

$$p_{w\_up} := 0.6 \cdot SDL_{rf} + 0.6 \cdot \left(\min\left(\begin{bmatrix} p_{rf\_neg1} \\ p_{rf\_neg2} \end{bmatrix}\right)\right)$$ Net uplift pressure (ASD) $p_{w\_up} = -1.59\ \text{psf}$

Roof Overhangs

$C_{poh} := -0.8$ External pressure coefficients for roof overhangs (ref. 27.5.3)

$p_{oh} := q_z \cdot \left(G_e \cdot C_{poh}\right) + \min\left(\begin{bmatrix} p_{rf\_neg1} \\ p_{rf\_neg2} \end{bmatrix}\right)$ Overhang pressure $p_{oh} = -29.07\ \text{psf}$

$OH_{net} := 0.6 \cdot SDL_{rf} + 0.6 \cdot p_{oh}$ Net uplift pressure (ASD) $OH_{net} = -10.24\ \text{psf}$

C+C (per ASCE 7 - 22, Chapter 30)

Walls (ref. eq. 30.4-1 and figure 30.4-1)

$GC_{pw4\_pos} := 1.0$ $GC_{pw4\_neg} := -1.1$ exterior pressure coefficients

$GC_{pw5\_pos} := 1.0$ $GC_{pw5\_neg} := -1.4$ exterior pressure coefficients (corner zone)

$p_{cc\_w4pos} := q_h \cdot \left(GC_{pw4\_pos} + GC_{pi} \right) = 25.04\ psf$ Positive design wind pressure (ref. eq. 30.4-1)

$p_{cc\_w4neg} := q_h \cdot \left(GC_{pw4\_neg} - GC_{pi} \right) = -27.16\ psf$ Negative design wind pressure

$p_{cc\_w5pos} := q_h \cdot \left(GC_{pw5\_pos} + GC_{pi} \right) = 25.04\ psf$ Corner zone positive design wind pressure

$p_{cc\_w5neg} := q_h \cdot \left(GC_{pw5\_neg} - GC_{pi} \right) = -33.53\ psf$ Corner zone negative design wind pressure

Roofs (ref. eq. 30.4-1 and figure 30.4-2B)

Negative design wind pressure $GC_{pr1} := -0.9$ $GC_{pr2} := -1.7$ $GC_{pr3} := -2.6$

$p_{cc\_r1} := q_h \cdot \left(GC_{pr1} - GC_{pi} \right) = -22.92\ psf$ $p_{cc\_r3} := q_h \cdot \left(GC_{pr3} - GC_{pi} \right) = -59\ psf$

$p_{cc\_r2} := q_h \cdot \left(GC_{pr2} - GC_{pi} \right) = -39.9\ psf$

Positive design wind pressure $GC_{pr\_pos} := 0.5$

$p_{cc\_r2} := q_h \cdot \left(GC_{pr\_pos} + GC_{pi} \right) = 14.43\ psf$

Wind Diaphragm Shear (LRFD)

$A_{wall\_L} := 760\ ft^2$ $A_{roof\_L} := 300\ ft^2$ $A_{wall\_T} := 640\ ft^2$ $A_{roof\_T} := 140\ ft^2$

$V_{wu\_L} := p_w \cdot A_{wall\_L} + p_{rf\_horiz} \cdot A_{roof\_L} = 18.99\ kip$ Longitudinal diaphragm shear

$V_{wu\_T} := p_w \cdot A_{wall\_T} + p_{rf\_horiz} \cdot A_{roof\_T} = 15.36\ kip$ Transverse diaphragm shear

Seismic (per ASCE 7 - 22, 12.8)

LRFD

Basic Parameters

- Equivalent Lateral Force Procedure (ELFP)
- Site class: D
- Seismic design category: D
- Light Framed Wood Walls Sheathed w/ Wood Panels

$I_s := 1.0$ Seismic importance factor (ref. table 1.5-2)

$S_{DS} := 0.939$ Design spectral acceleration parameter (ref. ASCE Summary Report)

$R := 6.5$ Response modification factor - (ref. table 12.2-1)

$\Omega_o := 3$ System overstrength factor (ref. table 12.2-1)

$C_d := 4$ Deflection amp. factor (ref. table 12.2-1)

$\rho := 1.0$ Redundancy factor (ref section 12.3.4)

$C_s := \frac{S_{DS}}{\left(\frac{R}{I_s}\right)} = 0.1445$ Seismic resonse coefficient (EQ. 12.8 - 2)

$S_{D1} := 0.88$ $S_1 := 0.49$

$h_n := h_{rf} = 20\ ft$ Highest level of structure $h_{in} := 10\ ft$ Interior wall height

$C_t := 0.02$ $x := 0.75$ Table 12.8-2

$T_a := C_t \cdot \left(\frac{h_n}{ft}\right)^x = 0.1891$ EQ 12.8-7

$C_{smax} := \frac{S_{D1}}{T_a \cdot \left(\frac{R}{I_s}\right)}$ $C_{smax} = 0.7158$

$C_s := \max\left(\left[\begin{matrix} 0.1 \\ \min\left(\left[\begin{matrix} C_s \\ C_{smax} \end{matrix}\right]\right) \end{matrix}\right]\right)$ $C_s = 0.1445$

$C_{s\_min} := \frac{0.5 \cdot S_{D1}}{\left(\frac{R}{I_s}\right)} = 0.0677$ EQ 12.8- 5 and 12.8- 6

$C_s := \rho \cdot C_s$ $C_s = 0.144$

Seismic Diaphragm Shear

Building Weights Contributing to Seismic Forces

$W_{diaphragm\_rf} := 1450\ ft^2 \cdot SDL_{rf}$

$W_{diaphragm\_flr} := 1750\ ft^2 \cdot SDL_{flr}$

$W_{diaphragm} := W_{diaphragm\_rf} + W_{diaphragm\_flr}$

$W_{walls\_T} := \left(p_{ext} + p_{int}\right) \cdot A_{wall\_T} \cdot 2$ $\quad W_{walls\_T} = 28.16\ kip$

$W_{walls\_L} := \left(p_{ext} + p_{int}\right) \cdot A_{wall\_L} \cdot 2$ $\quad W_{walls\_L} = 33.44\ kip$

Shear Loads

$V_{su} := C_s \cdot \left(W_{diaphragm} + W_{walls\_L} + W_{walls\_T}\right)$ $\quad V_{su} = 15.2046\ kip$

Lateral Summary

Seismic /Wind Shearwall Capacity Factor
(ref. NDS Shearwall Capacities)

$C_{sw\_cap} := \frac{310\ psf}{435\ psf} = 0.71$

	Wind	Seismic
Transverse	$V_{wu\_T} := 0.6 \cdot V_{wu\_T} \cdot C_{sw\_cap} = 6.57\ kip$	$V_{su\_L} := 0.7 \cdot V_{su} \cdot C_{sw\_cap} = 7.58\ kip$

```
V_T := if  V_wu_T > V_su_L        = "SEISMIC CONTROLS"
       "WIND CONTROLS"
     else
       "SEISMIC CONTROLS"
```

Longitudinal	$V_{wu\_L} := 0.6 \cdot V_{wu\_L} \cdot C_{sw\_cap} = 8.12\ kip$	$V_{su\_T} := 0.7 \cdot V_{su} \cdot C_{sw\_cap} = 7.58\ kip$

```
V_L := if  V_wu_L > V_su_T        = "WIND CONTROLS"
       "WIND CONTROLS"
     else
       "SEISMIC CONTROLS"
```

Wall Line Wind Force Reactions - Roof

$h_{wall} = 9\ ft$ Average Wall Height

$h_{rf\_proj} := 6\ ft$ Roof Projection above wall

$p_w = 22.76\ psf$ Design Wind Pressure (ref. 'Wind Loading')

$p_{rf\_horiz} = 5.63\ psf$ Design Wind Pressure (ref. 'Wind Loading')

Longitudinal Wall Line Reactions

Reaction 1

$trib1 := \frac{46\ ft}{2} = 23\ ft$

$R_{Lrf\_1} := \left(p_w \cdot \frac{h_{wall}}{2} + p_{rf\_horiz} \cdot h_{rf\_proj}\right) \cdot trib1$ $R_{Lrf\_1} = 3.13\ kip$

Reaction 2

$trib2 := \frac{46\ ft}{2} = 23\ ft$

$R_{Lrf\_2} := \left(p_w \cdot \frac{h_{wall}}{2} + p_{rf\_horiz} \cdot h_{rf\_proj}\right) \cdot (trib2)$ $R_{Lrf\_2} = 3.13\ kip$

Transverse Wall Line Reactions

Reaction A

$tribA := \frac{24\ ft}{2} = 12\ ft$

$R_{Trf\_A} := \left(p_w \cdot \frac{h_{wall}}{2} + p_{rf\_horiz} \cdot h_{rf\_proj}\right) \cdot tribA$ $R_{Trf\_A} = 1.63\ kip$

Reaction B

$tribB := \frac{24\ ft}{2} = 12\ ft$

$R_{Trf\_B} := \left(p_w \cdot \frac{h_{wall}}{2} + p_{rf\_horiz} \cdot h_{rf\_proj}\right) \cdot (tribB)$ $R_{Trf\_B} = 1.63\ kip$

Vertical Distribution of Seismic Forces - Roof Diaphragm (Per ASCE 7- 22, 12.8.3)

$V_{su} = 15.2046\ \text{kip}$

$$C_{vx\_roof} := \frac{\left(W_{diaphragm\_rf} + W_{walls\_L} \cdot \frac{1}{4} + W_{walls\_T} \cdot \frac{1}{4}\right)}{\left(W_{diaphragm} + W_{walls\_L} + W_{walls\_T}\right)} = 0.3116$$

$V_{rf} := V_{su} \cdot C_{vx\_roof}$ Distributed shear to roof $V_{rf} = 4.74\ \text{kip}$

Wall Line Seismic Force Reactions - Roof

Longitudinal

Reaction 1 $R_{Lrf\_1\_EL} := \frac{trib1}{46\ \text{ft}} \cdot V_{rf}$ $R_{Lrf\_1\_EL} = 2.37\ \text{kip}$

Reaction 2 $R_{Lrf\_2\_EL} := \frac{trib2}{46\ \text{ft}} \cdot V_{rf}$ $R_{Lrf\_2\_EL} = 2.37\ \text{kip}$

Transverse

Reaction A $R_{Trf\_A\_EL} := \frac{tribA}{24\ \text{ft}} \cdot V_{rf}$ $R_{Trf\_A\_EL} = 2.37\ \text{kip}$

Reaction B $R_{Trf\_B\_EL} := \frac{tribB}{24\ \text{ft}} \cdot V_{rf}$ $R_{Trf\_B\_EL} = 2.37\ \text{kip}$

Wall Line Wind Force Reactions - Upper Floor

$h_{wall} = 9\ ft$ Average Wall Height

$p_w = 22.76\ psf$ Design Wind Pressure (ref. 'Wind Loading')

Longitudinal Grid Line Reactions

Reaction 1 $trib1 := \frac{20\ ft}{2} = 10\ ft$

$R_{Lup\_1} := \left(p_w \cdot h_{wall}\right) \cdot trib1 + R_{Lrf\_1}$

$R_{Lup\_1} = 5.18\ kip$

Reaction 2 $trib2 := \frac{26\ ft}{2} = 13\ ft$

$R_{Lup\_2} := \left(p_w \cdot h_{wall}\right) \cdot \left(trib1 + trib2\right)$

$R_{Lup\_2} = 4.71\ kip$

Reaction 3 $trib3 := 10\ ft = 10\ ft$

$R_{Lup\_3} := \left(p_w \cdot h_{wall}\right) \cdot \left(trib3\right) + R_{Lrf\_2}$

$R_{Lup\_3} = 5.18\ kip$

Transverse Wall Line Reactions

Reaction A $tribA := \frac{24\ ft}{2} = 12\ ft$

$R_{Tup\_A} := \left(p_w \cdot h_{wall}\right) \cdot tribA + R_{Trf\_A}$

$R_{Tup\_A} = 4.09\ kip$

Reaction B $tribB := \frac{24\ ft}{2} = 12\ ft$

$R_{Tup\_B} := \left(p_w \cdot h_{wall}\right) \cdot \left(tribA + tribB\right) + R_{Trf\_B}$

$R_{Tup\_B} = 6.55\ kip$

Reaction C $tribC := tribB = 12\ ft$

$R_{Tup\_C} := \left(p_w \cdot h_{wall}\right) \cdot \left(tribC\right)$

$R_{Tup\_C} = 2.46\ kip$

Vertical Distribution of Seismic Forces - Upper Floor Diaphragm (Per ASCE 7- 22, 12.8.3)

$V_{su} = 15.2046\ \text{kip}$

$$C_{vx\_up} := \frac{\left(W_{diaphragm\_flr} + W_{walls\_L}\cdot\frac{1}{2} + W_{walls\_T}\cdot\frac{1}{2}\right)}{\left(W_{diaphragm} + W_{walls\_L} + W_{walls\_T}\right)} = 0.542$$

$V_{up} := V_{su}\cdot C_{vx\_up}$ Distributed shear to roof $V_{up} = 8.24\ \text{kip}$

Wall Line Seismic Force Reactions - Upper Floor

Longitudinal

Reaction 1 $R_{Lup\_1\_EL} := \frac{trib1}{L}\cdot V_{up} + R_{Lrf\_1\_EL}$ $R_{Lup\_1\_EL} = 4.09\ \text{kip}$

Reaction 2 $R_{Lup\_2\_EL} := \frac{trib1 + trib2}{L}\cdot V_{up}$ $R_{Lup\_2\_EL} = 3.95\ \text{kip}$

Reaction 3 $R_{Lup\_3\_EL} := \frac{trib3}{L}\cdot V_{up} + R_{Lrf\_2\_EL}$ $R_{Lup\_3\_EL} = 4.09\ \text{kip}$

Transverse

Reaction A $R_{Tup\_A\_EL} := \frac{tribA}{B}\cdot V_{up} + R_{Trf\_A\_EL}$ $R_{Tup\_A\_EL} = 4.43\ \text{kip}$

Reaction B $R_{Tup\_B\_EL} := \frac{tribA + tribB}{B}\cdot V_{up} + R_{Trf\_B\_EL}$ $R_{Tup\_B\_EL} = 6.49\ \text{kip}$

Reaction C $R_{Tup\_C\_EL} := \frac{tribC}{B}\cdot V_{up}$ $R_{Tup\_C\_EL} = 2.06\ \text{kip}$

Diaphragm Check (ref. ANSI/AF+PA SDPWS-2021)

Aspect Ratio

$L_T := L = 48\ ft$ $L_L := B = 48\ ft$ Length and width of diaphragm

$check_D := \text{if } \frac{L_L}{L_T} > 4$ "NG" else "OK"

$ratio := \frac{L_L}{L_T} = 1$

$check_D = \text{"OK"}$

Diaphragm Shear

Shear capacities for 19/32" APA Rated OSB/Plywood Sheathing - Un-Blocked (ref. table 4.2A):

$\Omega_{D\_w} := 2.0$ Wind ASD reduction factor

$v_{w6} := 800 \cdot plf \cdot \frac{1}{\Omega_{D\_w}} = 400\ plf$ Allowable Shear Capacity- 10d's @ 6" oc

$\Omega_{D\_s} := 2.8$ Seismic ASD reduction factor

$v_{s6} := 800 \cdot plf \cdot \frac{1}{\Omega_{D\_s}} = 285.7\ plf$ Allowable Shear Capacity- 10d's @ 6" oc

Diaphragm

$V_{diaphT\_WL} := 0.6 \cdot R_{Tup\_B} = 3.93\ kip$ Wind diaphragm shear transverse direction

$V_{diaphL\_WL} := 0.6 \cdot R_{Lup\_2} = 2.83\ kip$ Wind diaphragm shear longitudinal direction

$V_{diaphT\_EL} := 0.7 \cdot R_{Tup\_B\_EL} = 4.54\ kip$ Seismic diaphragm shear transverse direction

$V_{diaphL\_EL} := 0.7 \cdot R_{Lup\_2\_EL} = 2.76\ kip$ Seismic diaphragm shear longitudinal direction

Longitudinal Diaphargm Shear

$v_{L\_w} := \frac{V_{diaphL\_WL}}{L_T} = 58.89\ plf$

$v_{L\_s} := \frac{V_{diaphL\_EL}}{L_T} = 57.59\ plf$

6" Nailing

$Check_w := \text{if } v_{L\_w} \le v_{w6} = \text{"OK"}$ "OK" else "NG!!"

$Check_s := \text{if } v_{L\_s} \le v_{s6} = \text{"OK"}$ "OK" else "NG!!"

Transverse Base Shear

$v_{T\_w} := \frac{V_{diaphT\_WL}}{L_L} = 81.88\ plf$

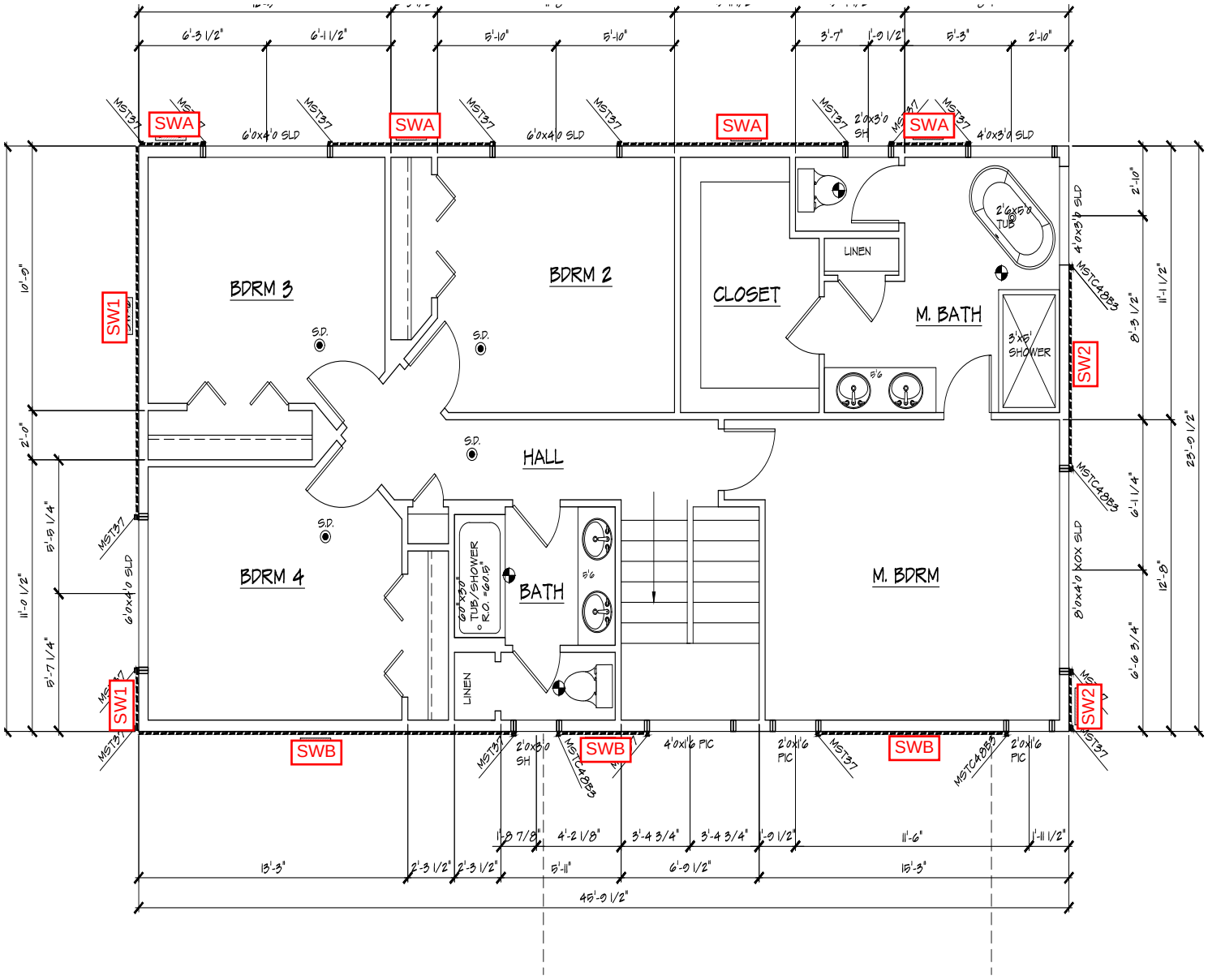
$v_{T\_s} := \frac{V_{diaphT\_EL}}{L_L} = 94.64\ plf$

6" Nailing

$Check_w := \text{if } v_{T\_w} \le v_{w6} = \text{"OK"}$ "OK" else "NG!!"

$Check_w := \text{if } v_{T\_s} \le v_{s6} = \text{"OK"}$ "OK" else "NG!!"

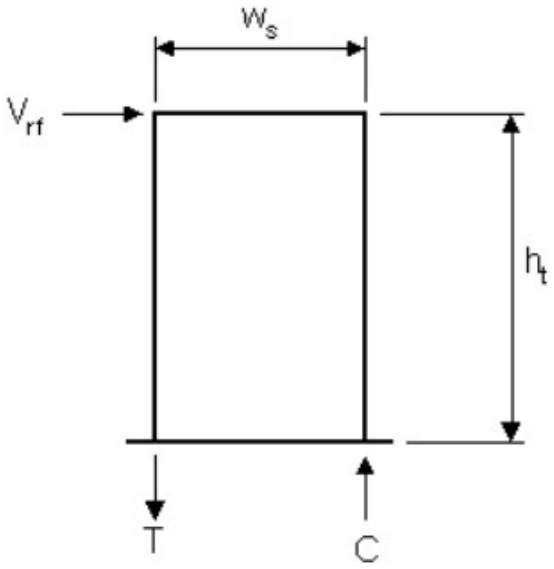
Use 15/32 APA Shtg w/ 10d nails @ 6"o.c. @ panel edges, 12" o.c. @ interior supports. Provide blocking @ panel edges.


BDRM 3
BDRM 2
CLOSET
LINEN
M. BATH
HALL
BDRM 4
BATH
LINEN
M. BDRM
SWA
SWB
SW1
SW2
S.D.
MST37
MSTC48B3
6'0x4'0 SLD
4'0x3'0 SLD
2'0x3'0 SH
2'0x8'0 SH
4'0x1'6 PIC
2'0x1'6 PIC
8'0x4'0 KOX SLD
2'6x5'6 TUB
3'x5' SHOWER
60"x30" TUB/SHOWER w/ R.O. "60B"
45'-0 1/2"

Upper Floor to Roof Analysis

Shear Wall Analysis - Upper Floor to Roof (ref. ANSI/AF+PA SDPWS -2021)

SW1 WIND IN - PLANE SHEAR



$h_t := 9\ ft$ — Wall height

$L_s := 15\ ft + 2.67\ ft$ — Total shear wall length

$SDL_{rf} = 12\ psf$ — Dead load of roof

$R := R_{Lrf\_1} = 3.13\ kip$ — Reaction at grid

$w_{rf} := \frac{2\ ft}{2} + 2\ ft = 3\ ft$ — Tributary width of roof on wall

$p_{ext} = 12\ psf$ — Dead load of exterior walls

$w_s := 2.67\ ft$ — Shear wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 3.3708$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ — Aspect ratio factor

$(WSP) = 0.8287$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s} \right) \cdot 0.6$ — Shear load at top of wall (ASD)

$0.28\ kip$

$M_{ot} := V_{rf} \cdot h_t$ — Overturning moment (ASD)

$M_{ot} = 2.56\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ — Roof load

$P_{rf} = 0.1\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ — Wall load

$P_w = 0.29\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2} \right) \cdot 0.6$ — Resisting moment (ASD)

$M_{res} = 0.31\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_w}} = 302.46\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 106.38\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.35 \qquad check_{wv} = \text{"OK"}$$

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness 16d Nail $sp_a := 6\ in$ Nail spacing

$Z_{ll} := 103\ lbf \cdot C_D = 0.165\ kip$ Allowable load parallel to grain (ref. NDS table 12N)

$V_{sp} := w_v \cdot sp_a = 0.0532\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.32 \qquad Check_a = \text{"OK"}$$

Use 16d Nails @ 6" o.c. staggered

Holdown

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.84\ kip \qquad check_T := \text{if } T > 0.15\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := MST37 = 2705\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{T}{T_{all}} = 0.3113 \qquad check_{HD} = \text{"OK"}$$

Use Simpson MST37 or MSTC48B3 between floors

SW1 SEISMIC IN - PLANE SHEAR

$h_t := h_t = 9\ ft$ Wall height

$L_s := L_s = 17.67\ ft$ Total shear wall length

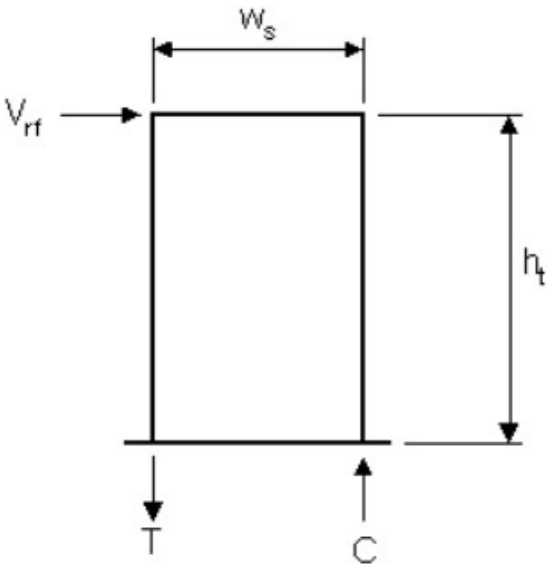
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Lrf\_1\_EL} = 2.37\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 3\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 2.67\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 3.3708$

$check_{ratio} := \text{if}\ \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if}\ \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor

$(WSP) = 0.8287$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.7$ Shear load at top of wall (ASD) $0.25\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 2.26\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 0.1\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load $P_w = 0.29\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.31\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} := 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_s}} = 216\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 93.86\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.43 \qquad check_{wv} = \text{"OK"}$$

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $16d$ Nail $sp_a := 6\ in$ Nail spacing

$Z_{ll} := 103\ lbf \cdot C_D = 0.165\ kip$ Allowable load parallel to grain (ref. NDS table 12N)

$V_{sp} := w_v \cdot sp_a = 0.0469\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.28 \qquad Check_a = \text{"OK"}$$

Use 16d Nails @ 6" o.c. staggered

Holdown

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.73\ kip \qquad check_T := \text{if } T > 0.150\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := MST37 = 2705\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{T}{T_{all}} = 0.2696 \qquad check_{HD} = \text{"OK"}$$

Use Simpson MST37

Holdown w/ Overstrength Factor

$\Omega_{hd} := \Omega_o - 0.5 = 2.5$ (ref. table 12.2-1, footnote'b')

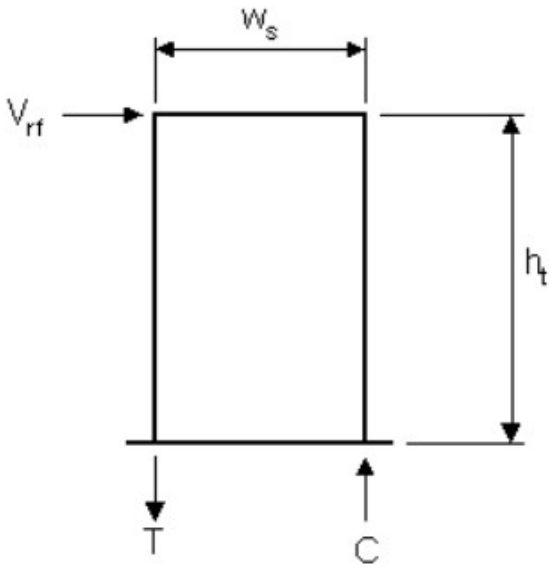
$$T := \frac{M_{ot} \cdot \Omega_{hd} - M_{res}}{w_s} = 2\ kip \qquad check_T := \text{if } T > 0.150\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := MSTC48B3 = 3975\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{T}{T_{all}} = 0.5022 \qquad check_{HD} = \text{"OK"}$$

Use Simpson MSTC48B3

SW2 WIND IN - PLANE SHEAR



$h_t := 9\ ft$ — Wall height

$L_s := 8.33\ ft + 2.67\ ft$ — Total shear wall length

$SDL_{rf} = 12\ psf$ — Dead load of roof

$R := R_{Lrf\_2} = 3.13\ kip$ — Reaction at grid

$w_{rf} := \frac{2\ ft}{2} + 2\ ft = 3\ ft$ — Tributary width of roof on wall

$p_{ext} = 12\ psf$ — Dead load of exterior walls

$w_s := 2.67\ ft$ — Shear wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 3.3708$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ — Aspect ratio factor

$(WSP) = 0.8287$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.6$ — Shear load at top of wall (ASD)

$0.46\ kip$

$M_{ot} := V_{rf} \cdot h_t$ — Overturning moment (ASD)

$M_{ot} = 4.11\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ — Roof load

$P_{rf} = 0.1\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ — Wall load

$P_w = 0.29\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ — Resisting moment (ASD)

$M_{res} = 0.31\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{4\_8d} \cdot n}{\Omega_{D\_w}} = 441.26\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 4" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 170.88\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.39 \qquad check_{wv} = \text{"OK"}$$

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness 16d Nail $sp_a := 6\ in$ Nail spacing

$Z_{ll} := 103\ lbf \cdot C_D = 0.165\ kip$ Allowable load parallel to grain (ref. NDS table 12N)

$V_{sp} := w_v \cdot sp_a = 0.0854\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.52 \qquad Check_a = \text{"OK"}$$

Use 16d Nails @ 6" o.c. staggered

Holdown

$$T := \frac{M_{ot} - M_{res}}{w_s} = 1.42\ kip \qquad check_T := \text{if } T > 0.15\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := MST37 = 2705\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{T}{T_{all}} = 0.5259 \qquad check_{HD} = \text{"OK"}$$

Use Simpson MST37

SW2 SEISMIC IN - PLANE SHEAR

$h_t := h_t = 9\ ft$ Wall height

$L_s := L_s = 11\ ft$ Total shear wall length

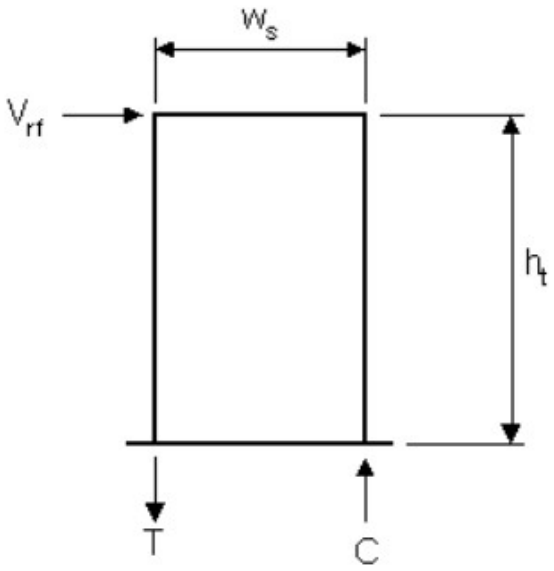
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Lrf\_2\_EL} = 2.37\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 3\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 2.67\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 3.3708$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor

$(WSP) = 0.8287$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.7$ Shear load at top of wall (ASD)

$0.4\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD)

$M_{ot} = 3.62\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load

$P_{rf} = 0.1\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load

$P_w = 0.29\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD)

$M_{res} = 0.31\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} := 2.8$ (ref. section 4.3.3) $n := 1$ sides

$w_{all} := \frac{(WSP) \cdot w_{4\_8d} \cdot n}{\Omega_{D\_s}} = 315.2\ plf$

Single Sided 7/16" Plywood/OSB w/ 8d @ 4" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$w_v := \frac{V_{rf}}{w_s} = 150.77\ plf$ $check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0$ "NG" else "OK" $ratio := \frac{w_v}{w_{all}} = 0.48$ $check_{wv} = \text{"OK"}$

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness 16d Nail $sp_a := 6\ in$ Nail spacing

$Z_{ll} := 103\ lbf \cdot C_D = 0.165\ kip$ Allowable load parallel to grain (ref. NDS table 12N)

$V_{sp} := w_v \cdot sp_a = 0.0754\ kip$ Shear load to each anchor

$Check_a := \text{if } V_{sp} > Z_{ll}$ "NG" else "OK" $ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.46$ $Check_a = \text{"OK"}$

Use 16d Nails @ 6" o.c. staggered

Holdown

$T := \frac{M_{ot} - M_{res}}{w_s} = 1.24\ kip$ $check_T := \text{if } T > 0.150\ kip$ "HD REQ'D" else "NOT REQ'D" $check_T = \text{"HD REQ'D"}$

$T_{all} := MST37 = 2705\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0$ "NG" else "OK" $ratio := \frac{T}{T_{all}} = 0.459$ $check_{HD} = \text{"OK"}$

Use Simpson MST37

Holdown w/ Overstrength Factor $\Omega_{hd} := \Omega_o - 0.5 = 2.5$ (ref. table 12.2-1, footnote'b')

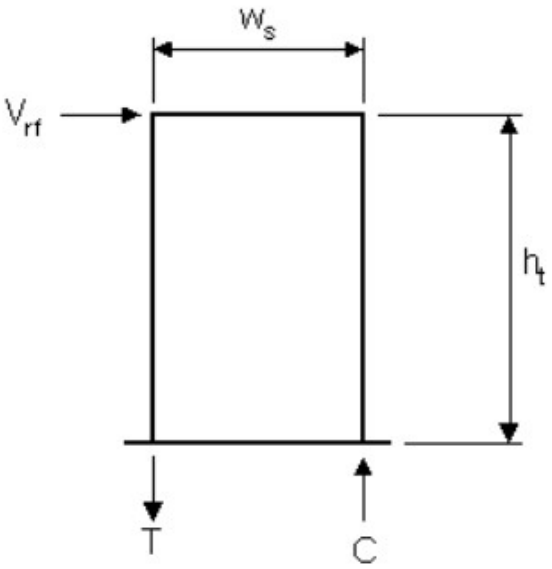
$T := \frac{M_{ot} \cdot \Omega_{hd} - M_{res}}{w_s} = 3.28\ kip$ $check_T := \text{if } T > 0.150\ kip$ "HD REQ'D" else "NOT REQ'D" $check_T = \text{"HD REQ'D"}$

$T_{all} := 2 \cdot MSTC48B3 = 7950\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0$ "NG" else "OK" $check_{HD} = \text{"OK"}$

Use Simpson (2)MSTC48B3

SWA WIND IN - PLANE SHEAR



$h_t := 9\ ft$ Wall height

$L_s := 2.75\ ft + 7.5\ ft + 10.5\ ft + 4\ ft$ Total shear wall length

$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Trf\_A} = 1.63\ kip$ Reaction at grid

$w_{rf} := \frac{24\ ft}{2} + 2\ ft = 14\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := 2.75\ ft$ Shear wall length

Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 3.2727$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor

$(WSP) = 0.8409$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.6$ Shear load at top of wall (ASD)

$0.11\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD)

$M_{ot} = 0.98\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load

$P_{rf} = 0.46\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load

$P_w = 0.3\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD)

$M_{res} = 0.63\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_w}} = 306.93\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 39.63\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.13 \qquad check_{wv} = \text{"OK"}$$

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness 16d Nail $sp_a := 6\ in$ Nail spacing

$Z_{ll} := 103\ lbf \cdot C_D = 0.165\ kip$ Allowable load parallel to grain (ref. NDS table 12N)

$V_{sp} := w_v \cdot sp_a = 0.0198\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.12 \qquad Check_a = \text{"OK"}$$

Use 16d Nails @ 6" o.c. staggered

Holdown

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.13\ kip \qquad check_T := \text{if } T > 0.15\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"NOT REQ'D"}$$

SWA SEISMIC IN - PLANE SHEAR

$h_t := h_t = 9\ ft$ Wall height

$L_s := L_s = 24.75\ ft$ Total shear wall length

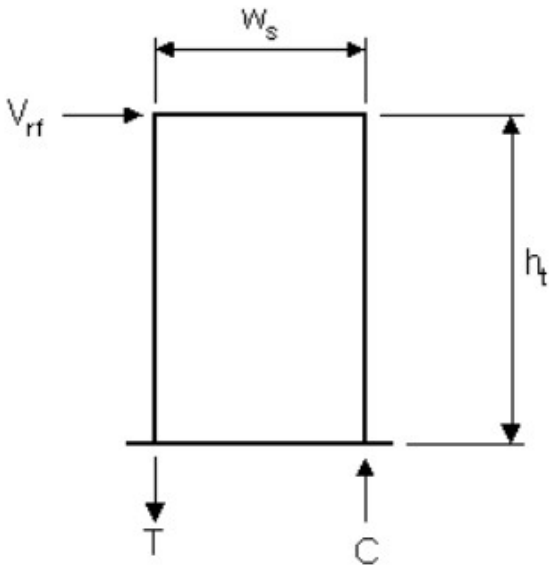
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Trf\_A\_EL} = 2.37\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 14\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 2.75\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 3.2727$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 0.8409$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.7$ Shear load at top of wall (ASD) $0.18\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 1.66\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 0.46\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load $P_w = 0.3\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 0.63\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} := 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_s}} = 219.2\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 67.01\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.31 \qquad check_{wv} = \text{"OK"}$$

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness 16d Nail $sp_a := 6\ in$ Nail spacing

$Z_{ll} := 103\ lbf \cdot C_D = 0.165\ kip$ Allowable load parallel to grain (ref. NDS table 12N)

$V_{sp} := w_v \cdot sp_a = 0.0335\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.2 \qquad Check_a = \text{"OK"}$$

Use 16d Nails @ 6" o.c. staggered

Holdown

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.38\ kip \qquad check_T := \text{if } T > 0.150\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := MST37 = 2705\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad check_{HD} = \text{"OK"}$$

Use Simpson MST37

Holdown w/ Overstrength Factor $\Omega_{hd} := \Omega_o - 0.5 = 2.5$ (ref. table 12.2-1, footnote'b')

$$T := \frac{M_{ot} \cdot \Omega_{hd} - M_{res}}{w_s} = 1.28\ kip \qquad check_T := \text{if } T > 0.150\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := MSTC48B3 = 3975\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad check_{HD} = \text{"OK"}$$

Use Simpson MSTC48B3

SWB WIND IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := 18.5\ ft + 4.75\ ft + 9.5\ ft$ Total shear wall length

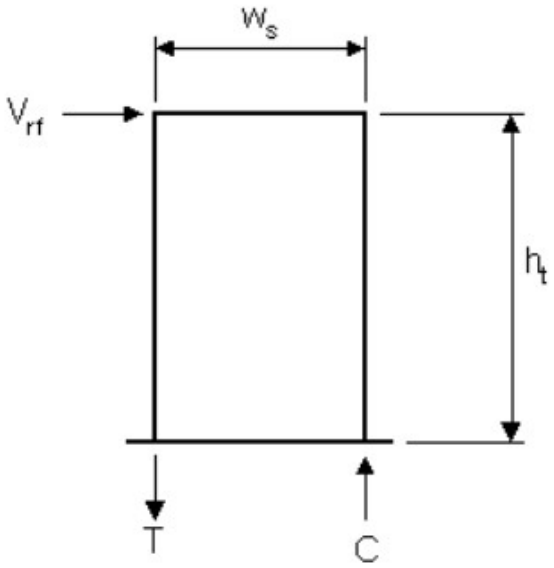
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Trf\_B} = 1.63\ kip$ Reaction at grid

$w_{rf} := \frac{24\ ft}{2} + 2\ ft = 14\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := 4.5\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.6$ Shear load at top of wall (ASD) $0.13\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 1.21\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 0.76\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load $P_w = 0.49\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 1.68\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_w}} = 365\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 29.95\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.08$$

$check_{wv} = \text{"OK"}$

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness 16d Nail $sp_a := 6\ in$ Nail spacing

$Z_{ll} := 103\ lbf \cdot C_D = 0.165\ kip$ Allowable load parallel to grain (ref. NDS table 12N)

$V_{sp} := w_v \cdot sp_a = 0.015\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.09$$

$Check_a = \text{"OK"}$

Use 16d Nails @ 6" o.c. staggered

Holdown

$$T := \frac{M_{ot} - M_{res}}{w_s} = -0.1\ kip \qquad check_T := \text{if } T > 0.15\ kip \text{ "HD REQ'D" else "NOT REQ'D"}$$

$check_T = \text{"NOT REQ'D"}$

SWB SEISMIC IN - PLANE SHEAR

$h_t := h_t = 9\ ft$ Wall height

$L_s := L_s = 32.75\ ft$ Total shear wall length

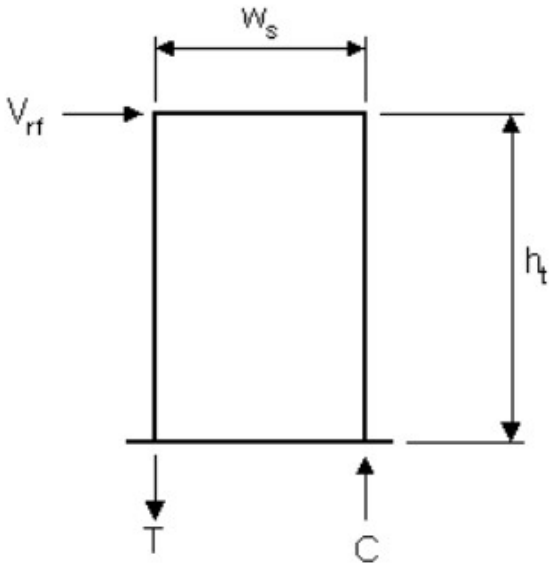
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Trf\_B\_EL} = 2.37\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 14\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 4.5\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor

$(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s} \right) \cdot 0.7$ Shear load at top of wall (ASD)

$0.23\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD)

$M_{ot} = 2.05\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load

$P_{rf} = 0.76\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load

$P_w = 0.49\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2} \right) \cdot 0.6$ Resisting moment (ASD)

$M_{res} = 1.68\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} := 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_s}} = 260.7\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 50.64\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.19 \qquad check_{wv} = \text{"OK"}$$

Bottom Plate Nailing $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $16d$ Nail $sp_a := 6\ in$ Nail spacing

$Z_{ll} := 103\ lbf \cdot C_D = 0.165\ kip$ Allowable load parallel to grain (ref. NDS table 12N)

$V_{sp} := w_v \cdot sp_a = 0.0253\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.15 \qquad Check_a = \text{"OK"}$$

Use 16d Nails @ 6" o.c. staggered

Holdown

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.08\ kip \qquad check_T := \text{if } T > 0.150\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"NOT REQ'D"}$$

$T_{all} := MST37 = 2705\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{T}{T_{all}} = 0.0307 \qquad check_{HD} = \text{"OK"}$$

Use Simpson MST37

Holdown w/ Overstrength Factor $\Omega_{hd} := \Omega_o - 0.5 = 2.5$ (ref. table 12.2-1, footnote'b')

$$T := \frac{M_{ot} \cdot \Omega_{hd} - M_{res}}{w_s} = 0.77\ kip \qquad check_T := \text{if } T > 0.150\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := MSTC48B3 = 3975\ lbf$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad check_{HD} = \text{"OK"}$$

Use Simpson MSTC48B3

Strap Ties

Straps are designed to transfer tension loads in a wide variety of applications.

HRS — Heavy strap designed for installation on the edge of 2x members. The HRS416Z installs with Strong-Drive® SDS Heavy-Duty Connector screws.

HTP — Heavy tie plate designed for installation on the side of 2x4 or larger members.

LSTA and MSTA — Designed for use on the edge of 2x members, with a nailing pattern that reduces the potential for splitting.

LSTI and MSTI — Light and medium straps that are suitable where pneumatic-nailing is necessary through diaphragm decking and wood chord open-web trusses.

MST — High-capacity strap that can be installed with either nails or bolts. Suitable for double 2x member connections or greater.

MSTC — High-capacity strap that utilizes a staggered nail pattern to help minimize wood splitting. Nail slots have been countersunk to provide a lower nail head profile.

Finish: Galvanized. Some products are available in stainless steel, ZMAX® coating or black powder coat (add PC to sku); contact Simpson Strong-Tie. See Corrosion Information, pp. 13–15.

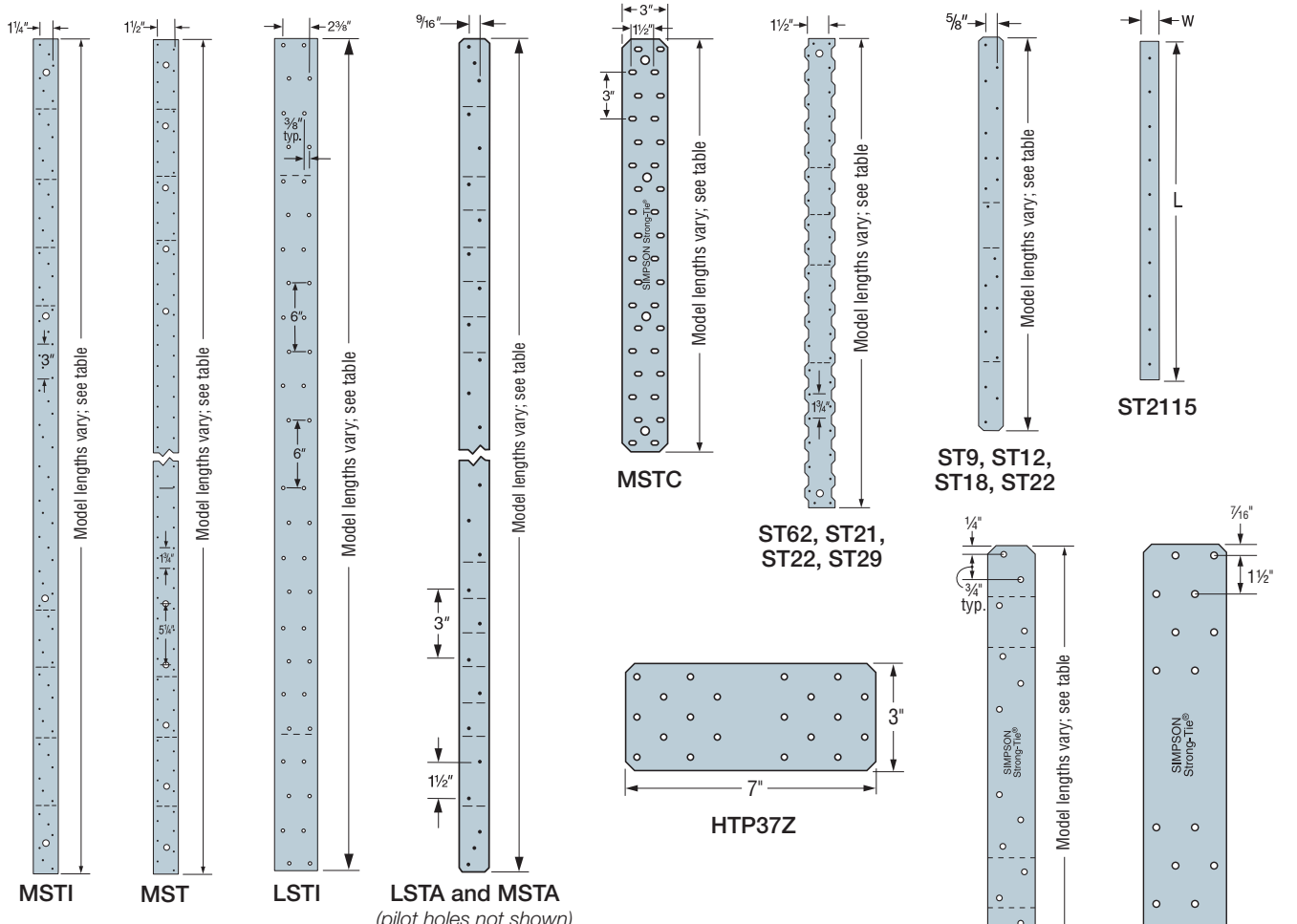
Installation: Use all specified fasteners; see General Notes

Options: Special sizes can be made to order; contact Simpson Strong-Tie

Codes: See p. 12 for Code Reference Key Chart

MSTC and RPS meet code requirements for reinforcing cut members (16 gauge) at top plate and RPS at sill plate. International Residential Code® — 2012/2015/2018 R602.6.1 International Building Code® — 2012/2015/2018 2308.9.8

(For RPS, refer to p. 303.)



Strap Ties (cont.)

Codes: See p. 12 for Code Reference Key Chart

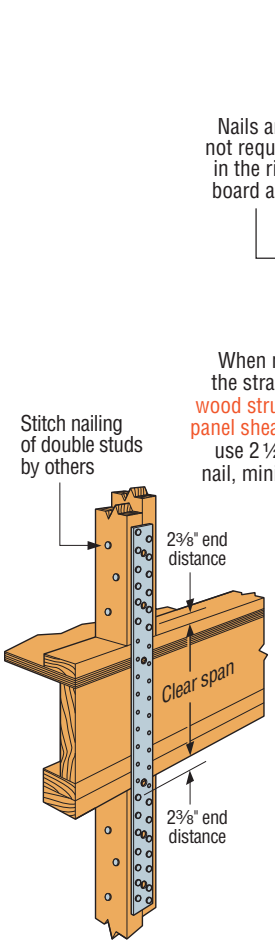
These products are available with additional corrosion protection. For more information, see p. 15.

SD Many of these products are approved for installation with Strong-Drive® SD Connector screws. See pp. 335–337 for more information.

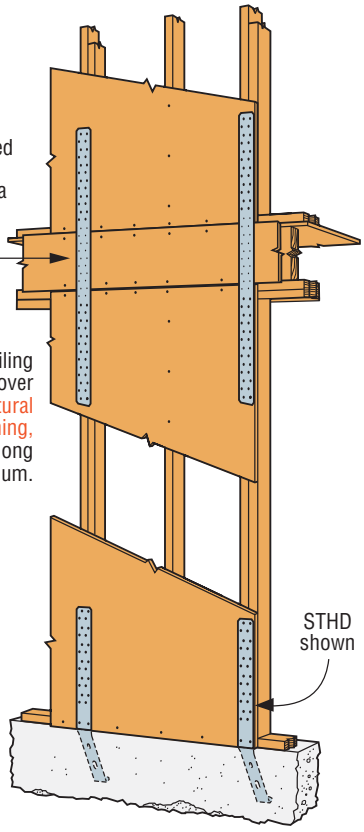
Floor to Floor Span Table

Model No.	Clear Span (in.)	Fasteners (Total) (in.)	Allowable Tension Loads (DF/SP) (160)	Allowable Tension Loads (SPF/HF) (160)
MSTA49	18	(26) 0.148 x 2½	2,020	2,020
	16	(26) 0.148 x 2½	2,020	2,020
MSTC28	18	(12) 0.148 x 3¼	1,150	995
	16	(16) 0.148 x 3¼	1,535	1,330
MSTC40	24	(20) 0.148 x 3¼	1,920	1,660
	18	(28) 0.148 x 3¼	2,690	2,325
	16	(32) 0.148 x 3¼	3,070	2,655
MSTC52	24	(36) 0.148 x 3¼	3,455	2,990
	18	(44) 0.148 x 3¼	4,225	3,650
	16	(48) 0.148 x 3¼	4,610	3,985
MSTC66	30	(48) 0.148 x 3¼	4,775	4,130
	24	(54) 0.148 x 3¼	5,375	4,645
	18	(64) 0.148 x 3¼	5,850	5,505
	16	(68) 0.148 x 3¼	5,850	5,850
MSTC78	30	(64) 0.148 x 3¼	5,850	5,505
	24	(72) 0.148 x 3¼	5,850	5,850
	18	(76) 0.148 x 3¼	5,850	5,850
MST37	24	(14) 0.162 x 2½	1,720	1,500
	18	(20) 0.162 x 2½	2,460	2,140
	16	(22) 0.162 x 2½	2,705	2,355
MST48	24	(26) 0.162 x 2½	3,210	2,780
	18	(32) 0.162 x 2½	3,950	3,425
	16	(34) 0.162 x 2½	4,200	3,640
MST60	30	(34) 0.162 x 2½	4,605	3,995
	24	(40) 0.162 x 2½	5,240	4,700
	18	(46) 0.162 x 2½	6,235	5,405
MST72	30	(48) 0.162 x 2½	6,505	5,640
	24	(54) 0.162 x 2½	6,730	6,345
	18	(62) 0.162 x 2½	6,730	6,475

See footnotes below.



Floor-to-Floor Tie Installation Showing a Clear Span



Typical Detail with Strap Installed over Wood Structural Panel Sheathing

Model No.	Ga.	Dimensions (in.) W	Dimensions (in.) L	Fasteners (Total) Nails (in.)	Fasteners (Total) Bolts Qty.	Fasteners (Total) Bolts Dia.	Allowable Tension Loads (DF/SP) Nails (160)	Allowable Tension Loads (DF/SP) Bolts (160)	Allowable Tension Loads (SPF/HF) Nails (160)	Allowable Tension Loads (SPF/HF) Bolts (160)	Code Ref.
MST27	12	2⅛	27	(30) 0.162 x 2½	4	½	3,700	2,165	3,210	2,000	IBC, FL, LA
MST37		2⅛	37½	(42) 0.162 x 2½	6	½	5,070	3,030	4,495	2,800	
MST48		2⅛	48	(50) 0.162 x 2½	8	½	5,310	3,675	5,190	3,395	
MST60	10	2⅛	60	(68) 0.162 x 2½	10	½	6,730	4,490	6,475	4,150	
MST72		2⅛	72	(68) 0.162 x 2½	10	½	6,730	4,490	6,475	4,150	

1. See pp. 260–261 for Straps and Ties General Notes.
2. Install bolts or nails as specified by Designer. Bolt and nail values may not be combined.
3. Allowable bolt loads are based on parallel-to-grain loading and minimum member thickness: MST – 2½".
4. Splitting may be a problem with installations on lumber smaller than 3½"; either fill every nail hole with 0.148" x 1½" nails or fill every other hole with 0.162" x 2½" nails. Reduce the allowable load based on the size and quantity of fasteners used.
5. **Fasteners:** Nail dimensions in the table are listed diameter by length. See pp. 21–22 for fastener information.

MSTC48B3/MSTC66B3Z

Pre-Bent Straps

The MSTC48B3 and MSTC66B3Z are pre-bent straps designed to transfer tension load from an upper-story shearwall to a beam on the story below.

Material: 14 gauge

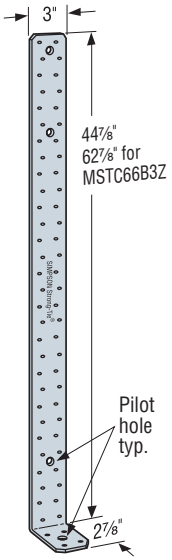
Finish: Galvanized; contact Simpson Strong-Tie

Codes: See p. 12 for Code Reference Key Chart

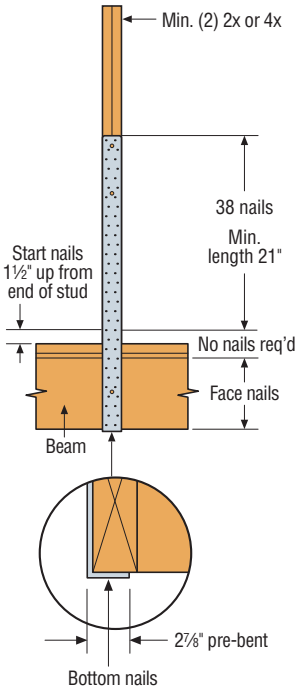
These products are available with additional corrosion protection. For more information, see p. 15.

Model No.	Min. Wood Beam Dimension (in.)		Fasteners (in.)			Allowable Tension Loads		Code Ref.
			Beam		Studs/ Post	DF/SP	SPF/HF	
	Width (min.)	Depth (min.)	Face	Bottom		(160)	(160)	
MSTC48B3	3	9¼	(12) 0.148 x 3	(4) 0.148 x 3	(38) 0.148 x 3	3,975	3,900	IBC, FL, LA
MSTC66B3Z	3½	11¼	(14) 0.148 x 3			4,490	4,490	

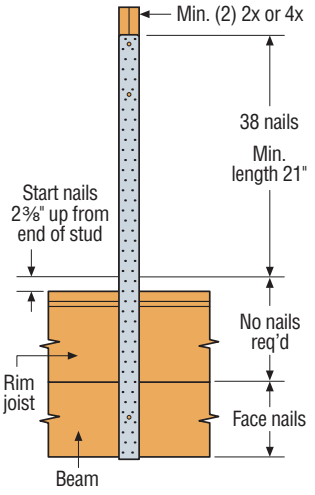
1. Using fewer than 38 nails in the studs/post will reduce the allowable load of the connection. To calculate a reduced allowable load, use 199 lb. per nail for DF/SP or 172 lb. per nail for HF/SPF. Minimum length of extent of reduced nails may not be less than 21" as is shown in graphic.
2. Nails in studs/post shall be installed symmetrically. Nails may be installed over the entire length of the strap in the studs/post.
3. The minimum 3"-wide beam may be made up of two 2x members.
4. MSTC48B3 and MSTC66B3Z installed over wood structural panel sheathing up to ½" thick achieve 0.85 of table loads.
5. PSL beam may be used in lieu of a standard-dimension lumber beam with no load reductions.
6. Multiply allowable loads by 1.85 to attain an allowable load for installations where two straps have been installed with a 1½" clear space between straps.
7. Structural composite lumber columns have sides that show either the wide face or the edges of the lumber strands/veneers known as the narrow face. Values in the tables reflect installation into the wide face. See technical bulletin T-C-SCLCLM at **strongtie.com** for load reductions resulting from narrow-face installations.
8. **Fasteners:** Nail dimensions in the table are listed diameter by length. See pp. 21–22 for fastener information.



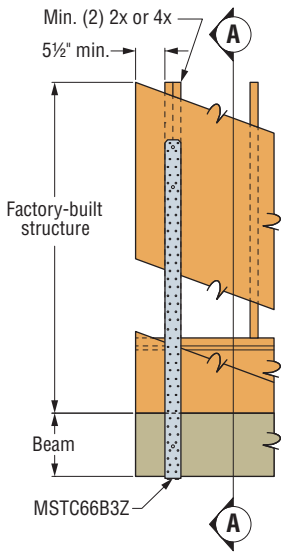
MSTC48B3



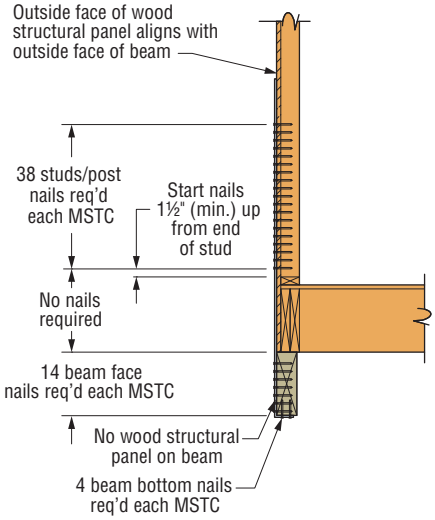
MSTC48B3 Installation with No Rim Board



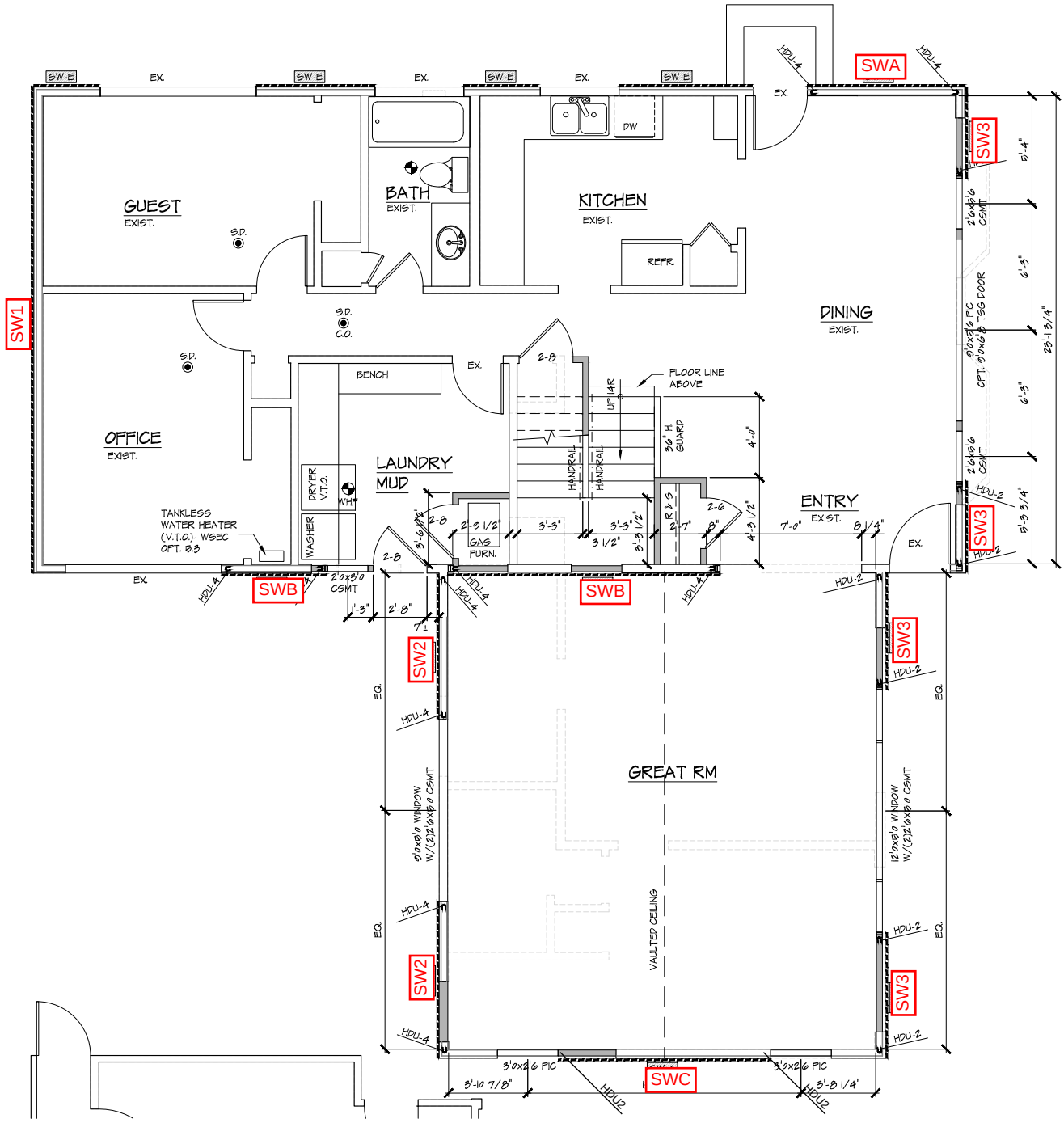
MSTC66B3Z Installation with Rim Board



(2) MSTC66B3Z Installation



Section A-A



NKH ENGINEERING

PROJECT: Rankin Addition

DESCRIPTION: Main Floor Shearwall Keyplan

BY: AKR NKH Engineering DATE: 11/5/2024 JOB #: 24-123 S31/57

Main to Upper FLoor Analysis

Shear Wall Analysis - Main Upper Floor (ref. ANSI/AF+PA SDPWS -2021)

SW1 WIND IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := 24\ ft$ Total shear wall length

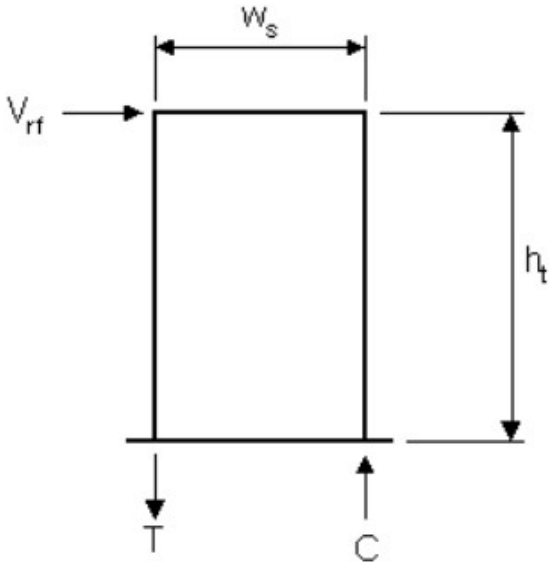
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Lup\_1} = 5.18\ kip$ Reaction at grid

$w_{rf} := \frac{2\ ft + 1.33\ ft}{2} + 2\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := 24\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.375$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.6$ Shear load at top of wall (ASD) 3.11 kip

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 27.98\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 1.06\ kip$

$P_w := p_{ext} \cdot (2 \cdot h_t) \cdot w_s$ Wall load $P_w = 5.18\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 44.92\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP)\cdot(w_{hsl} + w_{gyp})\cdot n}{\Omega_{D\_w}} = 195\ plf$$ **Horizontal Ship Lap Exterior w/ Gyp Interior (SDPWS Table 4.3C + D)**

$$w_v := \frac{V_{rf}}{w_s} = 129.53\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.66 \qquad check_{wv} = \text{"OK"}$$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $dia_a := 0.625\ in$ Anchor dia $sp_a := 48\ in$ Anchor spacing

$Z_{ll} := v_{A.5\_2x} \cdot C_D = 1.04\ kip$ Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.5181\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.4982 \qquad Check_a = \text{"OK"}$$

Existing 1/2" Dia. Anchor @ 48" o.c. OK

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = -0.7061\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"NOT REQ'D"}$$

SW1 SEISMIC IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := L_s = 24\ ft$ Total shear wall length

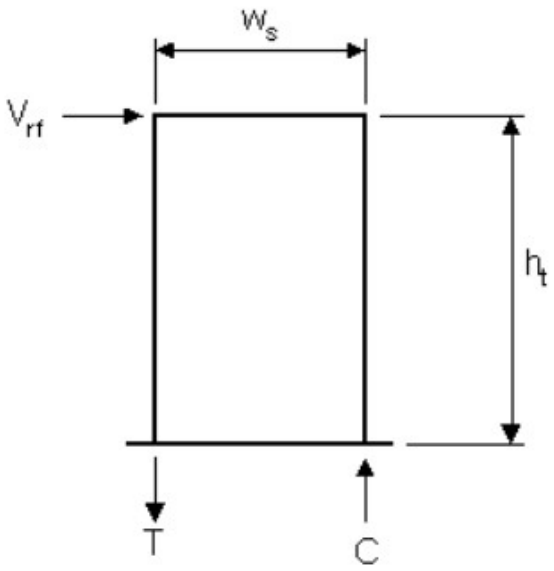
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Lup\_1\_EL} = 4.09\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 3.665\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 24\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.375$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.7$ Shear load at top of wall (ASD) $2.86\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 25.74\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 1.06\ kip$

$P_w := p_{ext} \cdot (2 \cdot h_t) \cdot w_s$ Wall load $P_w = 5.18\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 44.92\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} = 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP)\cdot\left(w_{hsl} + w_{gyp}\right)\cdot n}{\Omega_{D\_s}} = 139.29\ plf$$ **Horizontal Ship Lap Exterior w/ Gyp Interior (SDPWS Table 4.3C + D)**

$$w_v := \frac{V_{rf}}{w_s} = 119.18\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.10 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.86 \qquad check_{wv} = \text{"OK"}$$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $dia_a := 0.625\ in$ Anchor dia $sp_a := 48\ in$ Anchor spacing

$Z_{ll} := v_{A.5\_2x} \cdot C_D = 1.04\ kip$ Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.4767\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.4584 \qquad Check_a = \text{"OK"}$$

Existing 1/2" Dia. Anchor @ 48" o.c. OK

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = -0.7992\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"NOT REQ'D"}$$

SW2 WIND IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := 7.25\ ft + 7.25\ ft$ Total shear wall length

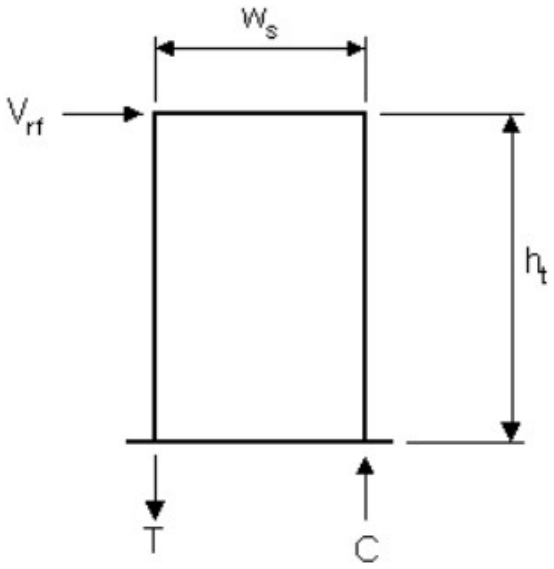
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Lup\_2} = 4.71\ kip$ Reaction at grid

$w_{rf} := \frac{22\ ft}{2} + 2\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := 7.25\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.2414$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$
"NG"
else
"OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$
1.0
else
$1.25 - 0.125 \cdot \frac{h_t}{w_s}$

Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.6$ Shear load at top of wall (ASD) $1.41\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 12.72\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 1.13\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load $P_w = 0.78\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 4.16\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{4\_8d} \cdot n}{\Omega_{D\_w}} = 532.5\ plf$$

Double Sided 7/16" Plywood/OSB w/ 8d @ 4" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 194.95\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.37 \qquad check_{wv} = \text{"OK"}$$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5$ in Sill plate thickness $dia_a := 0.625$ in Anchor dia $sp_a := 32$ in Anchor spacing

$Z_{ll} := 930\ lbf \cdot C_D = 1.488$ kip Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.5199$ kip Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.3494 \qquad Check_a = \text{"OK"}$$

Use 5/8" Dia. Anchor @ 32" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 1.1804 \text{ kip} \qquad check_T := \text{if } T > 0.25 \text{ kip "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := HDU4 \cdot \Omega_{HD\_ecc} = 4.2$ kip Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad check_{HD} = \text{"OK"}$$

Use Simpson HDU4 w/ 5/8" Dia anchor (12" embed into footing)

SW2 SEISMIC IN - PLANE SHEAR

$h_t := 10\ ft$ Wall height

$L_s := L_s = 14.5\ ft$ Total shear wall length

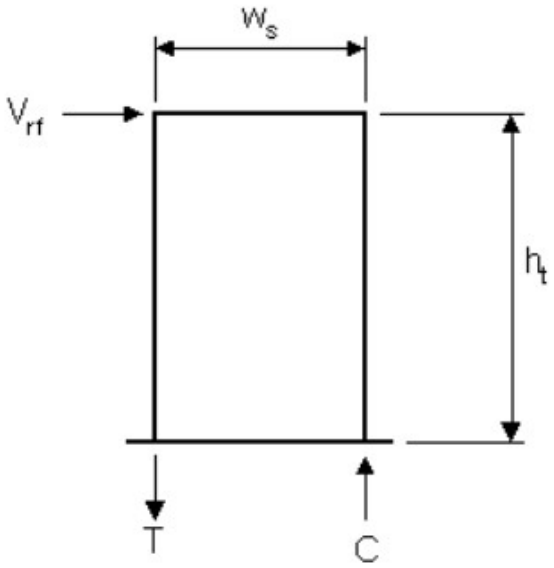
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Lup\_2\_EL} = 3.95\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 13\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 7.25\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.3793$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.7$ Shear load at top of wall (ASD) $1.38\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 13.82\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 1.13\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load $P_w = 0.87\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 4.35\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} := 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{4\_8d} \cdot n}{\Omega_{D\_s}} = 380.36\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 3" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 190.64\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.50$$

$check_{wv} = \text{"OK"}$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $dia_a := 0.625\ in$ Anchor dia $sp_a := 32\ in$ Anchor spacing

$Z_{ll} := 930\ lbf \cdot C_D = 1.488\ kip$ Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.5084\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.3417$$

$Check_a = \text{"OK"}$

Use 5/8" Dia. Anchor @ 32" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 1.3061\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"}$$

$check_T = \text{"HD REQ'D"}$

$T_{all} := HDU4 \cdot \Omega_{HD\_ecc} = 4.2\ kip$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"}$$

$check_{HD} = \text{"OK"}$

Use Simpson HDU4 w/ 5/8" Dia anchor (12" embed into footing)

SW3 WIND IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := 4.5\ ft \cdot 2 + 5.5\ ft + 6\ ft$ Total shear wall length

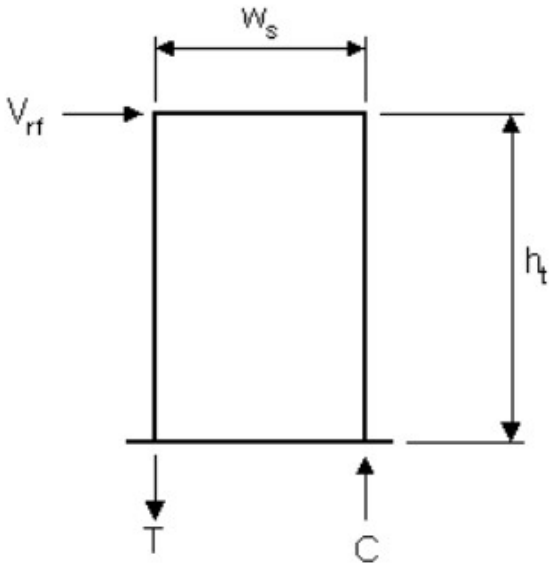
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Lup\_3} = 5.18\ kip$ Reaction at grid

$w_{rf} := \frac{2\ ft + 1.33\ ft}{2} + 2\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := 4.5\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.6$ Shear load at top of wall (ASD) $0.68\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 6.14\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 0.2\ kip$

$P_w := p_{ext} \cdot (2 \cdot h_t) \cdot w_s$ Wall load $P_w = 0.97\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 1.58\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_w}} = 365\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 151.65\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.02 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.42$$

$check_{wv} = \text{"OK"}$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $dia_a := 0.625\ in$ Anchor dia $sp_a := 48\ in$ Anchor spacing

$Z_{ll} := 930\ lbf \cdot C_D = 1.488\ kip$ Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.6066\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.4077$$

$Check_a = \text{"OK"}$

Use 5/8" Dia. Anchor @ 48" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 1.0139\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"}$$

$check_T = \text{"HD REQ'D"}$

$T_{all} := HDU2 \cdot \Omega_{HD\_ecc} = 2.83\ kip$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"}$$

$check_{HD} = \text{"OK"}$

Use Simpson HDU2 w/ 5/8" Dia anchor (10" embed into footing)

SW3 SEISMIC IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := L_s = 20.5\ ft$ Total shear wall length

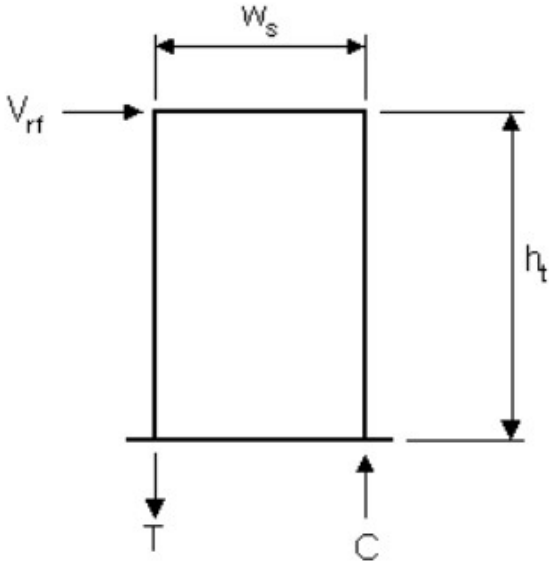
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Lup\_3\_EL} = 4.09\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 3.665\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 4.5\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 2$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s} \right) \cdot 0.7$ Shear load at top of wall (ASD) $0.63\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 5.65\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 0.2\ kip$

$P_w := p_{ext} \cdot (2 \cdot h_t) \cdot w_s$ Wall load $P_w = 0.97\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2} \right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 1.58\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} = 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_s}} = 260.71\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 139.53\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.54 \qquad check_{wv} = \text{"OK"}$$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $dia_a := 0.625\ in$ Anchor dia $sp_a := 48\ in$ Anchor spacing

$Z_{ll} := 930\ lbf \cdot C_D = 1.488\ kip$ Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.5581\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.3751 \qquad Check_a = \text{"OK"}$$

Use 5/8" Dia. Anchor @ 48" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.9048\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := HDU2 \cdot \Omega_{HD\_ecc} = 2.83\ kip$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad check_{HD} = \text{"OK"}$$

Use Simpson HDU2 w/ 5/8" Dia anchor (10" embed into footing)

SWA WIND IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := 7.75\ ft + (3.33\ ft \cdot 2 + 6\ ft \cdot 2) \cdot 50\ \%$ Total shear wall length

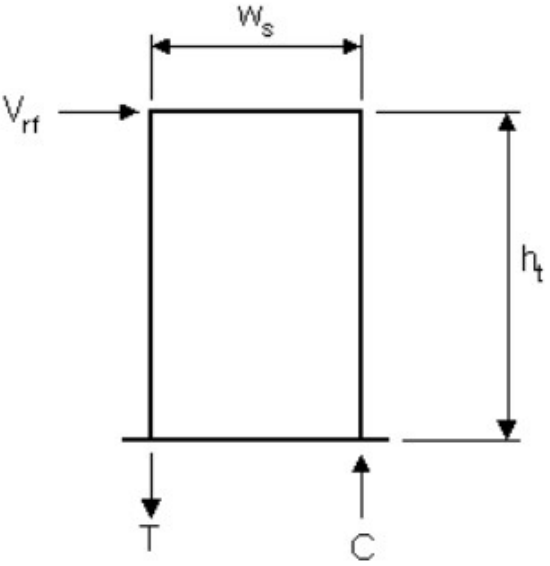
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Tup\_A} = 4.09\ kip$ Reaction at grid

$w_{rf} := \frac{24\ ft + 24\ ft}{2} + 2\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := 7.75\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.1613$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s} \right) \cdot 0.6$ Shear load at top of wall (ASD) $1.11\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 10.03\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 2.42\ kip$

$P_w := p_{ext} \cdot (2 \cdot h_t) \cdot w_s$ Wall load $P_w = 1.67\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2} \right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 9.51\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} = 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{4\_8d} \cdot n}{\Omega_{D\_w}} = 532.5\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 4" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 143.77\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.27 \qquad check_{wv} = \text{"OK"}$$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5$ in Sill plate thickness $dia_a := 0.625$ in Anchor dia $sp_a := 32$ in Anchor spacing

$Z_{ll} := 930$ lbf $\cdot C_D = 1.488$ kip Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.3834$ kip Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.2577 \qquad Check_a = \text{"OK"}$$

Use 5/8" Dia. Anchor @ 32" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.0663\ kip \qquad check_T := \text{if } T > 0.25 \text{ kip "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"NOT REQ'D"}$$

$T_{all} := HDU4 \cdot \Omega_{HD\_ecc} = 4.2$ kip Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad check_{HD} = \text{"OK"}$$

Use Simpson HDU4 w/ 5/8" Dia anchor (12" embed into footing)

SWA SEISMIC IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := L_s = 17.08\ ft$ Total shear wall length

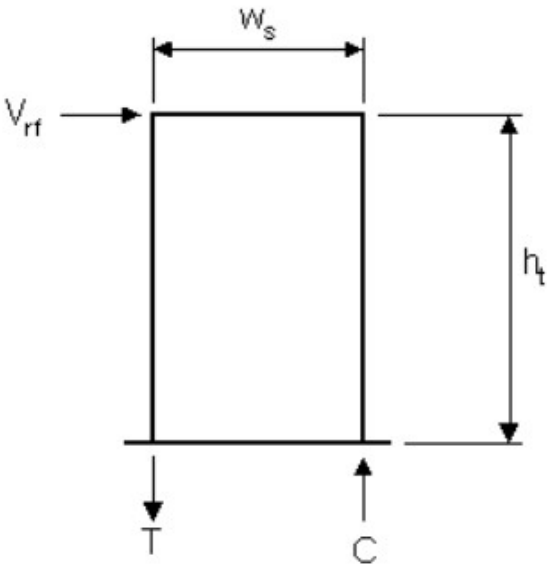
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Tup\_A\_EL} = 4.43\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 26\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 7.75\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.1613$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor

$(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.7$ Shear load at top of wall (ASD) $1.41\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD)

$M_{ot} = 12.66\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 2.42\ kip$

$P_w := p_{ext} \cdot (2 \cdot h_t) \cdot w_s$ Wall load $P_w = 1.67\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD)

$M_{res} = 9.51\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} := 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{4\_8d} \cdot n}{\Omega_{D\_s}} = 380.36\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 4" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 181.54\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.48$$

$check_{wv} = \text{"OK"}$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $dia_a := 0.625\ in$ Anchor dia $sp_a := 32\ in$ Anchor spacing

$Z_{ll} := 930\ lbf \cdot C_D = 1.488\ kip$ Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.4841\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.3253$$

$Check_a = \text{"OK"}$

Use 5/8" Dia. Anchor @ 32" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.4063\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"}$$

$check_T = \text{"HD REQ'D"}$

$T_{all} := HDU4 \cdot \Omega_{HD\_ecc} = 4.2\ kip$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"}$$

$check_{HD} = \text{"OK"}$

Use Simpson HDU4 w/ 5/8" Dia anchor (12" embed into footing)

SWB WIND IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := 5.25\ ft + 13.5\ ft$ Total shear wall length

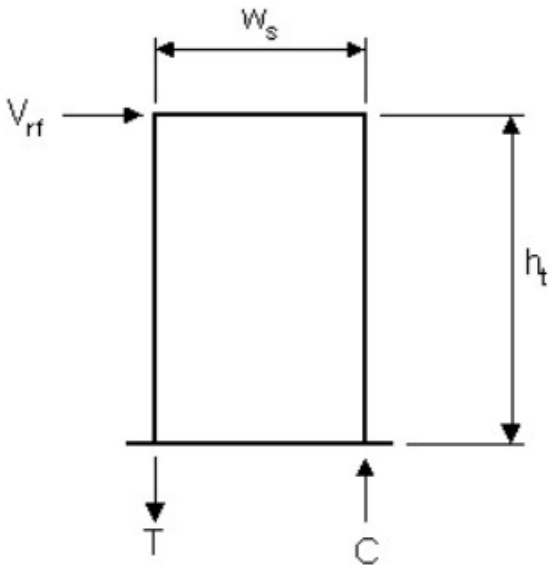
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Tup\_B} = 6.55\ kip$ Reaction at grid

$w_{rf} := \frac{24\ ft + 24\ ft}{2} + 2\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := 5.25\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.7143$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$
$\quad "NG"$
$\quad \text{else}$
$\quad "OK"$

$check_{ratio} = "OK"$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$
$\quad 1.0$
$\quad \text{else}$
$\quad 1.25 - 0.125 \cdot \frac{h_t}{w_s}$

Aspect ratio factor

$(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s} \right) \cdot 0.6$ Shear load at top of wall (ASD) $1.1\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 9.9\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 1.64\ kip$

$P_w := p_{ext} \cdot (2 \cdot h_t) \cdot w_s$ Wall load $P_w = 1.13\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2} \right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 4.37\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{4\_8d} \cdot n}{\Omega_{D\_w}} = 532.5\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 4" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 209.62\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.39 \qquad check_{wv} = \text{"OK"}$$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5$ in Sill plate thickness $dia_a := 0.625$ in Anchor dia $sp_a := 32$ in Anchor spacing

$Z_{ll} := 930\ lbf \cdot C_D = 1.488$ kip Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.559$ kip Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.3757 \qquad Check_a = \text{"OK"}$$

Use 5/8" Dia. Anchor @ 32" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 1.055 \text{ kip} \qquad check_T := \text{if } T > 0.25 \text{ kip "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := HDU4 \cdot \Omega_{HD\_ecc} = 4.2$ kip Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad check_{HD} = \text{"OK"}$$

Use Simpson HDU4 w/ 5/8" Dia anchor (12" embed into footing)

SWB SEISMIC IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := L_s = 18.75\ ft$ Total shear wall length

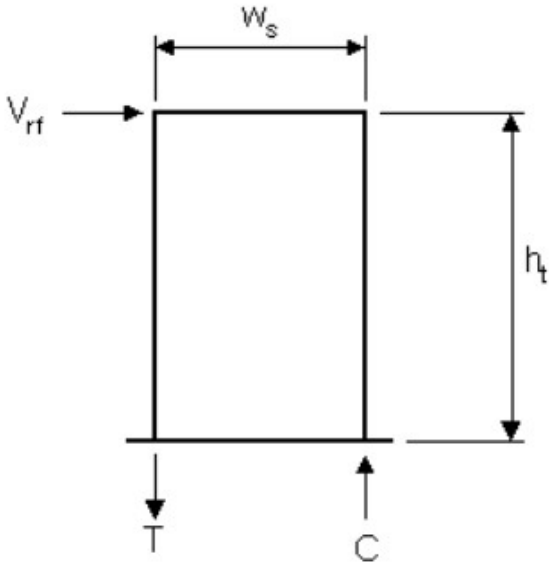
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Tup\_B\_EL} = 6.49\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 26\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 5.25\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 1.7143$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s} \right) \cdot 0.7$ Shear load at top of wall (ASD) $1.27\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 11.45\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 1.64\ kip$

$P_w := p_{ext} \cdot (2 \cdot h_t) \cdot w_s$ Wall load $P_w = 1.13\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2} \right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 4.37\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} := 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{4\_8d} \cdot n}{\Omega_{D\_s}} = 380.36\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 4" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 242.29\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.64 \qquad check_{wv} = \text{"OK"}$$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5$ in Sill plate thickness $dia_a := 0.625$ in Anchor dia $sp_a := 32$ in Anchor spacing

$Z_{ll} := 930$ lbf $\cdot C_D = 1.488$ kip Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.6461$ kip Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.4342 \qquad Check_a = \text{"OK"}$$

Use 5/8" Dia. Anchor @ 32" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 1.349\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"} \qquad check_T = \text{"HD REQ'D"}$$

$T_{all} := HDU4 \cdot \Omega_{HD\_ecc} = 4.2$ kip Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"} \qquad check_{HD} = \text{"OK"}$$

Use Simpson HDU4 w/ 5/8" Dia anchor (12" embed into footing)

SWC WIND IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := 10.5\ ft$ Total shear wall length

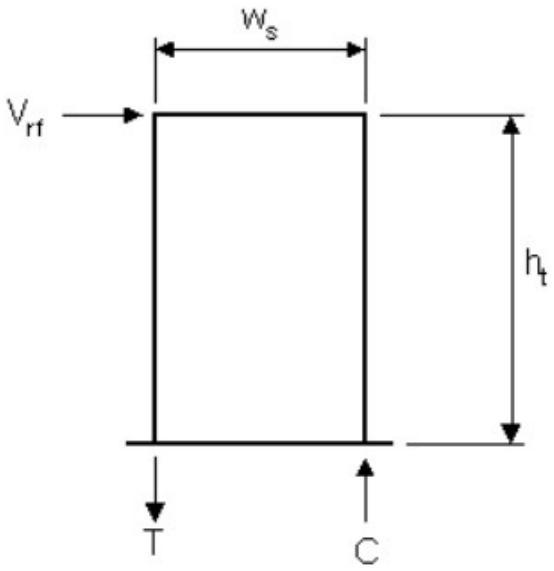
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Tup\_C} = 2.46\ kip$ Reaction at grid

$w_{rf} := \frac{2\ ft}{2} + 2\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := 10.5\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.8571$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$
"NG"
else
"OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$
1.0
else
$1.25 - 0.125 \cdot \frac{h_t}{w_s}$

Aspect ratio factor

$(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.6$ Shear load at top of wall (ASD) $1.47\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 13.27\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 0.38\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load $P_w = 1.13\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 4.76\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_w} := 2.0$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_w}} = 365\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 140.46\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.38$$

$check_{wv} = \text{"OK"}$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $dia_a := 0.625\ in$ Anchor dia $sp_a := 48\ in$ Anchor spacing

$Z_{ll} := 930\ lbf \cdot C_D = 1.488\ kip$ Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.5619\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.3776$$

$Check_a = \text{"OK"}$

Use 5/8" Dia. Anchor @ 48" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.8106\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"}$$

$check_T = \text{"HD REQ'D"}$

$T_{all} := HDU2 \cdot \Omega_{HD\_ecc} = 2.83\ kip$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"}$$

$check_{HD} = \text{"OK"}$

Use Simpson HDU2 w/ 5/8" Dia anchor (10" embed into footing)

SWC SEISMIC IN - PLANE SHEAR

$h_t := 9\ ft$ Wall height

$L_s := L_s = 10.5\ ft$ Total shear wall length

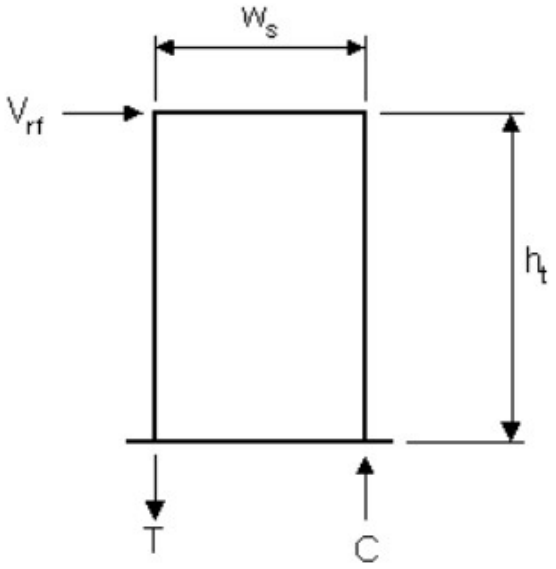
$SDL_{rf} = 12\ psf$ Dead load of roof

$R := R_{Tup\_C\_EL} = 2.06\ kip$ Reaction at grid

$w_{rf} := w_{rf} = 3\ ft$ Tributary width of roof on wall

$p_{ext} = 12\ psf$ Dead load of exterior walls

$w_s := w_s = 10.5\ ft$ Shear wall length



Aspect Ratio (Blocked Shear Wall)

$\frac{h_t}{w_s} = 0.8571$

$check_{ratio} := \text{if } \frac{h_t}{w_s} > 3.5$ "NG" else "OK"

$check_{ratio} = \text{"OK"}$

$(WSP) := \text{if } \frac{h_t}{w_s} < 2.0$ 1.0 else $1.25 - 0.125 \cdot \frac{h_t}{w_s}$ Aspect ratio factor $(WSP) = 1$

Overturning Forces

$V_{rf} := \left(R \cdot \frac{w_s}{L_s}\right) \cdot 0.7$ Shear load at top of wall (ASD) $1.44\ kip$

$M_{ot} := V_{rf} \cdot h_t$ Overturning moment (ASD) $M_{ot} = 12.98\ kip\ ft$

Resisting Forces

$P_{rf} := SDL_{rf} \cdot w_{rf} \cdot w_s$ Roof load $P_{rf} = 0.38\ kip$

$P_w := p_{ext} \cdot (h_t) \cdot w_s$ Wall load $P_w = 1.13\ kip$

$M_{res} := \left((P_{rf} + P_w) \cdot \frac{w_s}{2}\right) \cdot 0.6$ Resisting moment (ASD) $M_{res} = 4.76\ kip\ ft$

Plywood Shear (ref. ANSI/AF+PA SDPWS) $\Omega_{D\_s} = 2.8$ (ref. section 4.3.3) $n := 1$ sides

$$w_{all} := \frac{(WSP) \cdot w_{6\_8d} \cdot n}{\Omega_{D\_s}} = 260.71\ plf$$

Single Sided 7/16" Plywood/OSB w/ 8d @ 6" O.C. Panel Edges @ 12" O.C. Interior Supports (ref. table 4.3A, 15/32 values)

$$w_v := \frac{V_{rf}}{w_s} = 137.36\ plf \qquad check_{wv} := \text{if } \frac{w_v}{w_{all}} > 1.0 \text{ "NG" else "OK"} \qquad ratio := \frac{w_v}{w_{all}} = 0.53$$

$check_{wv} = \text{"OK"}$

Sill Plate Anchorage $C_D := 1.6$

$t_{sp} := 1.5\ in$ Sill plate thickness $dia_a := 0.625\ in$ Anchor dia $sp_a := 48\ in$ Anchor spacing

$Z_{ll} := 930\ lbf \cdot C_D = 1.488\ kip$ Allowable load parallel to grain (ref. NDS table 12E)

$V_{sp} := w_v \cdot sp_a = 0.5494\ kip$ Shear load to each anchor

$$Check_a := \text{if } V_{sp} > Z_{ll} \text{ "NG" else "OK"} \qquad ratio_a := \frac{V_{sp}}{Z_{ll}} = 0.3692$$

$Check_a = \text{"OK"}$

Use 5/8" Dia. Anchor @ 48" o.c. (6" min. embed)

Holdown $\Omega_{HD\_ecc} := 0.92$ HD eccentricity reduction factor (Table 4.3A, footnote 10)

$$T := \frac{M_{ot} - M_{res}}{w_s} = 0.7826\ kip \qquad check_T := \text{if } T > 0.25\ kip \text{ "HD REQ'D" else "NOT REQ'D"}$$

$check_T = \text{"HD REQ'D"}$

$T_{all} := HDU2 \cdot \Omega_{HD\_ecc} = 2.83\ kip$ Allowable tension load (ref. Simpson Load Tables)

$$check_{HD} := \text{if } \frac{T}{T_{all}} > 1.0 \text{ "NG" else "OK"}$$

$check_{HD} = \text{"OK"}$

Use Simpson HDU2 w/ 5/8" Dia anchor (10" embed into footing)

HDU/DTT

Holdowns

This product is preferable to similar connectors because of (a) easier installation, (b) higher loads, (c) lower installed cost, or a combination of these features.

HDU holdowns are pre-deflected during the manufacturing process, virtually eliminating deflection under load due to material stretch. They use Strong-Drive® SDS Heavy-Duty Connector screws which install easily, reduce fastener slip and provide a greater net section when compared to bolts.

The DTT tension ties are designed for lighter-duty holdown applications on single 2x posts. The DTT1Z is installed with nails or Strong-Drive SD Connector screws and the DTT2Z installs easily with the Strong-Drive SDS Heavy-Duty Connector screws (included). The DTT1Z holdowns have been tested for use in designed shearwalls and prescriptive braced wall panels as well as prescriptive wood-deck applications (see p. 289 for deck applications).

For more information on holdown options, contact Simpson Strong-Tie.

HDU Features:

- Uses Strong-Drive SDS Heavy-Duty Connector screws which install easily, reduce fastener slip and provide a greater net section area of the post compared to bolts
- Strong-Drive SDS Heavy-Duty Connector screws are supplied with the holdowns to ensure proper fasteners are used
- No stud bolts to countersink at openings

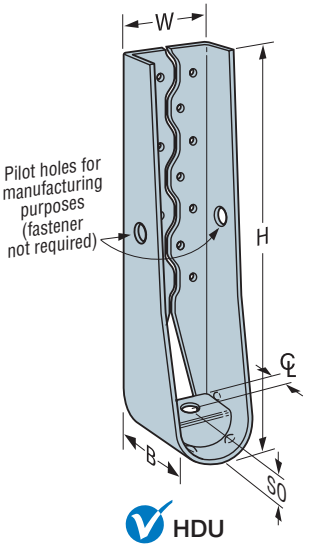
Material: See table

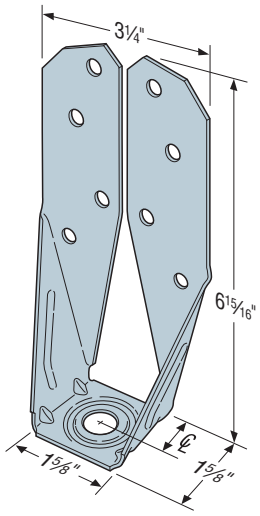
Finish: HDU — galvanized; DTT1Z and DTT2Z — ZMAX® coating; DTT2SS — stainless steel

Installation:

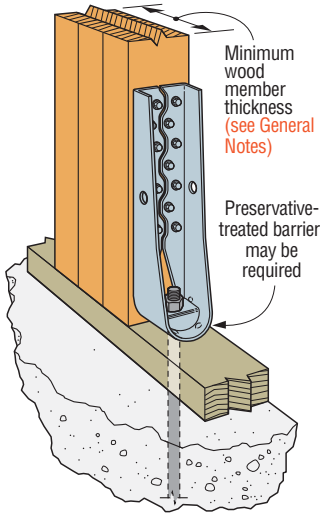
- See Holdown and Tension Tie General Notes on pp. 49–50.
- The HDU requires no additional washer; the DTT requires a standard-cut washer (included with DTT2Z) be installed between the nut and the seat.
- Strong-Drive SDS Heavy-Duty Connector screws install best with a low-speed high-torque drill with a ⅜" hex-head driver.
- Fasteners and crescent washer are included with the holdowns. For replacements, order part no. SDS25212-HDU_. (Fill in the size needed, e.g. HDU2.)

Codes: See p. 12 for Code Reference Key Chart

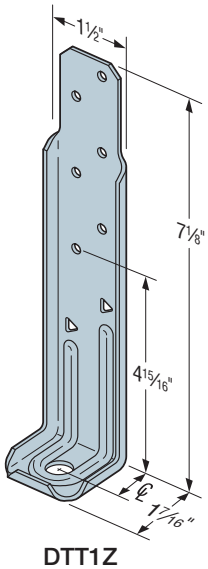




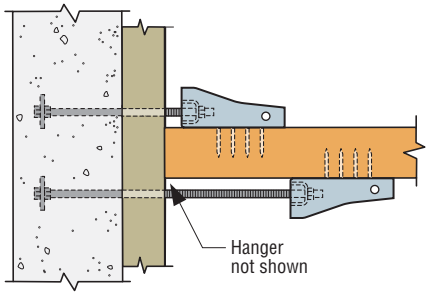
DTT2Z
U.S. Patent 8,555,580



Vertical HDU Installation



DTT1Z
U.S. Patent Pending



Horizontal HDU Offset Installation
(plan view)
See Holdown and Tension Tie General Notes.

Holdowns (cont.)

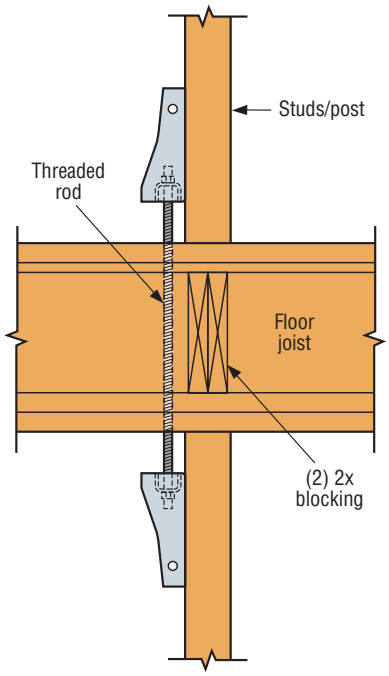
These products are available with additional corrosion protection. For more information, see p. 15.

SS For stainless-steel fasteners, see p. 21.

SD Many of these products are approved for installation with Strong-Drive® SD Connector screws. See pp. 335-337 for more information.

Model No.	Ga.	Dimensions (in.)					Fasteners (in.)		Minimum Wood Member Size (in.)	Allowable Tension Loads (160)			Code Ref.
		W	H	B	CL	SO	Anchor Bolt Dia. (in.)	Wood Fasteners		DF/SP	SPF/HF	Deflection at Allowable Load (in.)	
DTT1Z	14	1½	7⅛	1⁷⁄₁₆	¾	⅜	⅜	(6) SD #9 x 1½	1½ x 5½	840	840	0.17	IBC, FL, LA
								(6) 0.148 x 1½		910	640	0.167	
								(8) 0.148 x 1½		910	850	0.167	
SS DTT2Z	14	3¼	6¹⁵⁄₁₆	1⅝	¹³⁄₁₆	⅜	½	(8) ¼ x 1½ SDS	1½ x 3½	1,825	1,800	0.105	
								(8) ¼ x 1½ SDS	3 x 3½	2,145	1,835	0.128	
SS DTT2Z-SDS2.5								(8) ¼ x 2½ SDS	3 x 3½	2,145	2,105	0.128	
HDU2-SDS2.5	14	3	8¹⁄₁₆	3¼	1⁵⁄₁₆	1⅜	⅝	(6) ¼ x 2½ SDS	3 x 3½	3,075	2,215	0.088	
HDU4-SDS2.5	14	3	10¹⁵⁄₁₆	3¼	1⁵⁄₁₆	1⅜	⅝	(10) ¼ x 2½ SDS	3 x 3½	4,565	3,285	0.114	
HDU5-SDS2.5	14	3	13⅜	3¼	1⁵⁄₁₆	1⅜	⅝	(14) ¼ x 2½ SDS	3 x 3½	5,645	4,340	0.115	
HDU8-SDS2.5	10	3	16⅝	3½	1⅜	1½	⅞	(20) ¼ x 2½ SDS	3 x 3½	6,765	5,820	0.11	
									3½ x 3½	6,970	5,995	0.116	
									3½ x 4½	7,870	6,580	0.113	
HDU11-SDS2.5	10	3	22¼	3½	1⅜	1½	1	(30) ¼ x 2½ SDS	3½ x 5½	9,335	8,030	0.137	
									3½ x 7¼	11,175	9,610	0.137	
HDU14-SDS2.5	7	3	25¹¹⁄₁₆	3½	1⁹⁄₁₆	1⁹⁄₁₆	1	(36) ¼ x 2½ SDS	3½ x 5½	10,770	9,260	0.122	—
									3½ x 7¼	14,390	12,375	0.177	IBC, FL, LA
									5½ x 5½	14,445	12,425	0.172	

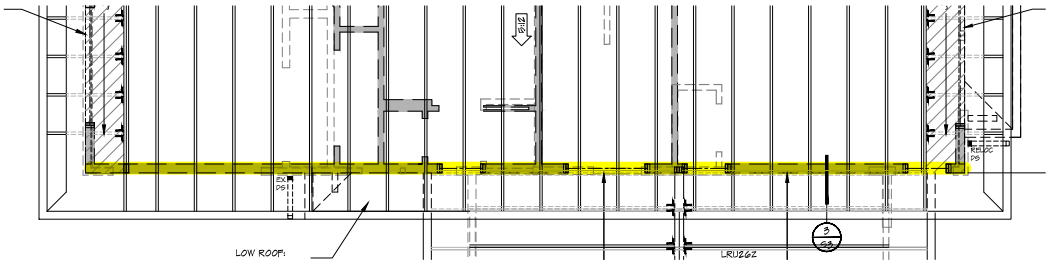
1. HDU14 requires heavy-hex anchor nut to achieve tabulated loads (supplied with holdown).
2. HDU14 loads on 4x6 post are applicable to installation on either the narrow or the wide face of the post.



Typical HDU Tie Between Floors

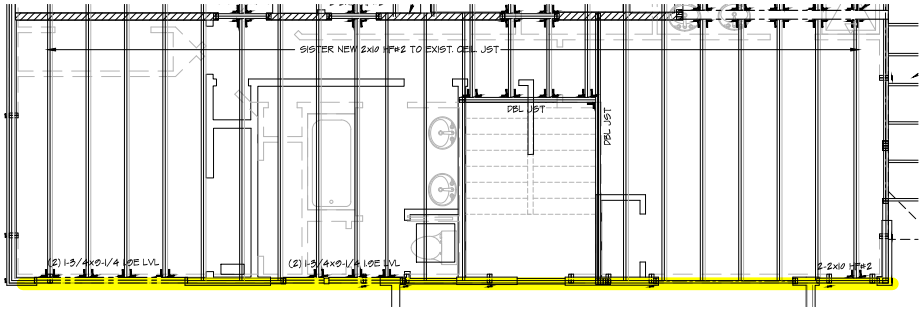
LOADING ON SOUTH HOUSE WALLS:

NEW ROOF LOAD:



DEAD LOAD = 15 PSF x 13.5ft = 203 PLF
SNOW LOAD = 25 PSF x 13.5ft = 338 PLF

NEW FLOOR LOAD:



DEAD LOAD = 15 PSF x 7ft = 105 PLF
LIVE LOAD = 40 PSF x 7ft = 280 PLF

EXISTING FLOOR LOAD:

DEAD LOAD = 15 PSF x 7ft = 105 PLF
LIVE LOAD = 40 PSF x 7ft = 280 PLF

NEW & EXISTING WALL DEAD LOAD:

DEAD LOAD = 10 PSF x 16ft = 160 PLF

TOTAL LOADS:

DEAD LOAD = 203 + 105 + 105 + 160 = **573 PLF**
LIVE LOAD = 280 +280 = **560 PLF**
SNOW LOAD = **338 PLF**

==> REQ MIN FOOTING: 1'-0" WIDE x 6" DEEP (SEE ENERCALC PRINTOUT)

Project Title: Rankin Addition
Engineer: NKH
Project ID: 24-123
Project Descr:

Wall Footing

Project File: (E) Foundation.ec6

DESCRIPTION: Existing Foundation

Code References

Calculations per ACI 318-19, IBC 2021
Load Combinations Used : ASCE 7-22 / IBC 2024 (L<=100psf)

General Information

Material Properties

f'c : Concrete 28 day strength	=	3.0 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
AutoCalc Footing Weight as DL :		Yes

Soil Design Values

Allowable Soil Bearing	=	2.0 ksf
Increase Bearing By Footing Weight	=	Yes
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing Depth

Reference Depth below Surface	=	ft
Allow. Pressure Increase per foot of depth	=	ksf
when base footing is below	=	ft

Increases based on footing Width

Allow. Pressure Increase per foot of width	=	ksf
when footing is wider than	=	ft

Adjusted Allowable Bearing Pressure = 2.073 ksf

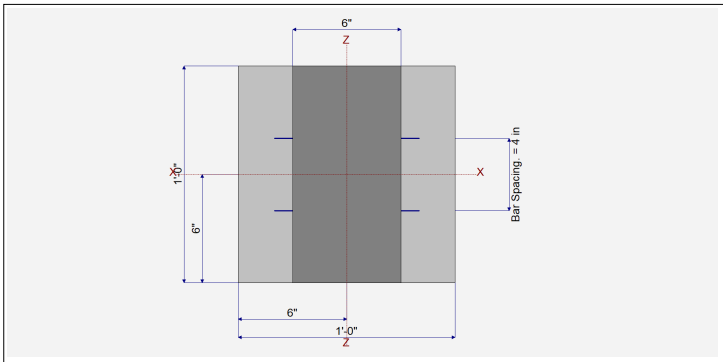
Dimensions

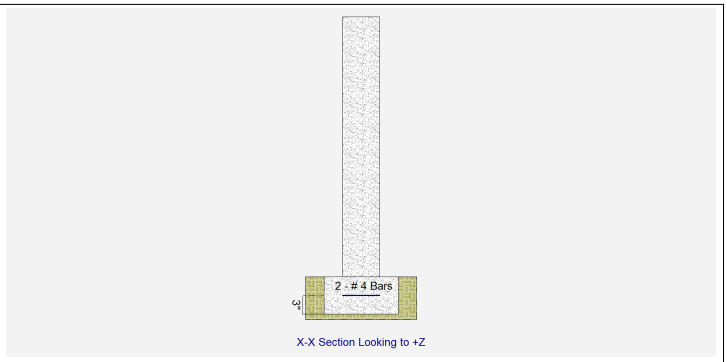
Footing Width	=	1.0 ft	Footing Thickness	=	6.0 in		
Wall Thickness	=	4 in	Rebar Centerline to Edge of Concrete...				
Wall center offset from center of footing	=	0 in	at Bottom of footing	=	3.0 in		

Reinforcing

Bars along X-X Axis

# of Bars in 12" Width	=	2			
Reinforcing Bar Size	=	#	4		





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=								k
OB : Overburden	=	0.5730		0.560	0.3380				ksf
V-x	=								k
M-zz	=								k-ft

Vx applied = in above top of footing

Project Title: Rankin Addition
Engineer: NKH
Project ID: 24-123
Project Descr:

Wall Footing

Project File: (E) Foundation.ec6

DESCRIPTION: Existing Foundation

DESIGN SUMMARY

Design OK

	Factor of Safety	Item	Applied	Capacity	Governing Load Combination
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift

	Utilization Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.3174	Soil Bearing	0.6577 ksf	2.073 ksf	+D+0.750L+0.5250S
PASS	0.008250	Z Flexure (+X)	0.03873 k-ft	4.694 k-ft	+1.20D+1.60L+0.30S
PASS	0.001593	Z Flexure (-X)	0.007477 k-ft	4.694 k-ft	+1.20D+0.50L+0.150S
PASS	N/A	1-way Shear (+X)	N/A psi	73.333 psi	N/A
PASS	N/A	1-way Shear (-X)	N/A psi	73.333 psi	N/A

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc	Actual Soil Bearing Stress -X	Actual Soil Bearing Stress +X	Actual / Allowable Ratio
D Only	2.073 ksf	0.0 in	0.3590 ksf	0.3590 ksf	0.173
+D+L	2.073 ksf	0.0 in	0.6390 ksf	0.6390 ksf	0.308
+D+0.70S	2.073 ksf	0.0 in	0.4773 ksf	0.4773 ksf	0.230
+D+0.750L	2.073 ksf	0.0 in	0.5690 ksf	0.5690 ksf	0.275
+D+0.750L+0.5250S	2.073 ksf	0.0 in	0.6577 ksf	0.6577 ksf	0.317
+0.60D	2.073 ksf	0.0 in	0.2154 ksf	0.2154 ksf	0.104
+D+0.750L+0.10S	2.073 ksf	0.0 in	0.5859 ksf	0.5859 ksf	0.283

Overturning Stability

Units : k-ft

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Sliding Safety Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot. or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
+1.40D	0.009363	-X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.40D	0.009363	+X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+1.60L	0.03398	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+1.60L	0.03398	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+1.60L+0.30S	0.03873	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+1.60L+0.30S	0.03873	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L	0.0051	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L	0.0051	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D	0.008025	-X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.20D	0.008025	+X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+S	0.02094	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+S	0.02094	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+S	0.007819	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+S	0.007819	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+0.30S	0.009853	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+0.30S	0.009853	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+0.90D	0.006019	-X	Top	0.1296	Min Temp %	0.4	4.694	OK
+0.90D	0.006019	+X	Top	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+0.150S	0.007477	-X	Bottom	0.1296	Min Temp %	0.4	4.694	OK
+1.20D+0.50L+0.150S	0.007477	+X	Bottom	0.1296	Min Temp %	0.4	4.694	OK

One Way Shear

Units : k

Load Combination...	vu @ -X	vu @ +X	vu:Max	Φ vn	vu / Φ vn	Status
+1.40D	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+1.60L	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK

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One Way Shear

Units : k

Load Combination...	vu @ -X	vu @ +X	vu:Max	Φ vn	vu / Φ vn	Status
+1.20D+1.60L+0.30S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+0.50L	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+0.50L+S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+0.50L+0.30S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+0.90D	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK
+1.20D+0.50L+0.150S	0.0 psi	0.0 psi	0.0 psi	73.3 psi	0.000	OK