

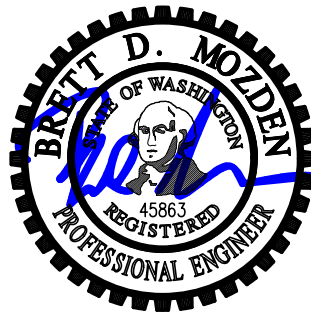


Structural Calculations For:

Korpela + Wiens Residence

8441 SE 33rd Place

Mercer Island, WA 98040



Prepared for: Jessyca Poole

Job #: 02327-2023-04

Date: December 14, 2023



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Criteria



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Criteria Sheet

Codes		Project Location	
Structural	IBC 2018	Street & Number	8441 SE 33rd Place
Loading	ASCE 7-16	City:	Mercer Island
Wood:	NDS 2018 / SDPWS 2015	State:	WA
Steel:	AISC 360-16	ZIP:	98040
Concrete:	ACI 318-14	Latitude:	47.5810 N
Masonry:	TMS 402/602-16	Longitude:	-122.2246 W
		Ground Elevation	255 ft

Occupancy Category
Risk Category: II ASCE 7 Table 1.5-1

Seismic Load Summary:	
Analysis Procedure:	Equivalent Lateral Force Procedure
Lateral System:	Light-frame (wood) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance
R:	6.50
C _d :	4
Base Shear V =	14 kips
Ω _o :	2.5
S _s :	1.399
S ₁ :	0.487
S _{DS} :	1.12
S _{D1} :	0.88
C _s :	0.172
I _E :	1.0



Story Information	
# Stories Above Grade (Including Mezzanine Levels)	3

Horizontal and Vertical Irregularities:	
Is the building a "Regular Structure"? (No horizontal or vertical irregularities)	Yes

Wind Load Summary:	
V =	98
K _{ZT} =	1.00
Exposure =	C

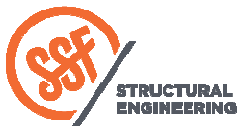
Dead Loads:			
Roof	Floor		
Roofing	1 psf	Finish Floor	2 psf
1/2" Sheathing	1.8 psf	3/4" Sheathing	2.7 psf
Trusses @ 24" oc	2.5 psf	Joists @ 16" oc	2.2 psf
Misc./Mech.	1.5 psf	Misc./Mech.	2 psf
Ceiling Finish	2.8 psf	Ceiling Finish	2.8
Solar Panels	5 psf		11.7 psf
	15 psf	Use	12 psf
Use	15 psf	Add'l Seismic Weight	10 psf
Add'l Seismic Weight	5 psf	Seismic Weight	22 psf
Seismic Weight	20 psf		

Live Loads:	
Roof	20 psf
Floor	40 psf
Deck	60 psf

Snow Loading Criteria:			
Ground Snow, p _g	20 psf	Flat Roof Snow Load, p _f	25.0 psf
Exposure Factor, C _e	1.00	Sloped Roof Snow Load, p _s	25.0 psf
Thermal Factor, C _t	1.00	Slope Factor, C _s	0.61
		Importance Factor, I _s	1.00

Soils:			
Allowable Bearing	2500 psf	Active	55/35 pcf (Restrained/Unrestrained)
Sliding, μ	0.3	Seismic Surcharge	8H
Passive	250 pcf		

Soils Report Provided?	Yes
Site Specific Ground Motion Hazard Analysis Provided?	No



Korpela + Wiens Residence

Criteria

DATE 10/26/2023

PROJ. # 02327-2023-04

DESIGN BDM

SHEET 1

Wind Design - MWFRS

ASCE 7 Chapter 27 - Directional Procedure

Design Method	ASD
---------------	-----

Wind Coefficients

Exposure	C	
V=	98	mph
K_d =	0.85	Table 26.6-1
K_{zt} =	0.96	Table 26.10-1
K_e =	0.99	Table 26.9-1
G=	0.85	26.9.4

Transverse Wind Pressures

L/B = 0.81 h/L = 0.61

Pressure Coefficients from Figure 27.3-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-0.99 / -0.18
Leeward Roof	-0.54

Location and Building Dimensions

Calculate K_{zt} ?	No	
K_{zt}	1.00	
Roof Type	Monoslope	
Roof Slope - Transverse Dir	7.7	degrees
Roof Slope - Long Dir	0	degrees
Ground to top of roof	28.5	ft
Bot of roof to top of roof	4.25	ft
Mean Roof Height, h	26.375	ft
Short Plan Dimension	43.5	ft
Long Plan Dimension	53.5	ft
Parapet ?	No	
Ground to top of parapet		ft
Average Parapet Height		ft

Velocity Pressure at Mean Roof Height, q_h =	19.8	psf
--	------	-----

Wall Pressures (Unfactored):

Ht	K_z	q_z	ASD		
			$P_{ww\ walls}$	$P_{lw\ walls}$	$P_{w\ walls} (psf)$
0-15	0.85	17.60	11.97	8.41	12.2
15-20	0.9	18.64	12.67	8.41	12.7
20-25	0.94	19.46	13.24	8.41	13.0
25-30	0.98	20.29	13.80	8.41	13.3
30-40	1.04	21.53	14.64	8.41	13.8
41-50	1.09	22.57	15.35	8.41	14.3
51-60	1.13	23.40	15.91	8.41	14.6
61-70	1.17	24.23	16.47	8.41	14.9
71-80	1.21	25.05	17.04	8.41	15.3
81-90	1.24	25.68	17.46	8.41	15.5
91-100	1.26	26.09	17.74	8.41	15.7

Roof Pressures (Unfactored)

ASD			Horiz Proj (psf)
Windward		Leeward	
Max	Min		
-3.0	-16.6	-9.1	4.80



Korpela + Wiens Residence _____
 Wind Criteria _____

DATE 10/26/2023
 PROJ. # 02327-2023-04
 DESIGN BDM
 SHEET 3

ASCE 7-16 Wind Loads - Components and Cladding
Monoslope Roof ($3^\circ < \theta \leq 30^\circ$)

Part 1: Low-Rise Buildings ($h \leq 60$ feet)
Section 30.3

Wind Coefficients

Exposure	C	
V=	98	mph
K_d =	0.85	Table 26.6-1
GC_p =	(Calculated from Ch. 30 Tables)	
GC_{pi} =	0.18	Table 26.13-1

Location and Building Dimensions

K_{zt} =	1.00	
K_e =	0.99	Table 26.9-1
K_z =	0.95	Table 26.10-1
Roof Angle, θ	15	degrees
Mean Roof Height, h	25	ft

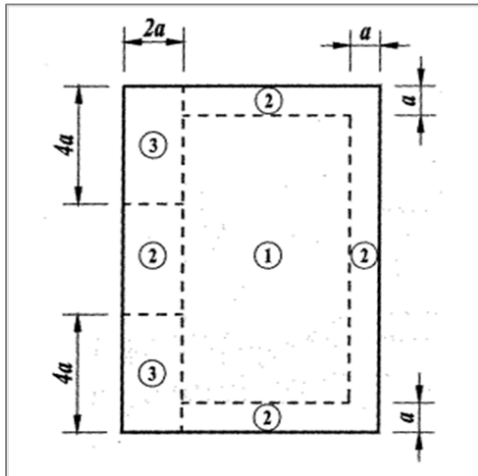
Velocity Pressure, $q_h = 0.00256K_dK_{zt}K_zV^2 = 11.7$ psf (30.3-1)
 Design Wind Pressure, $p = q_h[(GC_p)-(GC_{pi})] = (30.4-1)$

Design	ASD
--------	-----

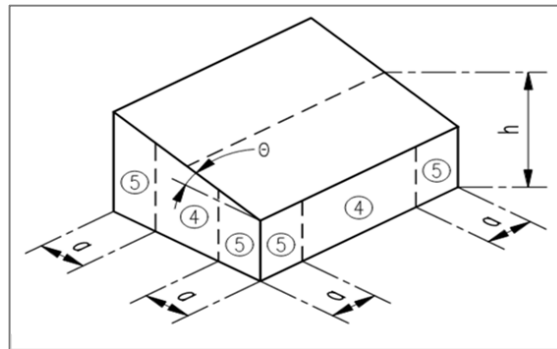
Design Wind Pressure (psf)

Roof Angle	Zone		Effective Wind Area (sq ft)					
			≤ 10	20	50	100	200	≥ 500
Roofs Monoslope Roofs $10^\circ < \theta \leq 30^\circ$ - Figure 30.3-5B	1	+	6.8*	6.5*	6.0*	5.6*	5.6*	5.6*
		-	-17.4	-16.7	-15.7*	-15.0*	-15.0*	-15.0*
	2	+	6.8*	6.5*	6.0*	5.6*	5.6*	5.6*
		-	-20.9	-19.5	-17.6	-16.2	-16.2	-16.2
		OH	-30.5	-28.5	-25.8	-23.8	-23.1	-22.3
	2'	+						
		-						
		OH						
	3	+	6.8*	6.5*	6.0*	5.6*	5.6*	5.6*
		-	-36.2	-33.0	-28.8	-25.6	-25.6	-25.6
		OH	-45.8	-42.0	-37.0	-33.2	-32.5	-31.7
	3'	+						
-								
OH								
Wall (Fig. 30.3-1)	4	+	13.9*	13.2*	12.4*	11.8*	11.2*	10.3*
		-	-15.0*	-14.4*	-13.6*	-13.0*	-12.3*	-11.5*
	5	+	13.9*	13.2*	12.4*	11.8*	11.2*	10.3*
		-	-18.6	-17.3	-15.7*	-14.4*	-13.2*	-11.5*

Note: * Indicates 10psf minimum wind pressure per 30.2.2 controls this load case for most buildings.



Monoslope Roofs $10^\circ < \theta \leq 30^\circ$ - Figure 30.3-5B



Wall Zones - Figure 30.3-5B

a : 10 percent of least horizontal dimension or $0.4h$, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

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Korpela + Wiens Residence

Date: 10/26/2023

Project #:

Design: BDM

Sheet:



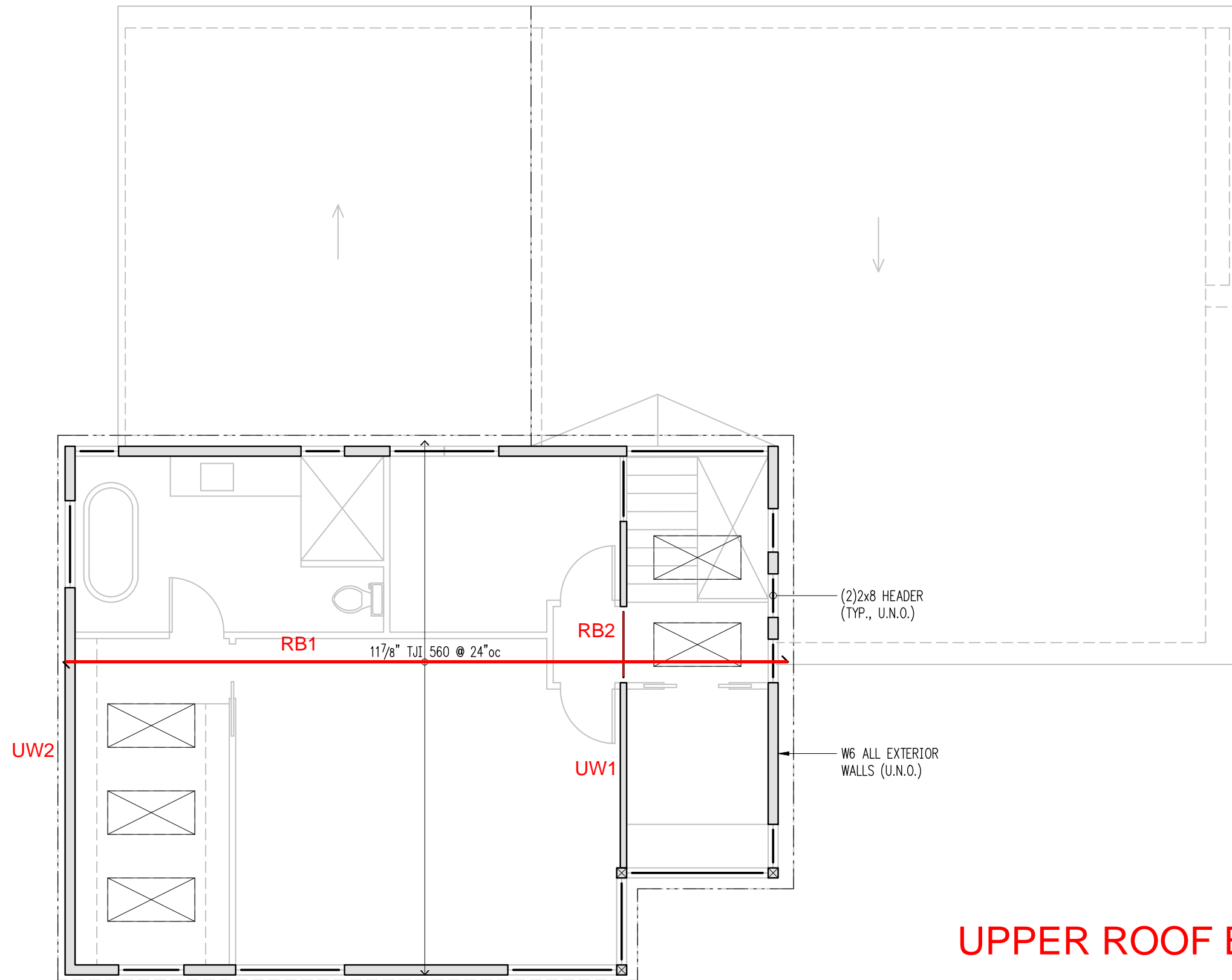
Gravity



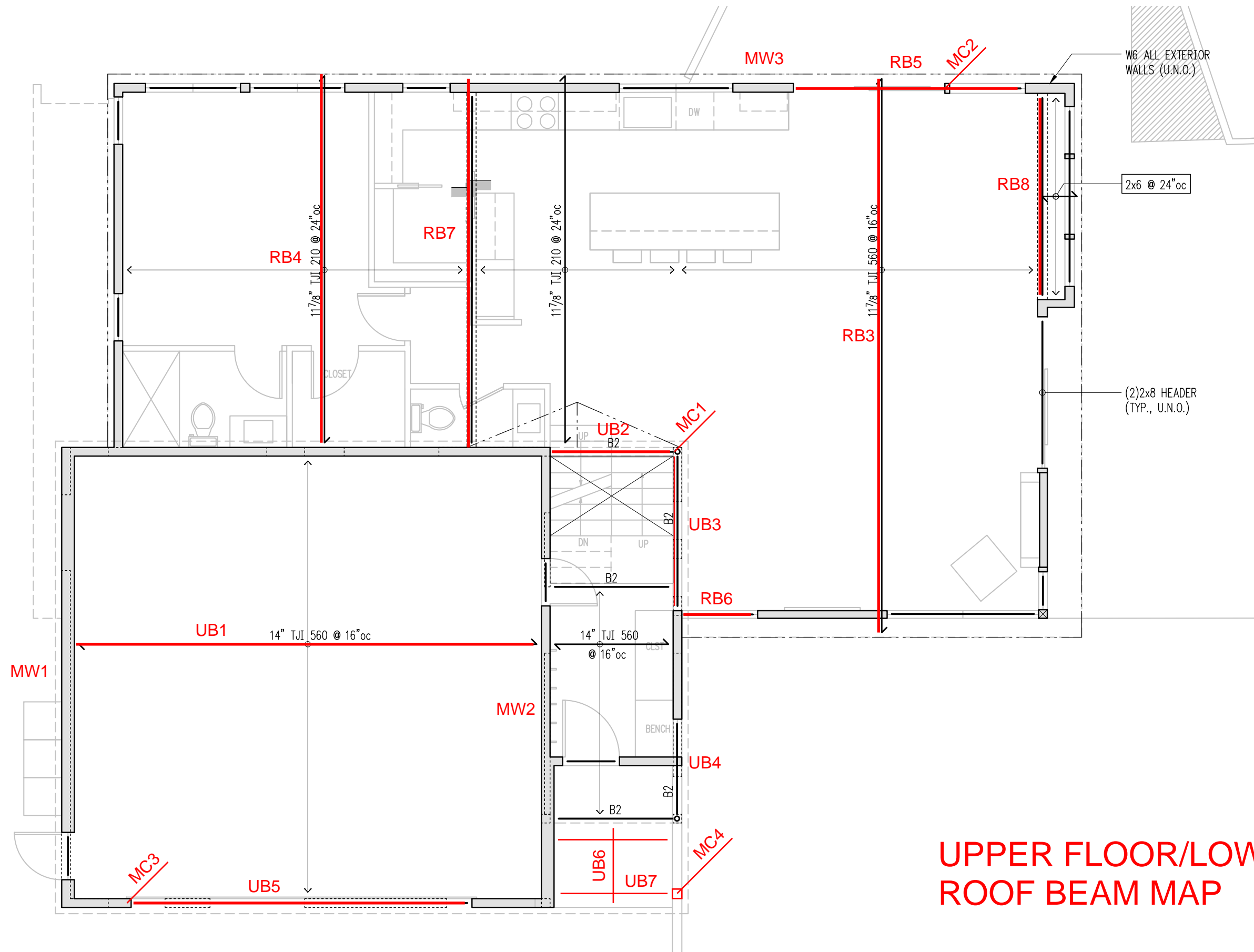
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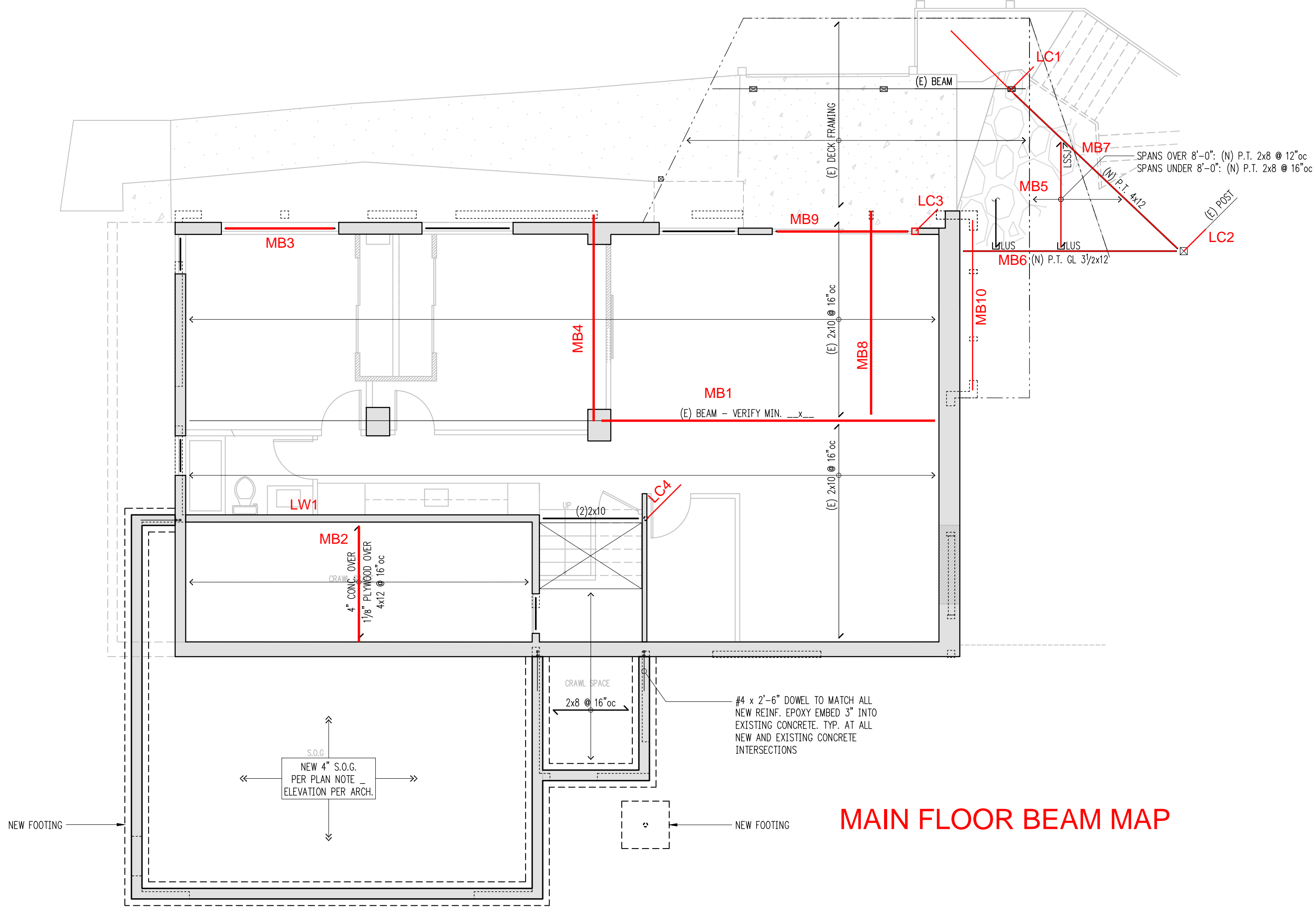
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UPPER ROOF BEAM MAP

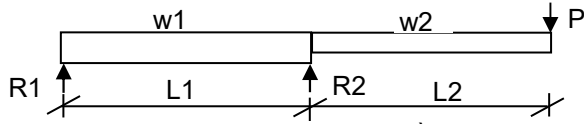


**UPPER FLOOR/LOW
ROOF BEAM MAP**



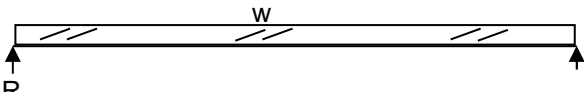
MAIN FLOOR BEAM MAP

Beam	RB1	HF	4	x 12
w1=	80 plf	R1=	1020	lbs
w2=	80 plf	R2=	1,060	lbs
L1=	26 ft	M+=	6,498	lb-ft
L2=	1 ft	M-=	10	lb-ft
X=	12.75 ft	Fb=	1,056	psi
P=	- lbs	Fv=	36	psi
b=	3.50 in	Δspan=	1.408	in
d=	11.25 in	I span/	217	
E=	1,300 ksi	Δcant=	(0.09)	in
Cv=	1.00	I cant/	(136)	

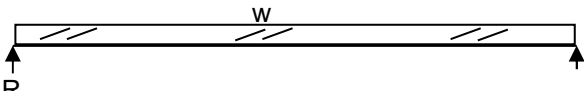


TJI Size	11.88 in	RE 3.5	11.875 TJI 560
span	Δ (in)	I /	Ma= 9500 lb-ft
1.39	221		Va= 2050 lbs
cant.	-0.09	138	Ra= 1725 lbs

Beam	RB2 (2-2x8)	HF	3	x 8
w=	646.6 plf	R=	1,293	lbs
L=	4 ft	M=	1,293	ft-lbs
b=	3.00 in	Fb=	590	psi
d=	7.25 in	Fv=	62	psi
E=	1300 ksi	Δ=	0.03	in
Cv=	1.00 ≤1.0	I /	1596	

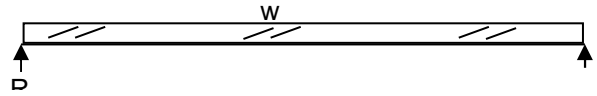


Beam	RB3	HF	4	x 12
w=	53.3333333 plf	R=	740	lbs
L=	27.75 ft	M=	5,134	ft-lbs
b=	3.50 in	Fb=	834	psi
d=	11.25 in	Fv=	26	psi
E=	1300 ksi	Δ=	1.32	in
Cv=	1.00 ≤1.0	I /	253	



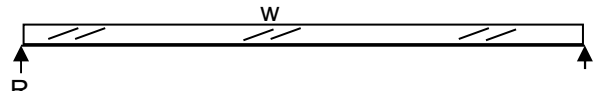
TJI Size	11.88 in	RE 3.5	11.875 TJI 560
EI =	636 in ⁴		Ma= 9500 lb-ft
Δ =	1.198 in		Va= 2050 lbs
I /	278		Ra= 1725 lbs

Beam	RB4	HF	4	x 12
w=	80 plf	R=	760	lbs
L=	19 ft	M=	3,610	ft-lbs
b=	3.50 in	Fb=	587	psi
d=	11.25 in	Fv=	26	psi
E=	1300 ksi	Δ=	0.43	in
Cv=	1.00 ≤1.0	I /	525	

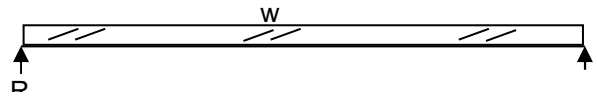


TJI Size	11.88 in	RE 3.5	11.875 TJI 210
EI =	315 in ⁴		Ma= 3795 lb-ft
Δ =	0.810 in		Va= 1655 lbs
I /	282		Ra= 2145 lbs

Beam	RB5	HF	6	x 10
w=	575 plf	R=	2,415	lbs
L=	8.4 ft	M=	5,072	ft-lbs
b=	5.50 in	Fb=	736	psi
d=	9.50 in	Fv=	56	psi
E=	1300 ksi	Δ=	0.13	in
Cv=	1.00 ≤1.0	I /	799	



Beam	RB6	HF	3	x 8
w=	575 plf	R=	1,294	lbs
L=	4.5 ft	M=	1,455	ft-lbs
b=	3.00 in	Fb=	665	psi
d=	7.25 in	Fv=	65	psi
E=	1300 ksi	Δ=	0.04	in
Cv=	1.00 ≤1.0	I /	1261	

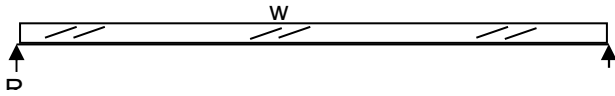


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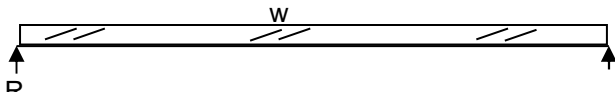
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Fax: 206.443.4870

Project: Korpela Wiens Date: 10/26/23
02327-2023-04 Project #: _____
Roof Framing Calcs Design: SS
Sheet: _____

Beam	RB7	LSL	3	1/2	x 11	7/8
w=	115	plf	R=	1,093	lbs	
L=	19	ft	M=	5,189	ft-lbs	
b=	3.50	in	Fb=	757	psi	
d=	11.875	in	Fv=	35	psi	
E=	1550	ksi	Δ=	0.45	in	
Cv=	1.00	≤1.0	I/	512		



Beam	RB8 (2-2x8)	HF	3	x 8	
w=	70	plf	R=	403	lbs
L=	11.5	ft	M=	1,157	ft-lbs
b=	3.00	in	Fb=	528	psi
d=	7.25	in	Fv=	25	psi
E=	1300	ksi	Δ=	0.22	in
Cv=	1.00	≤1.0	I/	620	



Column Buckling Calculations (UW-1)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs		
Hem-Fir Plates		
b	1.5	in
d	3.5	in
Le ₁	10.67	ft
Le ₂	1.00	ft
le _{bending}		ft

Column Design Values

F _b	850	psi
F _c	1300	psi
E'min	470	ksi
F _{cperp}	405	psi
cb	1.00	

Column Loading

P	862.13	lbs
W ₁	7	plf
M1	95	ft-lbs
W ₂	0	plf
M2 (Braced)	0	ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.50
Repetitive - C _r	1.15

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.15
Size Factor - C _F	1.15

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	289	psi
F _{c*1}	1719	psi
F _{ce1} /F _{c*1}	0.168	
C _{p1}	0.162	

Weak Axis

F _{ce2}	24146	psi
F _{c*2}	1719	psi
F _{ce2} /F _{c*2}	14.045	
C _{p2}	1.000	

Bracing

Braced
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	14667	psi
F _{b'1}	1466	psi
F _{be1} /F _{b'1}	10.0	
le	2.1	ft
CL ₁	1.00	

Weak Axis

F _{be2}	426,481	psi
F _{b'2}	1466	psi
F _{be2} /F _{b'2}	291	

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	278	psi
F _{b'1}	1466	psi

Weak Axis

F _{c'2}	1719	psi
F _{b'2}	1466	psi

Imposed Column Stresses

Strong Axis

f _{c1}	164	psi
f _{b1}	372	psi

Weak Axis

f _{c2}	164	psi
f _{b2}	0	psi

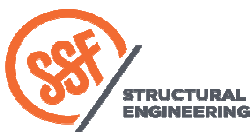
Perpendicular to Grain Stress Check f _c /F _c =	164 / 405	OK
Slenderness Check le/d	37	OK
Slenderness Check le/b	8	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}' [1 - f_c / F_{cE2}]} + \frac{f_{b2}}{F_{b2}' [1 - f_c / F_{cE2} - (f_{b1} / F_{b1}')] } \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{bE}} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_{c1}'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.94	OK
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Project: Korpela Wiens Date: 10/26/2023
Upper Floor Wall/Columns: UW-1 Project #: 02327-2023-04
Design: SS

Column Buckling Calculations (UW-2)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs		
Hem-Fir Plates		
b	1.5	in
d	5.5	in
Le ₁	10.67	ft
Le ₂	1.00	ft
le _{bending}		ft

Column Design Values

F _b	850	psi
F _c	1300	psi
E'min	470	ksi
F _{cperp}	405	psi
cb	1.00	

Column Loading

P	706.67	lbs
W ₁	30	plf
M1	427	ft-lbs
W ₂	0	plf
M2 (Braced)	0	ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.60
Size Factor - C _F	1.30
Repetitive - C _r	1.15

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.15
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
Kf	1
Column: Pinned Pinned	
Ke	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	713	psi
F _{c*1}	1645	psi
F _{ce1} /F _{c*1}	0.433	
C _{p1}	0.385	

Weak Axis

F _{ce2}	24146	psi
F _{c*2}	1645	psi
F _{ce2} /F _{c*2}	14.683	
C _{p2}	1.000	

Bracing

Braced
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	9334	psi
F _{b'1}	2033	psi
F _{be1} /F _{b'1}	4.6	
le	2.1	ft
CL ₁	1.00	

Weak Axis

F _{be2}	1,053,148	psi
F _{b'2}	2033	psi
F _{be2} /F _{b'2}	518	

Bearing
Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	633	psi
F _{b'1}	2033	psi

Weak Axis

F _{c'2}	1645	psi
F _{b'2}	2033	psi

Imposed Column Stresses

Strong Axis

f _{c1}	86	psi
f _{b1}	677	psi

Weak Axis

f _{c2}	86	psi
f _{b2}	0	psi

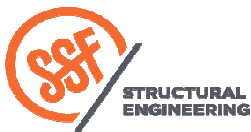
Perpendicular to Grain Stress Check f_c/F_c' =	86 / 405	OK
Slenderness Check le/d	23	OK
Slenderness Check le/b	8	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}' [1 - f_c / F_{cE2}]} + \frac{f_{b2}}{F_{b2}' [1 - f_c / F_{cE2} - (f_{b1} / F_{b1}')] } \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{bE}} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_{c1}'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.40	OK
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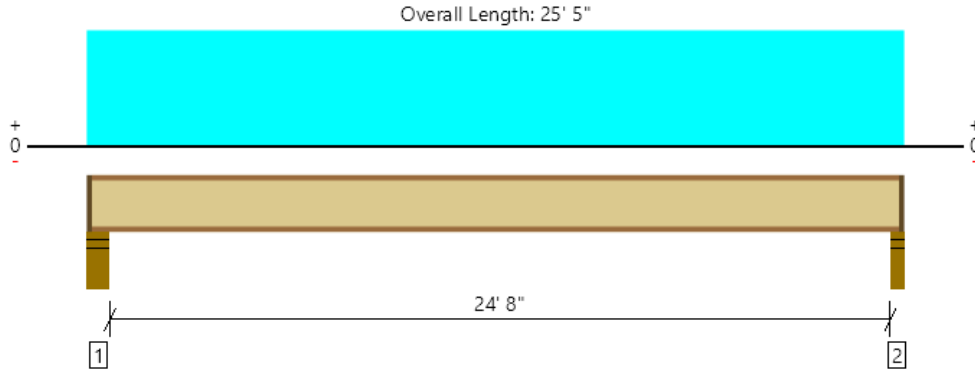


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Office: 206.443.6212

Project: Korpela Wiens Date: 10/26/2023
Upper Floor Walls & Columns: UW-2 Project #: 0232-2023-04
Design: SS

Upper Floor, UB-1
1 piece(s) 14" TJI ® 560 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	868 @ 25' 2 1/2"	1396 (2.25")	Passed (62%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	855 @ 5 1/2"	2390	Passed (36%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	5345 @ 12' 9 1/2"	11275	Passed (47%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.492 @ 12' 9 1/2"	0.621	Passed (L/606)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.640 @ 12' 9 1/2"	0.828	Passed (L/466)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	35	Any	Passed	--	--

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2021
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/360).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 19/32" Panel (20" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: bridging or blocking at max. 8' o.c., Perpendicular Partitions.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - HF	5.50"	4.25"	1.75"	205	682	887	1 1/4" Rim Board
2 - Stud wall - HF	3.50"	2.25"	1.75"	202	673	875	1 1/4" Rim Board

• Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	8' 4" o/c	
Bottom Edge (Lu)	25' 3" o/c	

- TJI joists are only analyzed using Maximum Allowable bracing solutions.
- Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 25' 5"	16"	12.0	40.0	Default Load

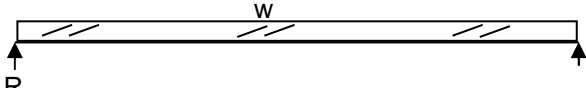
Member Notes
UB-1

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

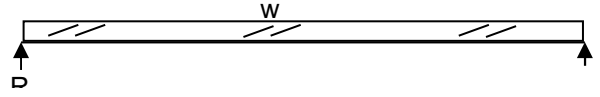
ForteWEB Software Operator	Job Notes
Sunny Sidhu SSF Engineers (360) 224-2499 ssidhu@ssfengineers.com	



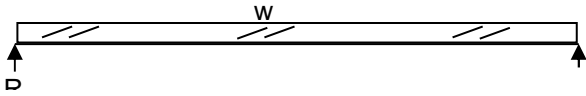
Beam	UB2	LSL	3 1/2 x 11 7/8
w=	508.75 plf	R=	1,717 lbs
L=	6.75 ft	M=	2,897 ft-lbs
b=	3.50 in	Fb=	423 psi
d=	11.875 in	Fv=	44 psi
E=	1550 ksi	Δ =	0.03 in
Cv=	1.00 \leq 1.0	I/	2580



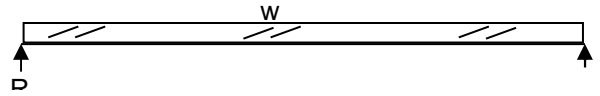
Beam	UB6	HF	4 x 8
w=	60 plf	R=	135 lbs
L=	4.5 ft	M=	152 ft-lbs
b=	3.50 in	Fb=	59 psi
d=	7.25 in	Fv=	6 psi
E=	1300 ksi	Δ =	0.00 in
Cv=	1.00 \leq 1.0	I/	14095



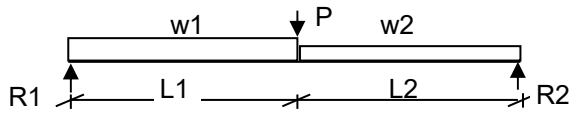
Beam	UB3	LSL	3 1/2 x 11 7/8
w=	487.5 plf	R=	2,072 lbs
L=	8.5 ft	M=	4,403 ft-lbs
b=	3.50 in	Fb=	642 psi
d=	11.875 in	Fv=	57 psi
E=	1550 ksi	Δ =	0.08 in
Cv=	1.00 \leq 1.0	I/	1349



Beam	UB7	HF	4 x 8
w=	135.0 plf	R=	473 lbs
L=	7 ft	M=	827 ft-lbs
b=	3.50 in	Fb=	324 psi
d=	7.25 in	Fv=	23 psi
E=	1300 ksi	Δ =	0.05 in
Cv=	1.00 \leq 1.0	I/	1664

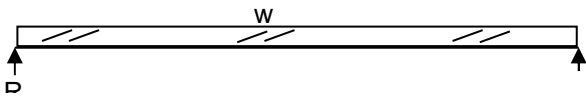


Beam	UB4	LSL	3 1/2 x 11 7/8
w1=	193 plf	R1 =	932 lbs
w2=	488 plf	R2 =	1,288 lbs
L1=	2 ft	M =	1,671 lb-ft
L2=	3 ft	Fb =	244 psi
X=	2.3 ft	Fv =	29 psi
P=	203 lbs	Δ =	0.01 in
b=	3.50 in	I/	5,813
d=	11.875 in	Cv=	1.00
E=	1,550 ksi		



Steel Size	HSS2X2X1/4		
I =	0.747 in ⁴	Fy=	50 ksi
Δ =	0.34 in	Mn/ Ω =	2.4 k-ft
I/	250	Vn/ Ω =	0.0 kips

Beam	UB5	HF	4 x 12
w=	60 plf	R=	555 lbs
L=	18.5 ft	M=	2,567 ft-lbs
b=	3.50 in	Fb=	417 psi
d=	11.25 in	Fv=	19 psi
E=	1300 ksi	Δ =	0.29 in
Cv=	1.00 \leq 1.0	I/	758



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Project: Korpela Wiens Date: 12/14/23
02327-2023-04 Project #: _____
Upper Floor Framing Calcs Design: SS
 Sheet: _____

Beam Analysis

Beam:		UB5 - Seismic West					
Load	Dead	Live	Snow	Seismic	Factored	Location	
Distributed (k/ft)	w ₁	0.012	0.040		0.014	0	
	w ₂	0.023		0.0375	0.026	2	
	w ₃	-0.023		-0.0375	-0.026	4.41667	
	w ₄	0.023		0.0375	0.026	9.42	
	w ₅	-0.023		-0.0375	-0.026	16.92	
	w ₆				0.000		
	w ₇				0.000		
	w ₈				0.000		
	w ₉				0.000		
	w ₁₀				0.000		
Trapezoidal (k/ft/ft)	t ₁				0.000		
	t ₂				0.000		
	t ₃				0.000		
	t ₄				0.000		
	t ₅				0.000		
	t ₆				0.000		
Point (k)	P ₁	0.0225		0.0375	0.026	2.00	
	P ₂	0.05625		0.09375	0.065	4.42	
	P ₃	0.05625		0.09375	0.065	9.42	
	P ₄	0.01219		0.02031	0.014	16.92	
	P ₅				7.14286	5.000	9.42
	P ₆				-7.14286	-5.000	16.92
	P ₇				0.000	0.000	
	P ₈				0.000	0.000	
	P ₉				0.000	0.000	
	P ₁₀				0.000	0.000	

Support Locations and Reactions	
# of Supports	2
Total Beam Length	18.50
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	2.370 0.00
R ₂	-1.684 18.50
R ₃	0.000 18.50
R ₄	0.000 18.50
R ₅	0.000 18.50
R ₆	0.000 18.50
R ₇	0.000 18.50
R ₈	0.000 18.50
R ₉	0.000 18.50
R ₁₀	0.000 18.50

Demand Output	
Location, ft	9.00
Shear, k	2.09
Moment, k-ft M =	19.92
Deflection, in D =	-0.74
Δ/Span	L/301

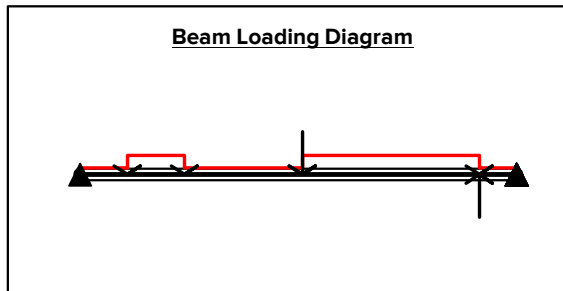
Load Factors	
Dead	1.16
Live	0.00
Snow	0.00
Seismic	0.70

Stresses @ Input Location	
f _v (psi)	66
f _b (psi)	2248

Max/Min Stresses	
f _v _MAX (psi)	75
f _v _MIN (psi)	0
f _b _MAX (psi)	2348
f _b _MIN (psi)	-300

Beam Properties	
E (ksi)	1800
b (in)	3.5
d (in)	13.5
I (in ⁴)	717.61
S (in ³)	106.31
A (in ²)	47.25
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section	NONE
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Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{TL} (in)	@ x =	L/	Δ _{LL} (in)	@ x =	L/
Span 1	2.37	1.68	-2.66	20.8	-1.17 (+)	9	L/190	-0.082 (+)	9.3	L/2707

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PROJECT Korpela Wiens

DATE 10/30/2023
 PROJ. # 02327-2023-04
 DESIGN SS
 SHEET 1

Beam Analysis

Beam: UB5 - Seismic East							
Load	Dead	Live	Snow	Seismic	Factored	Location	
Distributed (k/ft)	W ₁	0.012	0.040			0.005	0
	W ₂	0.023		0.0375		0.010	2
	W ₃	-0.023		-0.0375		-0.010	4.41667
	W ₄	0.023		0.0375		0.010	9.42
	W ₅	-0.023		-0.0375		-0.010	16.92
	W ₆					0.000	
	W ₇					0.000	
	W ₈					0.000	
	W ₉					0.000	
	W ₁₀					0.000	
Trapezoidal (k/ft/ft)	t ₁					0.000	
	t ₂					0.000	
	t ₃					0.000	
	t ₄					0.000	
	t ₅					0.000	
	t ₆					0.000	
Point (k)	P ₁	0.0225		0.0375		0.010	2.00
	P ₂	0.05625		0.09375		0.025	4.42
	P ₃	0.05625		0.09375		0.025	9.42
	P ₄	0.01219		0.02031		0.005	16.92
	P ₅				-7.14286	-5.000	9.42
	P ₆				7.14286	5.000	16.92
	P ₇					0.000	
	P ₈					0.000	
	P ₉					0.000	
	P ₁₀					0.000	

Support Locations and Reactions	
# of Supports	2
Total Beam Length	18.50
Left End Condition	Pinned
Right End Condition	Pinned
R ₁	-1.896 0.00
R ₂	2.158 18.50
R ₃	0.000 18.50
R ₄	0.000 18.50
R ₅	0.000 18.50
R ₆	0.000 18.50
R ₇	0.000 18.50
R ₈	0.000 18.50
R ₉	0.000 18.50
R ₁₀	0.000 18.50

Demand Output	
Location, ft	9.00
Shear, k	-2.00
Moment, k-ft M =	-17.60
Deflection, in D =	0.63
Δ/Span	L/354

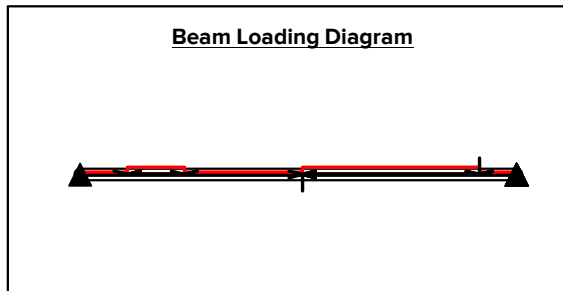
Load Factors	
Dead	0.44
Live	0.00
Snow	0.00
Seismic	0.70

Stresses @ Input Location	
f _v (psi)	-64
f _b (psi)	-1987

Max/Min Stresses	
f _{v_MAX} (psi)	0
f _{v_MIN} (psi)	-69
f _{b_MAX} (psi)	383
f _{b_MIN} (psi)	-2077

Beam Properties	
E (ksi)	1800
b (in)	3.5
d (in)	13.5
I (in ⁴)	717.61
S (in ³)	106.31
A (in ²)	47.25
I (Override)	
S (Override)	
A (Override)	

Steel Beam Section **NONE**



Span	V _L (kips)	V _R (kips)	M(-) (k-ft)	M(+) (k-ft)	Δ _{TL} (in)	@ x =	L/	Δ _{LL} (in)	@ x =	L/
Span 1	-1.9	-2.16	-18.4	3.39	0.716 (+)	8.9	L/310	-0.082 (+)	9.3	L/2707

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PROJECT Korpela Wiens

DATE 10/30/2023

PROJ. # 02327-2023-04

DESIGN SS

SHEET 1

Column Buckling Calculations (MW-1)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
Hem-Fir Plates	
b	3 in
d	3.5 in
Le ₁	9.50 ft
Le ₂	1.00 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E' _{min}	470 ksi
F _{cperp}	405 psi
cb	1.00

Column Loading

P	1584.8 lbs
W ₁	30 plf
M1	338 ft-lbs
W ₂	0 plf
M2 (Braced)	0 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.60
Size Factor - C _F	1.30
Repetitive - C _r	1.15

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.15
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	364 psi
F _{c*1}	1645 psi
F _{ce1} /F _{c*1}	0.221
C _{p1}	0.210

Weak Axis

F _{ce2}	96585 psi
F _{c*2}	1645 psi
F _{ce2} /F _{c*2}	58.732
C _{p2}	1.000

Bracing

Braced
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	58669 psi
F _{b'1}	2033 psi
F _{be1} /F _{b'1}	28.9
le	2.1 ft
CL ₁	1.00

Weak Axis

F _{be2}	213,241 psi
F _{b'2}	2033 psi
F _{be2} /F _{b'2}	105

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	346 psi
F _{b'1}	2033 psi

Weak Axis

F _{c'2}	1645 psi
F _{b'2}	2033 psi

Imposed Column Stresses

Strong Axis

f _{c1}	151 psi
f _{b1}	663 psi

Weak Axis

f _{c2}	151 psi
f _{b2}	0 psi

Perpendicular to Grain Stress Check f_c/F_cp =	151 / 405	OK
Slenderness Check le/d	33	OK
Slenderness Check le/b	4	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}' [1 - f_c / F_{cE}]} + \frac{f_{b2}}{F_{b2}' [1 - f_c / F_{cE} - (f_{b1} / F_{b1}')] } \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{bE}} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_c'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.75	OK
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Project: Korpela Wiens Date: 10/30/2023
Main Floor Walls & Columns: MW-1 Project #: 0232-2023-04
 Design: SS
 Sheet: 1

Column Buckling Calculations (MW-2)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
Hem-Fir Plates	
b	1.5 in
d	5.5 in
Le ₁	9.50 ft
Le ₂	1.00 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E'min	470 ksi
F _{cperp}	405 psi
cb	1.00

Column Loading

P	1982.9 lbs
W ₁	7 plf
M1	75 ft-lbs
W ₂	0 plf
M2 (Braced)	0 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.30
Repetitive - C _r	1.15

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.15
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	899 psi
F _{c*1}	1645 psi
F _{ce1} /F _{c*1}	0.547
C _{p1}	0.466

Weak Axis

F _{ce2}	24146 psi
F _{c*2}	1645 psi
F _{ce2} /F _{c*2}	14.683
C _{p2}	1.000

Bracing

Braced
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	9334 psi
F _{b'1}	1271 psi
F _{be1} /F _{b'1}	7.3
le	2.1 ft
CL ₁	1.00

Weak Axis

F _{be2}	1,053,148 psi
F _{b'2}	1271 psi
F _{be2} /F _{b'2}	829

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	766 psi
F _{b'1}	1271 psi

Weak Axis

F _{c'2}	1645 psi
F _{b'2}	1271 psi

Imposed Column Stresses

Strong Axis

f _{c1}	240 psi
f _{b1}	119 psi

Weak Axis

f _{c2}	240 psi
f _{b2}	0 psi

Perpendicular to Grain Stress Check f_c/F_cp =	240 / 405	OK
Slenderness Check le/d	21	OK
Slenderness Check le/b	8	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}'[1-f_c/F_{cE1}]} + \frac{f_{b2}}{F_{b2}'[1-f_c/F_{cE2}-(f_{b1}/F_{bE1})]} \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{bE}} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_{c'}} + \frac{f_{b1}}{F_{b1}'} + \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.31	OK
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Project: Korpela Wiens Date: 10/30/2023
Main Floor Wall/Columns: MW-2 Project #: 02327-2023-04
 Design: SS
 Sheet: 1

Column Buckling Calculations (MW-3)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
Hem-Fir Plates	
b	1.5 in
d	5.5 in
Le ₁	12.00 ft
Le ₂	1.00 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E' _{min}	470 ksi
F _{cperp}	405 psi
cb	1.00

Column Loading

P	780 lbs
W ₁	30 plf
M1	540 ft-lbs
W ₂	0 plf
M2 (Braced)	0 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.60
Size Factor - C _F	1.30
Repetitive - C _r	1.15

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.15
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	564 psi
F _{c*1}	1645 psi
F _{ce1} /F _{c*1}	0.343
C _{p1}	0.314

Weak Axis

F _{ce2}	24146 psi
F _{c*2}	1645 psi
F _{ce2} /F _{c*2}	14.683
C _{p2}	1.000

Bracing

Braced
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	9334 psi
F _{b'1}	2033 psi
F _{be1} /F _{b'1}	4.6
le	2.1 ft
CL ₁	1.00

Weak Axis

F _{be2}	1,053,148 psi
F _{b'2}	2033 psi
F _{be2} /F _{b'2}	518

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	516 psi
F _{b'1}	2033 psi

Weak Axis

F _{c'2}	1645 psi
F _{b'2}	2033 psi

Imposed Column Stresses

Strong Axis

f _{c1}	95 psi
f _{b1}	857 psi

Weak Axis

f _{c2}	95 psi
f _{b2}	0 psi

Perpendicular to Grain Stress Check f_c/F_c =	95 / 405	OK
Slenderness Check le/d	26	OK
Slenderness Check le/b	8	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}' [1 - f_c/F_{cE1}]} + \frac{f_{b2}}{F_{b2}' [1 - f_c/F_{cE2} - (f_{b1}/F_{bE1})]} \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{bE}} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_{c'}} + \frac{f_{b1}}{F_{b1}'} + \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.54	OK
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Project: Korpela Wiens Date: 10/30/2023
Main Floor Wall/Columns: MW-3 Project #: 02327-2023-04
 Design: SS
 Sheet: 1

Column Buckling Calculations (MC-2)

NDS 2018

Column Geometry Data

2X or 4X Doug Fir - Larch #1	
Hem-Fir Plates	
b	3 in
d	5.5 in
Le ₁	11.00 ft
Le ₂	11.00 ft
le _{bending}	ft

Column Design Values

F _b	1000 psi
F _c	1500 psi
E'min	620 ksi
F _{cperp}	405 psi
cb	1.00

Column Loading

P	3583.1 lbs
W ₁	6 plf
M1	85 ft-lbs
W ₂	2.2917 plf
M2	35 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.60
Size Factor - C _F	1.30
Repetitive - C _r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.15
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	885 psi
F _{c*1}	1898 psi
F _{ce1} /F _{c*1}	0.466
C _{p1}	0.409

Weak Axis

F _{ce2}	263 psi
F _{c*2}	1898 psi
F _{ce2} /F _{c*2}	0.139
C _{p2}	0.135

Bracing

No Brace
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	5255 psi
F _{b'1}	2080 psi
F _{be1} /F _{b'1}	2.5
le	19.3 ft
CL ₁	0.97

Weak Axis

F _{be2}	31,574 psi
F _{b'2}	2080 psi
F _{be2} /F _{b'2}	15

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	777 psi
F _{b'1}	2017 psi

Weak Axis

F _{c'2}	255 psi
F _{b'2}	2080 psi

Imposed Column Stresses

Strong Axis

f _{c1}	217 psi
f _{b1}	68 psi

Weak Axis

f _{c2}	217 psi
f _{b2}	50 psi

Perpendicular to Grain Stress Check f_c/F_c =	217 / 405	OK
Slenderness Check le/d	24	OK
Slenderness Check le/b	44	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}'[1-f_c/F_{cE1}]} + \frac{f_{b2}}{F_{b2}'[1-f_c/F_{cE2}-(f_{b1}/F_{bE1})]} \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{bE}} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_{c'}} + \frac{f_{b1}}{F_{b1}'} + \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.91	OK
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Project: Korpela Wiens Date: 10/30/2023
Main Floor Wall/Columns: MC-2 Project #: 02327-2023-04
 Design: SS
 Sheet: 1

Column Buckling Calculations (MC-3)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
Hem-Fir Plates	
b	3 in
d	3.5 in
Le ₁	9.50 ft
Le ₂	1.00 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E'min	470 ksi
F _{cperp}	405 psi
cb	1.00

Column Loading

P	3000 lbs
W ₁	6 plf
M1	63 ft-lbs
W ₂	2.2917 plf
M2 (Braced)	0 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.60
Size Factor - C _F	1.30
Repetitive - C _r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.60
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	364 psi
F _{c*1}	2288 psi
F _{ce1} /F _{c*1}	0.159
C _{p1}	0.154

Weak Axis

F _{ce2}	96585 psi
F _{c*2}	2288 psi
F _{ce2} /F _{c*2}	42.214
C _{p2}	1.000

Bracing

Braced
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	58669 psi
F _{b'1}	1768 psi
F _{be1} /F _{b'1}	33.2
le	2.1 ft
CL ₁	1.00

Weak Axis

F _{be2}	213,241 psi
F _{b'2}	1768 psi
F _{be2} /F _{b'2}	121

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	351 psi
F _{b'1}	1768 psi

Weak Axis

F _{c'2}	2288 psi
F _{b'2}	1768 psi

Imposed Column Stresses

Strong Axis

f _{c1}	286 psi
f _{b1}	124 psi

Weak Axis

f _{c2}	286 psi
f _{b2}	0 psi

Perpendicular to Grain Stress Check f_c/F_c =	286 / 405	OK
Slenderness Check le/d	33	OK
Slenderness Check le/b	4	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}' [1 - f_c / F_{cE1}]} + \frac{f_{b2}}{F_{b2}' [1 - f_c / F_{cE2} - (f_{b1} / F_{b1}')] } \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{b1}'} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_c'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.99	OK
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Project: Korpela Wiens Date: 10/30/2023
Main Floor Wall/Columns: MC-3 Project #: 02327-2023-04
 Design: SS
 Sheet: 1

* Design MC1

- P: • Main Floor Beam Reaction = $(15 + 25 \text{ psf})(0.75 \text{ ft})(7 \text{ ft} / 2) = 105 \text{ lb}$

• UB2 Reaction = 1717 lb

• UB3 Reaction = 2072 lb

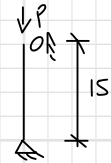
• Main Floor Beam Reaction = $(12 + 40 \text{ psf})(11 \text{ ft} / 2)(7 \text{ ft} / 2) = 1000 \text{ lb}$

$P_{ca} = 4900 \text{ lb}$

By inspection, use pipe 2 1/2 STD

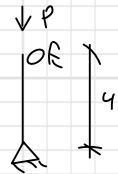
↳ Fty: $q_{max} = 4.9 \text{ k} / (1.5 \text{ ft})^2 = 2.18 \text{ ksf} < q_{allow} = 2.5 \text{ ksf} \therefore \text{OK}$

∴ Use pipe 3 std w/ 1.5' sq. Fty

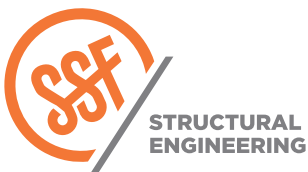


* Design MC4

- P: UB7 Reaction = 470 lb



∴ Use HSS 2x2x1/4 By Inspection



Korpela Wiens

PROJECT

Main Floor Framing Calcs

10/17/23

DATE

02327-2023-04

PROJ. #

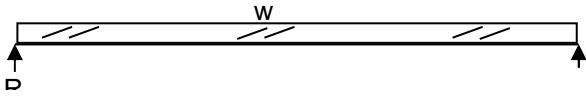
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DESIGN

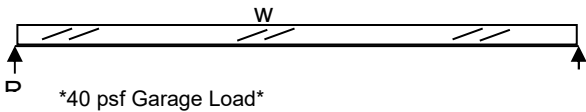
V1

SHEET

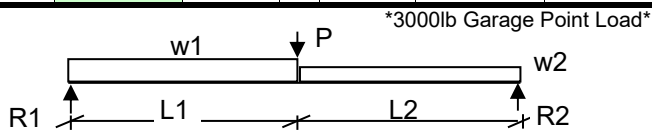
Beam	MB1	GL	5 1/2 x 15
w=	676 plf	R=	7,267 lbs
L=	21.5 ft	M=	39,060 ft-lbs
b=	5.50 in	Fb=	2,273 psi
d=	15.000 in	Fv=	117 psi
E=	1800 ksi	Δ=	1.17 in
Cv=	0.97 ≤1.0	I/	221



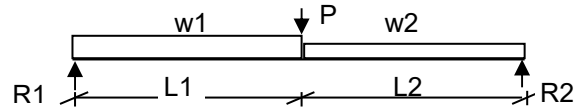
Beam	MB2	HF	4 x 12
w=	140 plf	R=	531 lbs
L=	7.58333333 ft	M=	1,006 ft-lbs
b=	3.50 in	Fb=	164 psi
d=	11.25 in	Fv=	15 psi
E=	1300 ksi	Δ=	0.02 in
Cv=	1.00 ≤1.0	I/	4716



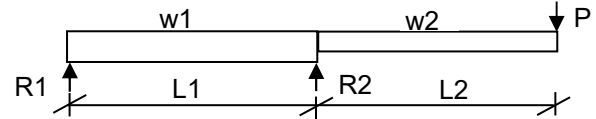
Beam	MB2	HF	4 x 12
w1=	87 plf	R1 =	1,829 lbs
w2=	87 plf	R2 =	1,829 lbs
L1=	3.792 ft	M =	6,310 lb-ft
L2=	3.792 ft	Fb =	1,026 psi
X=	3.792 ft	Fv =	67 psi
P=	3,000 lbs	Δ=	0.10 in
b=	3.50 in	I/	917
d=	11.25 in	Cv=	1.00
E=	1,300 ksi		



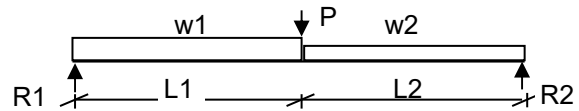
Beam	MB3	DF	6 x 10
w1=	486 plf	R1 =	2,963 lbs
w2=	486 plf	R2 =	3,100 lbs
L1=	4.25 ft	M =	8,210 lb-ft
L2=	3.75 ft	Fb =	1,191 psi
X=	4.25 ft	Fv =	78 psi
P=	2,179 lbs	Δ=	0.13 in
b=	5.50 in	I/	760
d=	9.50 in	Cv=	1.00
E=	1,700 ksi		



Beam	MB4 (Seismic C)	HF	4 x 10
w1=	58 plf	R1=	147 lbs
w2=	58 plf	R2=	3,125 lbs
L1=	12 ft	M+=	187 lb-ft
L2=	1 ft	M=-	2,535 lb-ft
X=	6.13 ft	Fb=	610 psi
P=	2,506.49 lbs	Fv=	117 psi
b=	3.50 in	Δspan=	(0.039) in
d=	9.25 in	I span/	(3,733)
E=	1,300 ksi	Δcant=	0.04 in
Cv=	1.00	I cant/	616



Beam	MB4 (Seismic T)	HF	4 x 10
w1=	10 plf	R1 =	(70) lbs
w2=	10 plf	R2 =	(1,525) lbs
L1=	12 ft	M =	(653) lb-ft
L2=	1 ft	Fb =	(157) psi
X=	12.0 ft	Fv =	(4) psi
P=	(1,720) lbs	Δ=	(0.03) in
b=	3.50 in	I/	(4,940)
d=	9.25 in	Cv=	1.00
E=	1,300 ksi		



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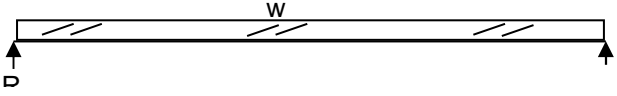
Project: Korpela Wiens Date: 10/26/23

02327-2023-04 Project #: _____

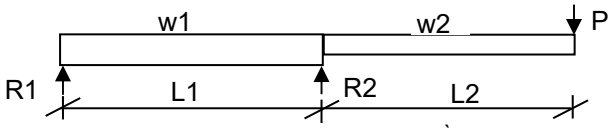
Main Floor Framing Calcs Design: SS

Sheet: _____

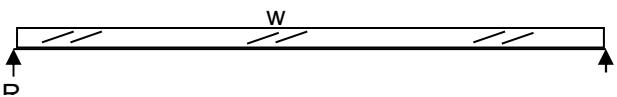
Beam	MB5 (12" O.C.)	HF	2	x 8
w=	87.78 plf	R=	395	lbs
L=	9 ft	M=	889	ft-lbs
b=	1.50 in	Fb=	812	psi
d=	7.25 in	Fv=	47	psi
E=	1300 ksi	Δ =	0.21	in
Cv=	1.00 ≤ 1.0	I/	516	



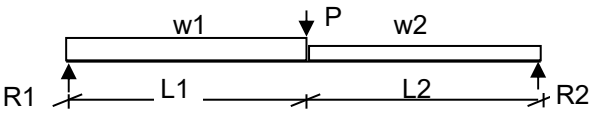
Beam	MB8	HF	4	x 10
w1=	73 plf	R1=	98	lbs
w2=	73 plf	R2=	4,446	lbs
L1=	12.0 ft	M+=	65	lb-ft
L2=	1.1 ft	M-=	4,095	lb-ft
X=	6.00 ft	Fb=	985	psi
P=	3,583 lbs	Fv=	167	psi
b=	3.50 in	Δ span=	(0.099)	in
d=	9.25 in	I span/	(1,462)	
E=	1,300 ksi	Δ cant=	0.08	in
Cv=	1.00	I cant/	329	



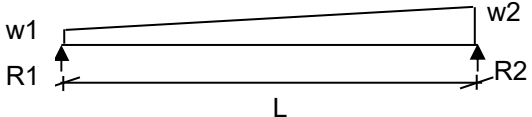
Beam	MB5 (16" O.C.)	HF	2	x 8
w=	87.78 plf	R=	351	lbs
L=	8 ft	M=	702	ft-lbs
b=	1.50 in	Fb=	641	psi
d=	7.25 in	Fv=	41	psi
E=	1300 ksi	Δ =	0.13	in
Cv=	1.00 ≤ 1.0	I/	735	



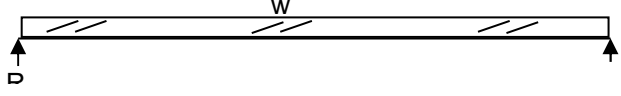
Beam	MB9	GL	5 1/2	x 10 1/2
w1=	700 plf	R1 =	4,560	lbs
w2=	700 plf	R2 =	6,362	lbs
L1=	6.50 ft	M =	14,849	lb-ft
L2=	2.75 ft	Fb =	1,763	psi
X=	6.5 ft	Fv =	149	psi
P=	4,446 lbs	Δ =	0.19	in
b=	5.50 in	I/	584	
d=	10.50 in	Cv=	1.00	
E=	1,800 ksi			



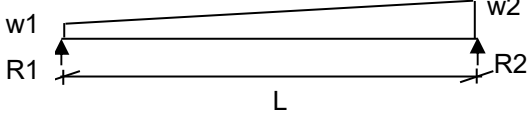
Beam	MB6	GL	3 1/2	x 12
w1=	517 plf	R1 =	2,663	lbs
w2=	88 plf	R2 =	1,644	lbs
L=	14.25 ft	M =	7,816	lb-ft
b=	3.50 in	Fb =	1,117	psi
d=	12.00 in	Fv =	77	psi
E=	1,800 ksi	Δ =	0.31	in
Cv=	1.00	I/	554	



Beam	MB10	DF-L	6	x 6
w=	166.8 plf	R=	917	lbs
L=	11 ft	M=	2,523	ft-lbs
b=	5.50 in	Fb=	1,092	psi
d=	5.50 in	Fv=	42	psi
E=	1700 ksi	Δ =	0.42	in
Cv=	1.00 ≤ 1.0	I/	311	



Beam	MB7	HF	4	x 12
w1=	338 plf	R1 =	1,635	lbs
w2=	- plf	R2 =	817	lbs
L=	14.50 ft	M =	4,562	lb-ft
b=	3.50 in	Fb =	742	psi
d=	11.25 in	Fv =	51	psi
E=	1,300 ksi	Δ =	0.31	in
Cv=	1.00	I/	559	




Project: Korpela Wiens Date: 10/26/23
02327-2023-04 Project #: _____
Main Floor Framing Calcs Design: SS
 Sheet: _____

Column Buckling Calculations (LW-1)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
Hem-Fir Plates	
b	1.5 in
d	5.5 in
Le ₁	8.50 ft
Le ₂	1.00 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E'min	470 ksi
F _{cperp}	405 psi
cb	1.00

Column Loading

P	2988 lbs
W ₁	7 plf
M1	60 ft-lbs
W ₂	0 plf
M2 (Braced)	0 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.30
Repetitive - C _r	1.15

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.15
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	1123 psi
F _{c*1}	1645 psi
F _{ce1} /F _{c*1}	0.683
C _{p1}	0.549

Weak Axis

F _{ce2}	24146 psi
F _{c*2}	1645 psi
F _{ce2} /F _{c*2}	14.683
C _{p2}	1.000

Bracing

Braced
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	9334 psi
F _{b'1}	1271 psi
F _{be1} /F _{b'1}	7.3
le	2.1 ft
CL ₁	1.00

Weak Axis

F _{be2}	1,053,148 psi
F _{b'2}	1271 psi
F _{be2} /F _{b'2}	829

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	903 psi
F _{b'1}	1271 psi

Weak Axis

F _{c'2}	1645 psi
F _{b'2}	1271 psi

Imposed Column Stresses

Strong Axis

f _{c1}	362 psi
f _{b1}	96 psi

Weak Axis

f _{c2}	362 psi
f _{b2}	0 psi

Perpendicular to Grain Stress Check f_c/F_c =	362 / 405	OK
Slenderness Check le/d	19	OK
Slenderness Check le/b	8	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}'[1-f_c/F_{cE1}]} + \frac{f_{b2}}{F_{b2}'[1-f_c/F_{cE2}-(f_{b1}/F_{b1}')] } \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{b1}'} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_c'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.40	OK
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Project: Korpela Wiens Date: 11/8/2023
Lower Floor Wall/Columns: LW-1 Project #: 02327-2023-04
 Design: SS
 Sheet: 1

Column Buckling Calculations (LC-1)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
-N/A-	
b	3.5 in
d	5.5 in
Le ₁	8.00 ft
Le ₂	8.00 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E'min	470 ksi
F _{cperp}	0 psi
cb	1.00

Column Loading

P	4720.8 lbs
W ₁	1.46 plf
M1	12 ft-lbs
W ₂	2.29 plf
M2	18 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.30
Repetitive - C _r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	1268 psi
F _{c*1}	1430 psi
F _{ce1} /F _{c*1}	0.887
C _{p1}	0.648

Weak Axis

F _{ce2}	514 psi
F _{c*2}	1430 psi
F _{ce2} /F _{c*2}	0.359
C _{p2}	0.327

Bracing

No Brace
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	7262 psi
F _{b'1}	1105 psi
F _{be1} /F _{b'1}	6.6
le	14.4 ft
CL ₁	0.99

Weak Axis

F _{be2}	28,209 psi
F _{b'2}	1105 psi
F _{be2} /F _{b'2}	26

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	927 psi
F _{b'1}	1095 psi

Weak Axis

F _{c'2}	468 psi
F _{b'2}	1105 psi

Imposed Column Stresses

Strong Axis

f _{c1}	245 psi
f _{b1}	8 psi

Weak Axis

f _{c2}	245 psi
f _{b2}	20 psi

Perpendicular to Grain Stress Check f _c /F _c =	-N/A-	OK
Slenderness Check le/d	17	OK
Slenderness Check le/b	27	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}'[1-f_c/F_{cE1}]} + \frac{f_{b2}}{F_{b2}'[1-f_c/F_{cE2}-(f_{b1}/F_{b1}')] } \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{b1}'} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_c'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.52	OK
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Fax: 206.443.4870

Project: Korpela Wiens Date: 11/8/2023
Lower Floor Wall/Columns: LC-1 Project #: 02327-2023-04
 Design: SS
 Sheet: 1

Column Buckling Calculations (LC-2)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
-N/A-	
b	3.5 in
d	3.5 in
Le ₁	8.00 ft
Le ₂	8.00 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E'min	470 ksi
F _{cperp}	0 psi
cb	1.00

Column Loading

P	2461 lbs
W ₁	2.29 plf
M1	18 ft-lbs
W ₂	2.29 plf
M2	18 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.00
Repetitive - C _r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.00

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	514 psi
F _{c*1}	1300 psi
F _{ce1} /F _{c*1}	0.395
C _{p1}	0.356

Weak Axis

F _{ce2}	514 psi
F _{c*2}	1300 psi
F _{ce2} /F _{c*2}	0.395
C _{p2}	0.356

Bracing

No Brace
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	11822 psi
F _{b'1}	850 psi
F _{be1} /F _{b'1}	13.9
le	13.9 ft
CL ₁	1.00

Weak Axis

F _{be2}	11,424 psi
F _{b'2}	850 psi
F _{be2} /F _{b'2}	13

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	462 psi
F _{b'1}	850 psi

Weak Axis

F _{c'2}	462 psi
F _{b'2}	850 psi

Imposed Column Stresses

Strong Axis

f _{c1}	201 psi
f _{b1}	31 psi

Weak Axis

f _{c2}	201 psi
f _{b2}	31 psi

Perpendicular to Grain Stress Check f _{cp} /F _{cp} =	-N/A-	OK
Slenderness Check le/d	27	OK
Slenderness Check le/b	27	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}'[1-f_c/F_{cE}]} + \frac{f_{b2}}{F_{b2}'[1-f_c/F_{cE}-(f_{b1}/F_{b1}')]}} \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{b1}'} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_c'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.43	OK
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Project:	Korpela Wiens	Date:	11/8/2023
	Lower Floor Wall/Columns: LC-2	Project #:	02327-2023-04
		Design:	SS
		Sheet:	1

Column Buckling Calculations (LC-3)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
Hem-Fir Plates	
b	3 in
d	5.5 in
Le ₁	7.50 ft
Le ₂	1.00 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E'min	470 ksi
F _{cperp}	405 psi
cb	1.00

Column Loading

P	6400 lbs
W ₁	2.29 plf
M1	16 ft-lbs
W ₂	2.29 plf
M2 (Braced)	0 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.30
Repetitive - C _r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.10
Size Factor - C _F	1.00

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	1443 psi
F _{c*1}	1430 psi
F _{ce1} /F _{c*1}	1.009
C _{p1}	0.694

Weak Axis

F _{ce2}	96585 psi
F _{c*2}	1430 psi
F _{ce2} /F _{c*2}	67.542
C _{p2}	1.000

Bracing

Braced
No Brace

Beam Stability Factor Calculation

Strong Axis

F _{be1}	37335 psi
F _{b'1}	1105 psi
F _{be1} /F _{b'1}	33.8
le	2.1 ft
CL ₁	1.00

Weak Axis

F _{be2}	526,574 psi
F _{b'2}	1105 psi
F _{be2} /F _{b'2}	477

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	993 psi
F _{b'1}	1105 psi

Weak Axis

F _{c'2}	1430 psi
F _{b'2}	1105 psi

Imposed Column Stresses

Strong Axis

f _{c1}	388 psi
f _{b1}	13 psi

Weak Axis

f _{c2}	388 psi
f _{b2}	0 psi

Perpendicular to Grain Stress Check f_c/F_c =	388 / 405	OK
Slenderness Check le/d	16	OK
Slenderness Check le/b	4	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}'[1-f_c/F_{cE1}]} + \frac{f_{b2}}{F_{b2}'[1-f_c/F_{cE2}-(f_{b1}/F_{b1}')] } \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{b1}'} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_c'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.39	OK
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Project: Korpela Wiens Date: 11/8/2023
Lower Floor Wall/Columns: LC-3 Project #: 02327-2023-04
 Design: SS
 Sheet: 1

Column Buckling Calculations (LC-4)

NDS 2018

Column Geometry Data

Hem-Fir #2 Studs	
Hem-Fir Plates	
b	3.5 in
d	5.5 in
Le ₁	1.00 ft
Le ₂	7.50 ft
le _{bending}	ft

Column Design Values

F _b	850 psi
F _c	1300 psi
E'min	470 ksi
F _{cperp}	405 psi
cb	1.00

Column Loading

P	4900 lbs
W ₁	0.00 plf
M1 (Braced)	0 ft-lbs
W ₂	2.29 plf
M2	16 ft-lbs

Flexural Stress Adjustment Factors

Roof/EQ / Wind - C _D	1.00
Size Factor - C _F	1.30
Repetitive - C _r	1.00

Compressive Parallel Adjustment Factors

Roof/EQ / Wind - C _D	1.15
Size Factor - C _F	1.10

Other Factors

Visually Graded Lumber	
c	0.8
Solid Column	
K _f	1
Column: Pinned Pinned	
K _e	1

Column Stability Factor Calculation

Strong Axis

F _{ce1}	324633 psi
F _{c*1}	1645 psi
F _{ce1} /F _{c*1}	197.405
C _{p1}	1.000

Weak Axis

F _{ce2}	584 psi
F _{c*2}	1645 psi
F _{ce2} /F _{c*2}	0.355
C _{p2}	0.324

Bracing

No Brace
Braced

Beam Stability Factor Calculation

Strong Axis

F _{be1}	7697 psi
F _{b'1}	1105 psi
F _{be1} /F _{b'1}	7.0
le	13.6 ft
CL ₁	0.99

Weak Axis

F _{be2}	30,090 psi
F _{b'2}	1105 psi
F _{be2} /F _{b'2}	27

Bearing

Area
Increase
No

Adjusted Allowable Stresses

Strong Axis

F _{c'1}	1645 psi
F _{b'1}	1096 psi

Weak Axis

F _{c'2}	533 psi
F _{b'2}	1105 psi

Imposed Column Stresses

Strong Axis

f _{c1}	255 psi
f _{b1}	0 psi

Weak Axis

f _{c2}	255 psi
f _{b2}	17 psi

Perpendicular to Grain Stress Check f_c/F_c =	255 / 405	OK
Slenderness Check le/d	2	OK
Slenderness Check le/b	26	OK

$$(1) \left(\frac{f_c}{F_c'} \right)^2 + \frac{f_{b1}}{F_{b1}'[1-f_c/F_{cE1}]} + \frac{f_{b2}}{F_{b2}'[1-f_c/F_{cE2}-(f_{b1}/F_{bE1})]} \leq 1.0$$

$$(2) \frac{f_c}{F_{cE2}} + \left(\frac{f_{b1}}{F_{bE}} \right)^2 < 1.0$$

$$(3) \frac{f_c}{F_c'}, \frac{f_{b1}}{F_{b1}'}, \frac{f_{b2}}{F_{b2}'} < 1.0$$

Allowable Stress Interaction Formula	0.48	OK
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Project: Korpela Wiens Date: 11/8/2023
Lower Floor Wall/Columns: LC-4 Project #: 02327-2023-04
 Design: SS
 Sheet: 1

Spread Footing Soil Bearing Design (1.5'x1.5')

Service Loads Loading

Dead Load =	0.0 kips
Live Load =	5.3 kips
Wind/EQ Load =	0.0 kips
Wind/EQ Moment (M_v) =	0 ft-kips
Gravity Load Eccentricity ($\pm X$) =	0.00 ft.
Footing Weight =	0.3 kips
Total Load =	5.6 kips
Total Moment =	0 ft-kips

Service Load Factors

DL	1
LL	1
EQ/Wind	1

Soil Properties

Allowable Soil Brg. (Q_a) =	2.50 ksf
Overburden Density (γ_s) =	120 psf
Net Ftg Wt? ($\gamma_c - \gamma_s$)	No

Column Dimensions and Location

Column Xc Dimension (D_x) =	4.00 in.
Column Yc Dimension (D_y) =	9.50 in.
Column Face from right (C_r) =	0.58 ft.
Column Face from left (C_l) =	0.58 ft.

Soil Bearing Check (Allowable)

Eccentricity =	0.00 ft.
Leng. Soil Brg. Under Ftg. =	1.50 ft.
q_{max} =	2.50 ksf
q_{min} =	2.50 ksf

OK

Footing Dimensions

L Dimension (X) =	1.50 ft.
B Dimension (Y) =	1.50 ft.
Footing Thickness (t) =	10.00 in.
Ftg Overburden (O_t) =	0.00 ft.

Soil Pressure Equations:

$$e \leq L/6$$

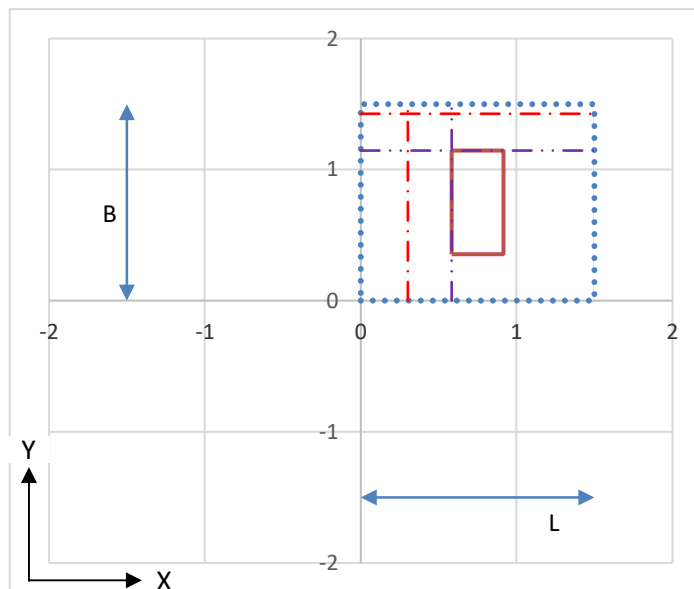
$$q_{max} = \frac{Q}{LB} \left(1 + \frac{6e}{L} \right)$$

$$q_{min} = \frac{Q}{LB} \left(1 - \frac{6e}{L} \right)$$

$$e > L/6$$

$$q_{max} = \frac{4Q}{3L(L-2e)}$$

$$q_{min} = 0$$



PROJECT	Korpela Wiens
	Spread Footing Design

DATE	10/26/2023
PROJ. #	SS
DESIGN	1
SHEET	

Spread Footing Concrete Design - ACI 318-14

Footing Properties

Concrete Strength (f'_c) =	2500 psi
Rebar Yield Strength (f_y) =	60000 psi
Reinforcing Clear Cover (c _{vr}) =	3.00 in.
Reinforcing Depth (d) =	6.75 in.

Strength Load Factors

DL	1.2
LL	1.6
EQ/Wind	1

Factored Loads

Factored Total Load =	8.9 kips
Factored Total moment =	0 ft-kips

Factored Moments and Shears

	Mu k-ft	Vu kips
X Right Side	1	2
X Left Side	1	2
Y Both Sides	0	0

Factored Bearing

Eccentricity =	0.00 ft.
Length of Soil Brg. Under Ftg. =	1.50 ft.
q _{max} =	3.95 ksf
q _{colr} =	3.95 ksf
q _{coll} =	3.95 ksf
q _{min} =	3.95 ksf

Flexural Design - X Direction (About Y-Axis)

Bar Size =	#4
Bars =	2
Mu =	1 ft-kips
∅Mn =	12 ft-kips
ρ _{min} =	0.0018
ρ _{req} =	0.0003
A _s Required =	0.22 sq. in.
A _s Provided =	0.40 sq. in.

OK
Controls

Flexural Design - Y Direction (About X-Axis)

Bar Size =	#4
Bars =	2
Mu =	0 ft-kips
∅Mn =	12 ft-kips
ρ _{min} =	0.0018
ρ _{req} =	0.0001
A _s Required =	0.22 sq. in.
A _s Provided =	0.40 sq. in.

OK
Controls

One-Way Shear Design - X Direction

Vu =	2 kips
∅Vn =	9 kips

OK

One-Way Shear Design - Y Direction

Vu =	0 kips
∅Vn =	9 kips

OK

β =	1.000
γ _s = 2/(β+1) =	1.00
Provide A _{s,req} γ _s =	0.22 sq. in.

Provide evenly distributed bars in each direction.

Two-Way (Punching) Shear Design

d _o =	54 in
vu =	4 kips
∅vn =	48 kips

OK

Concrete Capacity Equations:

$$Mn = A_s F_y \left[d - \frac{1}{2} \left(\frac{A_s F_y}{0.85 f'_c b} \right) \right] \quad vn = \min \left(\begin{array}{l} 4\sqrt{f'_c} \\ \left(2 + \frac{4}{\beta} \right) \sqrt{f'_c} \\ \left(2 + \frac{\alpha_s d}{b_o} \right) \sqrt{f'_c} \end{array} \right) b_o d$$

$$Vn = 2 \gamma \sqrt{f'_c} b_w d \quad b_o = 2(Dx + d) + 2(Dy + d)$$

$$\beta = \max(Dx, Dy) / \min(Dx, Dy)$$

Korpela Wiens

PROJECT

Spread Footing Design

10/26/2023

DATE

02327-2023-04

PROJ. #

SS

DESIGN

2

SHEET



Lateral



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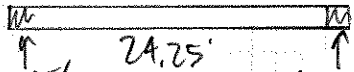
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LATERAL DESIGN

N/S

UPPER ROOF: $V_{eq} = \frac{4.0^k}{24.25} = 165^{#}$ $V_w = \frac{2.90^k}{24.25} = 120^{#}$

West East



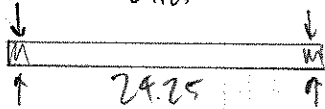
V(L) w/eq	1.45/2.0	1.45/2.0
L(ft)	7.5	17.08
w(#)	267	117
SW	w4	w6
OT	2.6"	—
HD	(2)CS16	—

LOWER ROOF: $V_{eq} = \frac{4.5}{27.5} = 164^{#}$ $V_w = \frac{3.3}{27.5} = 120^{#}$

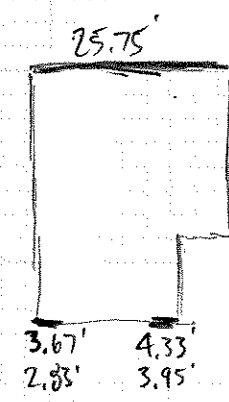
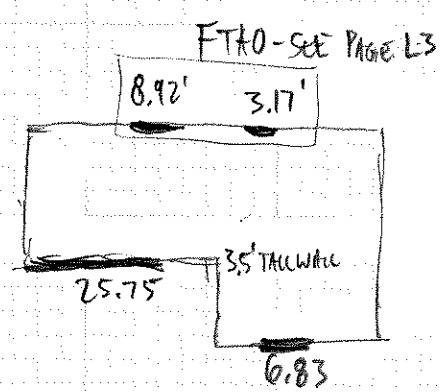
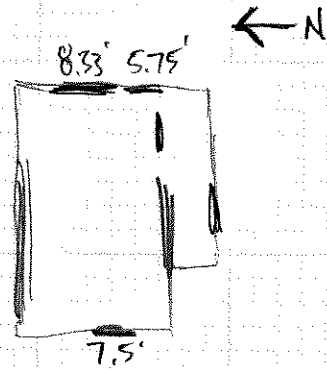


V(L) w/eq	.51/1.0	3.1/4.25	1.14/1.56
L(ft)	6.83	25.75	FTA0
w(#)	102	165	230
SW	w6	w6	w4
OT	—	.66" DL	1.04"
HD	—	—	CS16

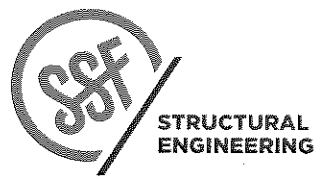
2ND FLOOR: $V_{eq} = \frac{2.0}{24.25} = 82.5^{#}$ $V_w = \frac{2.4^k}{24.25} = 101^{#}$



V(L) w/eq	2.67/3.0	4.32/5.25
L(ft)	8/6.78	25.75
w(#)	442	204
SW	w3	w6
OT	3.6" + 2.6"	1.12"
HD	HDU8 w/STRAPS ABOVE	APPLIED MIGHT
	HDU4 w/NO STRAPS	OF STUD - CARRY DOWN TO NEXT LEVEL FOR HD



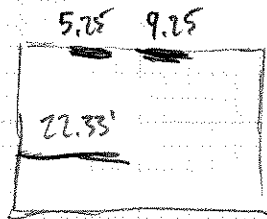
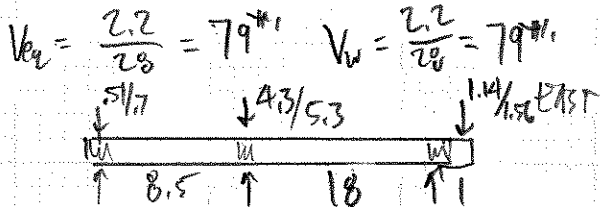
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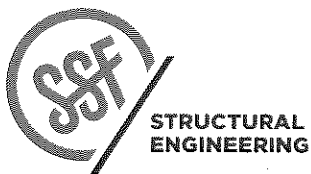
PROJECT: KORPILA W/RENS
 DATE: 10/13/23
 PROJ. #: 02327-2023-04
 DESIGN: BDM
 SHEET: L1

1st:

WEST



V(w)/ft	.85/1.04	5.4/6.4	1.93/2.35
L(ft)	7.074	22.33	14.5
V(+)	-	287	162
SW	-	W4	W6
OT	-	2.15+1.12	1.2
HD	-	HDU4	HDUZ



PROJECT KORPELA WRENS

DATE 10/13/23
 PROJ # 01327-2023-04
 DESIGN BDM
LZ
 SHEET



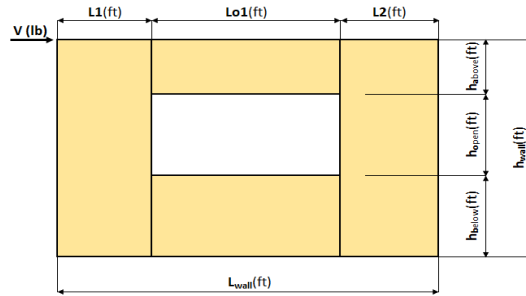
Force Transfer Around Openings Calculator

ONE OPENING

The force transfer around openings (FTAO) method of shear wall analysis is an approach that aims to reinforce the wall such that it performs as if there was no opening. This approach lends certain advantages over segmented shear walls: more versatility, because it allows for narrower wall segments while still meeting the height-to-width ratios and, often, fewer required hold-downs.

Project Information

Code:	IBC 2018	Date:	10/19/2023
Designer:	BDM		
Client:	Pooler		
Project:	Korpela		
Wall Line:			



Shear Wall Calculation Variables

V	1560 lbf	Opening 1	Adj. Factor Method =	1.25-0.125h/bs
L1	8.92 ft	ha	Wall Pier Aspect Ratio	Adj. Factor
L2	3.17 ft	ho	P1=ha/L1=	0.84
hwall	12.00 ft	hb	P2=hb/L2=	2.37
Lwall	18.09 ft	Lo1		0.954

1. Hold-down forces: $H = Vh_{wall}/L_{wall}$ = 1035 lbf

2. Unit shear above + below opening
First opening: $va1 = vb1 = H/(h_a+h_b) = 230$ plf

3. Total boundary force above + below openings
First opening: $O1 = va1 \times (Lo1) = 1380$ lbf

4. Corner forces
 $F1 = O1(L1)/(L1+L2) = 1018$ lbf
 $F2 = O1(L2)/(L1+L2) = 362$ lbf

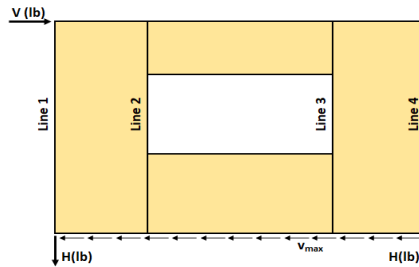
5. Tributary length of openings
 $T1 = (L1*Lo1)/(L1+L2) = 4.43$ ft
 $T2 = (L2*Lo1)/(L1+L2) = 1.57$ ft

6. Unit shear beside opening
 $v1 = (V/L)(L1+T1)/L1 = 129$ plf
 $v2 = (V/L)(T2+L2)/L2 = 129$ plf
Check $v1*L1+v2*L2=V?$ = 1560 lbf **OK**

7. Resistance to corner forces
 $R1 = v1*L1 = 1151$ lbf
 $R2 = v2*L2 = 409$ lbf

8. Difference corner force + resistance
 $R1-F1 = 133$ lbf
 $R2-F2 = 47$ lbf

9. Unit shear in corner zones
 $vc1 = (R1-F1)/L1 = 15$ plf
 $vc2 = (R2-F2)/L2 = 15$ plf



Check Summary of Shear Values for One Opening

Line 1: $vc1(h_a+h_b)+v1(h_o)=H?$		67	968	1035 lbf
Line 2: $va1(h_a+h_b)-vc1(h_a+h_b)-v1(h_o)=0?$	1035	67	968	0
Line 3: $va1(h_a+h_b)-vc2(h_a+h_b)-v1(h_o)=0?$	1035	67	968	0
Line 4: $vc2(h_a+h_b)+v2(h_o)=H?$		67	968	1035 lbf

Design Summary*

Req. Sheathing Capacity	230 plf	4-Term Deflection		3-Term Deflection	
Req. Strap Force	1018 lbf	4-Term Story Drift %		3-Term Story Drift %	
Req. HD Force (H)	1035 lbf				
Req. Shear Wall Anchorage Force (v_{max})	86 plf				

*The Design Summary assumes that the shear wall is designed as blocked.

E/W

UPPER ROOF:

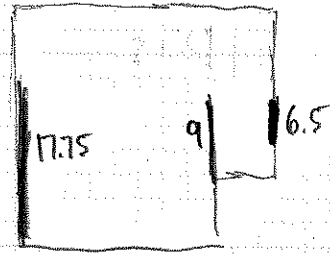
$$V_{eq} = \frac{4.0^k}{32.75} = 122 \quad V_w = \frac{3.1}{32.75} = 95$$

NORTH

SOUTH



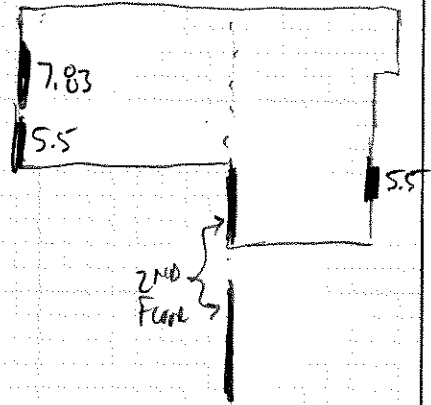
	W1	W2	W3
V(k) w/eq	1.21/1.56	1.55/2.0	34/.44
L(A)	17.75	9	6.5
v(#)	00	222	60
SW	W6	W6	W6
OT	—	2.4" - DL	—
HD	—	(2) C16/HDR	—



LOWER ROOF:

$$V_{eq} = \frac{4.5^k}{50.75} = 89 \quad V_w = \frac{6.7}{50.75} = 132$$

	W1	W2	W3
V(k) w/eq	1.50/1.01	3.25/2.19	1.95/1.31
L(A)	13.33		5.5
v(#)	113	TRANSFER TO 2ND FLOOR	355
SW	W6		W4
OT	—		3.2
HD	—		HDR4



2ND FLOOR:

From UPPER ROOF

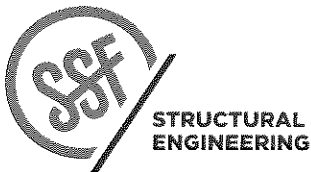
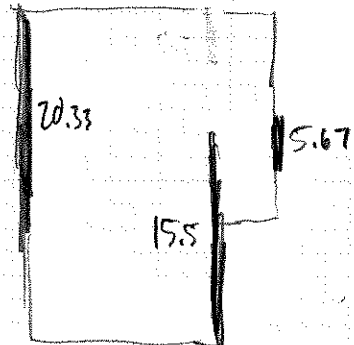
$$V_{eq} = \frac{2.0}{32.75} = 61$$

$$V_w = \frac{4.7}{32.75} = 144$$

From UPPER ROOF AND LOWER ROOF

From UPPER ROOF

	W1	W2	W3
V(k) w/eq	3.05/2.34	7.15/5.19	0.86/0.66
L(A)	20.33	15.5	5.67
v(#)	150	461	152
SW	W6	W3	W6
OT	—	4.6" - DL	—
HD	—	HDR4	—



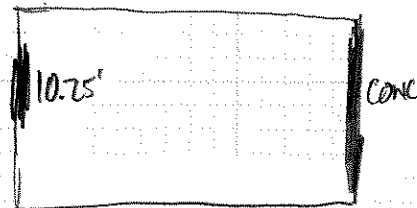
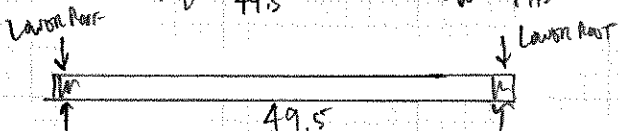
PROJECT _____

DATE _____
 PROJ. # _____
 DESIGN L4
 SHEET _____

1ST:

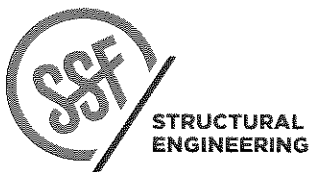
$$V_{eq} = \frac{2.2}{49.5} = 44^{lb}$$

$$V_w = \frac{6.2}{49.5} = 126^{lb}$$



V(L) w/eq	4.6/2.11
L(A)	10.25
V(A)	449
SW	W3
OS	3.37'
HD	HDU4

5.05/2.91
FLOOR



PROJECT _____

DATE _____
 PROJ. # _____
 DESIGN _____
 SHEET _____

LS