ADDENDUM STRUCTURAL CALCS

Derkashani Residence
8151 SE 48th St
Mercer Island, WA

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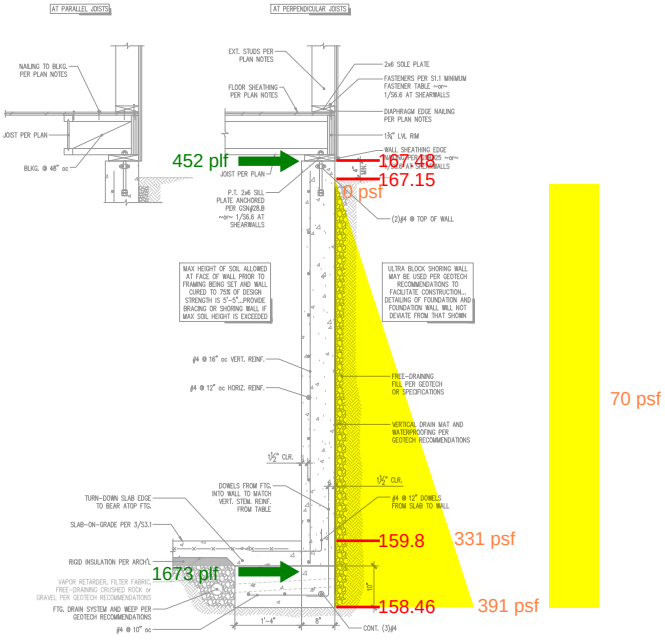
ATLAS CONSULTING ENGINEERS INC.

Project:	Derkashani Residence (8151 SE 48th St)	By:	JDA
Proj No:	167-2020	Date:	9/29/2021

Summary

See pages 2 to 5 for updated lateral design (slight adjustment in wind, does not impact original design).
See page 6 updated wind areas.
See pages 7 to 8 for diaphragm design.
See pages 9 to 13 anchorage design.
See pages 14 to 25 for design of force transfer around openings in shearwalls
See pages 26 to 41 for updated framing design including 5 psf rain on snow.
See page 42 for sample uplift calculation at extended roof
See pages 43 to 47 for updated retaining wall design.
See pages 49 to 50 for stair stringer design.
See page 51 for rockery wall design.
See page 52 for railing connection calculation.

New foundation walls retain soil and must either be detailed to allow framing to brace top of wall, or be designed to ensure wall can span horizontally to return walls. The new northwest and southwest walls span 12'-2" between return walls; the west wall is not retaining soil; and the east wall spans 24'-4". Looking at the FBD below, the ultimate worst case scenario for a pin-pin wall would need to resolve an ASD load of 452 plf at the top of wall (using 1.0H+0.7E). Similarly if the wall were to span horizontally, we would essentially have a 7.68' wide beam with #4 @ 12" oc bottom bars and depth of 8". With these values, the wall would have a flexural capacity of 51.4 k-ft. When considering 1.6H+1.0E pressures on the wall above the slab, this equates to a beam with a distributed load of 2460 plf. We can use this to get a maximum allowable wall horizontal span of 13', meaning the wall at the east face needs to be detailed to resolve 452 plf force into framing. Provide 3/4" diameter anchor @ 24" oc (936#/anchor, 468 plf capacity) to get load from top of wall into sill plate; an A35 @ 16" oc (487.5 plf capacity) to get load from sill plate into in-framing joists; and (8)8d nails from sheathing into joist (94#/nail, 752# per joist, 564 plf) to allow joists to brace wall.



R	6.5		ASCE 7-16 Table 12.2-1
Ω_o	2.5		
C_d	4		
V	39.0	Kips	= CsW ~ ASCE 7-16 (12.8-1)
C_s	0.178		
	0.178		= Sds / (R/Ie) ~ ASCE 7-16 (12.8-2)
	0.495		< Sd1 / T(R/Ie) ~ if T<TL, ASCE 7-16 (12.8-3)
	-		< Sd1TL / T2(R/Ie) ~ if T>TL, ASCE 7-16 (12.8-3)
	0.051		>0.044Sdsle ~ ASCE 7-16 (12.8-5)
	0.01		>0.01 ~ ASCE 7-16 (12.8-5)
	-		>0.5S1 / (R/Ie) ~ if S1>0.6g, ASCE 7-16 (12.8-6)
W	219	Kips	
I_e	1		ATC Hazard
F_v	1.8		Table 11.4-2 and Section 11.4.8 Exception
F_a	1.2		ATC Hazard
S_S	1.443	g	ATC Hazard
S_1	0.501	g	ATC Hazard
S_{mS}	1.732	g	ATC Hazard
S_{m1}	0.9018	g	= F_vS_1 ~ ASCE 7-16 (11.4-1)
S_{ds}	1.155	g	ATC Hazard
S_{d1}	0.6012	g	= 2/3 S_{m1} ~ ASCE 7-16 (11.4-4)
S_{DC}	D		
T_a	0.187	seconds	= Cthnx ~ ASCE 7-16 (12.8-7)
C_t	0.02		ASCE 7-16 Table 12.8-2
h_n	19.66	feet	
x	0.75		ASCE 7-16 Table 12.8-2
T_L	6	seconds	USGS Seismic Values
T_S	0.521	seconds	= S_{d1} /S_{ds}, ASCE 7-16 (11.4-3)
$1.5T_S$	0.781	seconds	

EXCEPTION: A ground motion hazard analysis is not required for structures other than seismically isolated structures and structures with damping systems where:

1. Structures on Site Class E sites with S_S greater than or equal to 1.0, provided the site coefficient F_a is taken as equal to that of Site Class C.
2. Structures on Site Class D sites with S_1 greater than or equal to 0.2, provided the value of the seismic response coefficient C_s is determined by Eq. (12.8-2) for values of $T \le 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. (12.8-3) for $T_L \ge T > 1.5T_s$ or Eq. (12.8-4) for $T > T_L$.
3. Structures on Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_s and the equivalent static force procedure is used for design.

Table 11.4-2 Long-Period Site Coefficient, F_v

Site Class	Mapped Risk-Targeted Maximum Considered Earthquake (MCE$_R$) Spectral Response Acceleration Parameter at 1-s Period $S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 = 0.5$	$S_1 \ge 0.6$
A	0.8	0.8	0.8	0.8	0.8	0.8
B	0.8	0.8	0.8	0.8	0.8	0.8
C	1.5	1.5	1.5	1.5	1.5	1.4
D	2.4	2.2[a]	2.0[a]	1.9[a]	1.8[a]	1.7[a]
E	4.2	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8
F	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8

Note: Use straight-line interpolation for intermediate values of S_1.
[a]Also, see requirements for site-specific ground motions in Section 11.4.8.

$$\delta_{an} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b} \qquad (4.3\text{-}1)$$

where:

b = shear wall length, ft

Δ_a = total vertical elongation of wall anchorage system (including fastener slip, device elongation, rod elongation, etc.) at the induced unit shear in the shear wall, in.

E = modulus of elasticity of end posts, psi

A = area of end post cross-section, in.^{2}

G_a = apparent shear wall shear stiffness from nail slip and panel shear deformation, kips/in. (from Column A, Tables 4.3A, 4.3B, 4.3C, or 4.3D)

h = shear wall height, ft

v = induced unit shear, lbs/ft

δ_{an} = maximum shear wall deflection determined by elastic analysis, in.

Story	Weight (Kips)	Height (ft)	Wh (Kip-ft)	C_{vx} (Wh/∑Wh)	F_{xE}, Kips ($C_{vx}V$)	$\sum F_{xE}$, Kips LRFD	F_{xE}, Kips ($C_{vx}V$)	$\sum F_{xE}$, Kips ASD	$\sum F_{xW}$, Kips West ASD	$\sum F_{xW}$, Kips South ASD
Roof	103.86	19.66	2,042	0.66	25.8	25.8	18.077	**18.077**	8.169	5.696
Main Floor	115.36	9.00	1,038	0.34	13.1	39.0	9.192	**27.3**	18.356	13.628
∑W	219.23									

UP-to-DOWN RUNNING WALLS

Main-to-Roof

	%	Length (ft)	# in Wall	SEISMIC PLF	Chord F (#)	# in Wall	WIND PLF	Chord F (#)	Wall W (#)	GRAVITY LOADING (plf) Snow	Dead	Live	Uplift	Comp	Anchorage	9.34 ft / 12.33333 ft			Deflection $\delta_{bending}$	δ_{shear}	$\delta_{anchorage}$	δ_{SW}
A	9.2%	25.33	1,669			754										12.33333 ft						
388	100.0%	25.33	1,669	66	615	754	30	278	2,957	90	54	0	0	2,534	1,032	6 OK	HDU2	OK	0.001	0.063	0.000	0.064
B	24.0%	9.00	4,332			1,958																
1007	19.0%	2.17	823	380	4,685	372	172	1,603	334	325	195	0	4,554	5,138	16,529	33 OK	HDU8	OK	0.140	0.197	0.282	0.619
	58.0%	4.38	2,513	574	7,083	1,135	260	2,424	674	325	195	0	6,817	7,749	24,884	33 OK	HDU8	OK	0.105	0.298	0.209	0.612
	23.0%	2.46	996	405	4,999	450	183	1,711	379	325	195	0	4,849	5,480	17,621	33 OK	HDU8	OK	0.132	0.210	0.265	0.607
C	23.6%	15.00	4,263			1,927										12.33333						
991	6.5%	2.17	277	128	1,577	125	58	540	334	325	195	0	1,446	2,098	5,429	2 OK	CU3,5	OK	0.071	0.098	0.267	0.436
	93.5%	12.83	3,986	311	3,831	1,801	140	1,311	1,978	325	195	0	3,051	5,313	12,471	4 OK	HDU2	OK	0.029	0.322	0.084	0.435
D	24.1%	16.73	4,354			1,967										9.34						
1012	5.5%	2.19	239	109	1,022	108	49	462	255	365	219	0	895	1,722	3,453	4 OK	CU2.5	OK	0.026	0.086	0.173	0.285
	25.0%	5.54	1,088	196	1,834	492	89	829	647	365	219	0	1,511	2,563	6,049	4 OK	CU2.5	OK	0.018	0.154	0.116	0.288
	69.5%	9.00	3,026	336	4,146	1,367	152	1,419	1,388	294	176	0	3,629	5,236	14,005	4 OK	MSTC52	OK	0.013	0.264	0.007	0.284
E	17.8%	14.83	3,214			1,452										9.34						
747	56.8%	7.96	1,825	229	2,142	825	104	968	929	365	219	0	1,678	2,998	6,930	6 OK	HDU2	OK	0.015	0.219	0.056	0.290
	43.2%	6.88	1,388	202	2,490	627	91	852	1,060	294	176	0	2,095	3,375	8,281	6 OK	HDU2	OK	0.015	0.192	0.081	0.289
F	1.4%	10.00	245			111										9.34						
57	100.0%	10.00	245	25	229	111	11	103	1,168	25	15	0	0	979	462	6 OK	HDU2	OK	0.001	0.023	0.000	0.025

Lower-to-Main

D	28.4%	19.46	6,965		2,612	7,183		5,216														
942	74.7%	14.54	5,205			5,368																
	25.3%	4.92	1,760	358	1,208	1,815	369	2,413	553	0	0	0	5,876	7,925	18,171	4 OK	CU6	OK	0.017	0.271	0.203	0.491
E	24.3%	21.17	5,696		2,238	6,032		4,469														
807		16.5	2,826	171	605	2,992	181	1,209	1,856	0	0	0	2,330	5,135	8,591	4	CU2.5	OK	0.005	0.130	0.058	0.192
	21.3%	4.50	1,211	269		1,282	285									4 OK						
	28.3%	6.00	1,615	269		1,710	285									4 OK						
		19.67	2,871	146	516	3,040	155	1,030	2,213	0	0	0	366	2,137	1,245	4	HDU2	OK	0.003	0.110	0.005	0.119
	36.2%	7.67	2,063	269		2,185	285									4 OK						
	14.2%	3.00	807	269		855	285									4 OK						

LEFT-to-RIGHT RUNNING WALLS

Main-to-Roof

				SEISMIC		WIND		GRAVITY LOADING (plf)													
	%	Length (ft)	# in Wall	PLF	Chord F (#)	# in Wall	PLF	Chord F (#)	Wall W (#)	Snow	Dead	Live	Uplift	Comp	Anchorage	*9.34 ft*					
1	7.1%	20.17	1,278			403										*12.33333 fr*					
297		23.17	1,278	55	515	403	17	162	2,705	0	0	0	45	2,208	1,110	6	HDU2	OK	0.001	0.053	0.001	0.054
	77.1%	15.54	985	63		310	20									6 OK						
	22.9%	4.63	293	63		92	20									6 OK						
2	41.3%	21.47	7,470			2,354																
1736	5.5%	0.00	411		0	129		0	0	0	0	0	0	0	0							
	41.8%	6.39	3,122	489	4,567	984	154	1,439	745	0	0	0	4,437	5,034	16,110	3 OK	HDU4	OK	0.040	0.343	0.162	0.545
100.0%	14.6%	4.38	1,091	249	3,074	344	79	969	674	0	0	0	2,957	3,497	10,798	4 OK	HDU4	OK	0.068	0.258	0.208	0.535
	14.6%	4.38	1,091	249	3,074	344	79	969	674	0	0	0	2,957	3,497	10,798	4 OK	HDU4	OK	0.068	0.258	0.208	0.535
	11.0%	3.00	822	274	2,558	259	86	806	350	0	0	0	2,497	2,777	9,042	4 OK	CU3	OK	0.048	0.215	0.294	0.556
	12.5%	3.33	934	280	2,616	294	88	824	389	0	0	0	2,549	2,860	9,239	4 OK	CU3	OK	0.044	0.220	0.270	0.534
3	8.6%	7.42	1,558			491																
362	100.0%	7.42	1,558	210	1,962	491	66	618	866	0	0	0	1,811	2,504	6,772	6 OK	HDU4	OK	0.015	0.200	0.057	0.272
4	18.7%	4.92	3,373			1,063																
784	50.0%	2.46	1,687	686	8,462	532	216	2,667	379	0	0	0	8,396	8,700	30,120	33 OK	HDU11	OK	0.116	0.356	0.516	0.988
	50.0%	2.46	1,687	686	8,462	532	216	2,667	379	0	0	0	8,396	8,700	30,120	33 OK	HDU11	OK	0.116	0.356	0.516	0.988
5	17.8%	13.42	3,214			1,013																
747	50.0%	6.71	1,607	240	2,238	506	75	705	783	0	0	0	2,101	2,728	7,780	6 OK	HDU2	OK	0.019	0.228	0.084	0.331
	50.0%	6.71	1,607	240	2,238	506	75	705	783	0	0	0	2,101	2,728	7,780	6 OK	HDU2	OK	0.019	0.228	0.084	0.331
6	5.4%	7.17	977			308																
227	50.0%	3.58	488	136	1,681	154	43	530	552	0	0	0	1,585	2,027	5,854	6 OK	MSTC40	OK	0.046	0.172	0.015	0.232
	50.0%	3.58	488	136	1,681	154	43	530	552	0	0	0	1,585	2,027	5,854	6 OK	MSTC40	OK	0.046	0.172	0.015	0.232
7	1.1%	4.67	207			65																
48	100.0%	4.67	207	44	413	65	14	130	545	0	0	0	319	754	1,329	6 OK	HDU2	OK	0.005	0.042	0.018	0.065

Lower-to-Main

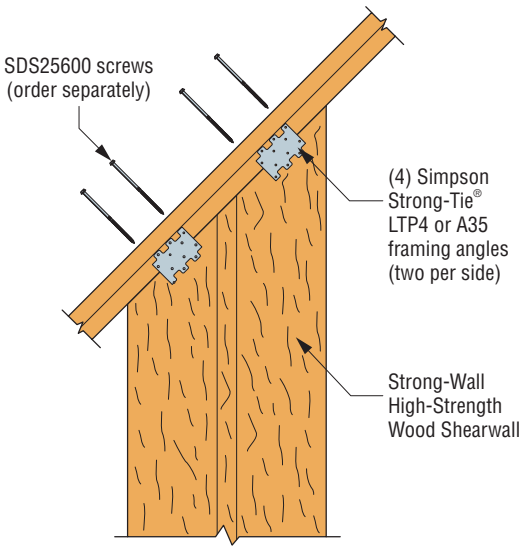
				SEISMIC		WIND		GRAVITY LOADING (plf)													
	%	Length (ft)	# in Wall	PLF	Chord F (#)	# in Wall	PLF	Chord F (#)	Wall W (#)	Snow	Dead	Live	Uplift	Comp	Anchorage	*9 ft*					
7																					
248	7.7%	15.00	708			1,049															
	76.0%	9.67	538	56	501	797	82	742	1,088	0	0	0	416	1,286	1,495	6 OK	HDU2	OK	0.003	0.051	0.011	0.065
	12.0%	2.67	85	32	287	126	47	425	300	0	0	0	335	575	943	6 OK	HDU2	OK	0.006	0.029	0.032	0.067
	12.0%	2.67	85	32	287	126	47	425	300	0	0	0	335	575	943	6 OK	HDU2	OK	0.006	0.029	0.032	0.067
427	13.3%	19.67	1,219			1,807															
	34.7%	6.83	423	62	558	628	92	827	769	0	0	0	596	1,211	1,784	6 OK	HDU2	OK	0.004	0.057	0.022	0.084
	65.3%	12.83	795	62	558	1,179	92	827	1,444	0	0	0	394	1,549	1,602	6 OK	HDU2	OK	0.002	0.057	0.008	0.067
5	8.4%	9.88	3,988		*773*	2,159		*1,147*														
271	27.5%	3.88	1,097	283	494	594	153	732	436	0	0	0	2,703	3,678	9,426	3 OK	CU3.5	OK	0.034	0.191	0.203	0.429
	72.5%	6.00	2,891	482	841	1,566	261	1,247	675	0	0	0	1,044	1,584	2,821	3 OK	HDU2	OK	0.037	0.326	0.045	0.408
6	8.8%	15.17	1,997		*813*	1,579		*1,206*														
285		23.17	1,997	86	316	1,579	68	468	2,606	0	0	0	1,585	3,974	6,279	6	CU2.5	OK	0.002	0.079	0.028	0.109
	76.4%	11.58	1,525	132		1,206	104									6 OK						
	23.6%	3.58	472	132		373	104									6 OK						

Standard and Balloon Framing on Concrete Foundations

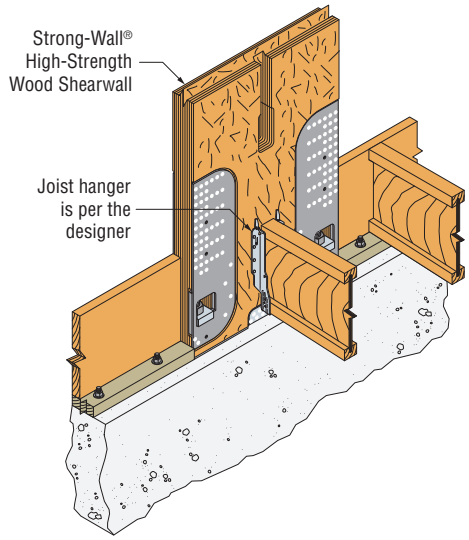
Strong-Wall® High-Strength Wood Shearwall Product Data

Model No.	Panel Information			Anchor Bolts	
	Width (in.)	Height (in.)	Weight (lb.)	Quantity	Diameter (in.)
WSWH12x7	12	84	105	2	1
WSWH18x7	18	84	155	2	1
WSWH12x8	12	96	120	2	1
WSWH18x8	18	96	175	2	1
WSWH24x8	24	96	225	2	1
WSWH12x9	12	108	130	2	1
WSWH18x9	18	108	195	2	1
WSWH24x9	24	108	250	2	1
WSWH12x10	12	120	145	2	1
WSWH18x10	18	120	210	2	1
WSWH24x10	24	120	275	2	1
WSWH12x12	12	144	165	2	1
WSWH18x12	18	144	245	2	1
WSWH24x12	24	144	325	2	1
WSWH18x14	18	168	285	2	1
WSWH24x14	24	168	370	2	1
WSWH24x16	24	192	420	2	1
WSWH18x20	18	240	390	2	1
WSWH24x20	24	240	520	2	1

1. To achieve evaluated panel heights listed in the allowable load table or for those not listed, order the next tallest panel and trim to fit. Minimum trimmed height for all panels is 74½".
2. All panels are supplied with preattached holdowns, two heavy hex nuts, two heavy bearing plates, one WSWH-TP top connection plate (width based on panel model), required fasteners and installation instructions.
3. All panels are 3½" thick.

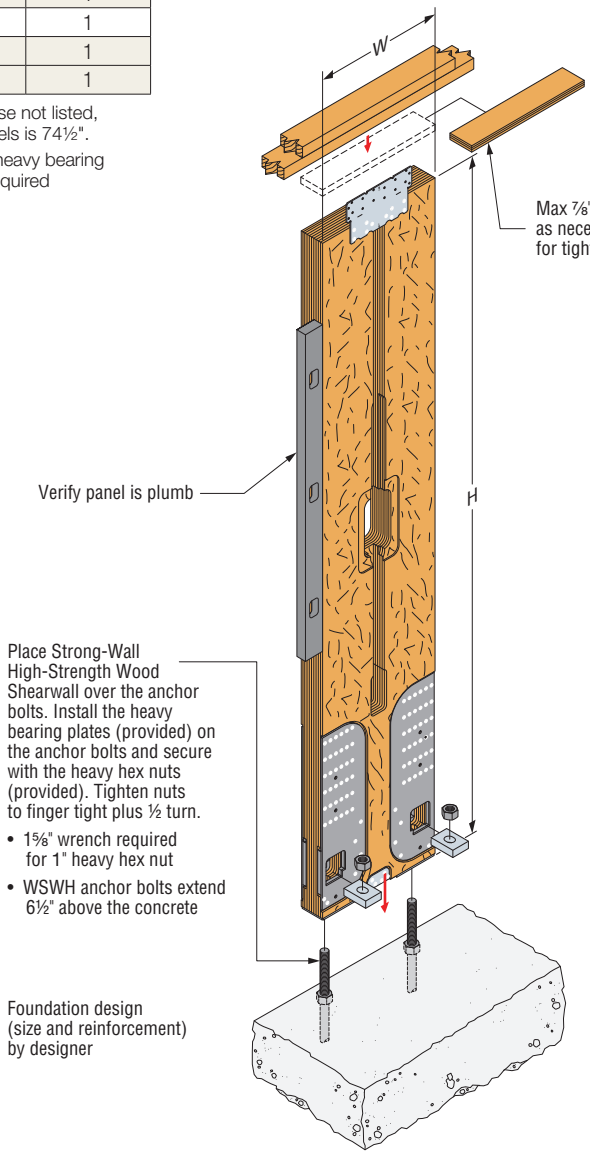


Rake Wall Application



First-Story Installation with Wood Floor System

Specify panel height from top of foundation to underside of the top plates or beam.



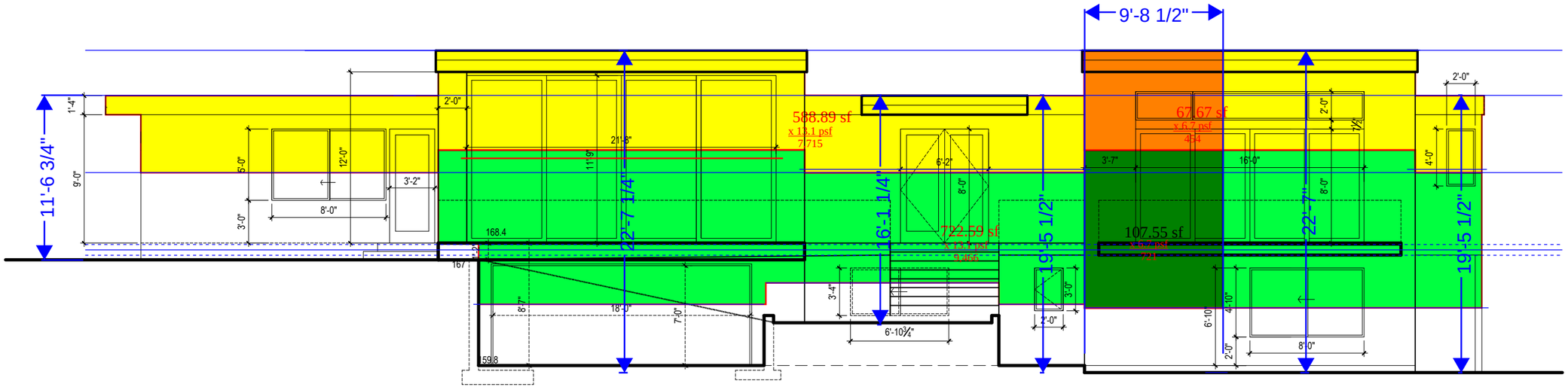
Standard Installation

Standard and Balloon Framing on Concrete Foundations

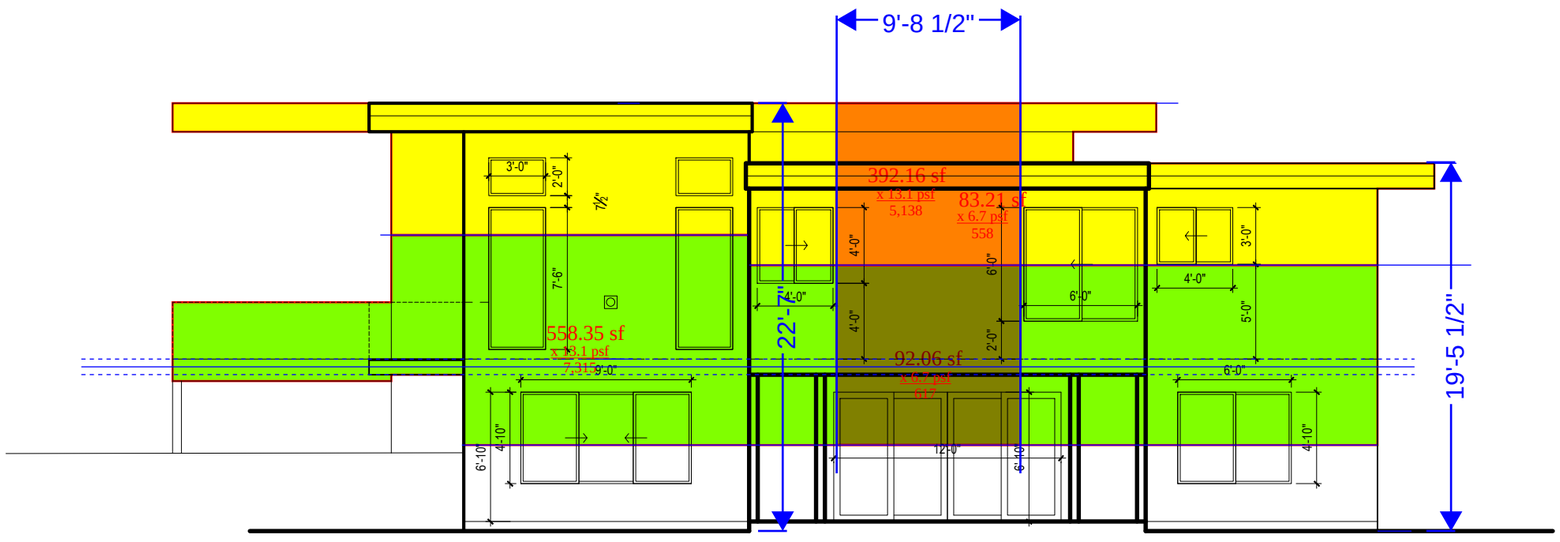
(cont.)

Strong-Wall High-Strength Wood Shearwall Model No.	Panel Evaluation Height, H_e (lb.)[6]	Allow Vertical Load, P (lb.)[4]	2,500 psi Concrete						3,000 psi Concrete					
			Seismic[3]			Wind			Seismic[3]			Wind		
			Allowable ASD Shear Load, V (lb.)	Drift at Allowable Shear, Δ (in.)[7]	Anchor Tension at Allowable Shear, T (lb.)[11]	Allowable ASD Shear Load, V (lb.)	Drift at Allowable Shear, Δ (in.)[7]	Anchor Tension at Allowable Shear, T (lb.)[11]	Allowable ASD Shear Load, V (lb.)	Drift at Allowable Shear, Δ (in.)[7]	Anchor Tension at Allowable Shear, T (lb.)[11]	Allowable ASD Shear Load, V (lb.)	Drift at Allowable Shear, Δ (in.)[7]	Anchor Tension at Allowable Shear, T (lb.)[11]
WSWH12x12	144	1,000	505	0.61	9,495	645	0.80	12,150	505	0.61	9,495	645	0.80	12,150
		4,000	505	0.61	9,495	645	0.80	12,150	505	0.61	9,495	645	0.80	12,150
		7,500	505	0.61	9,495	645	0.80	12,150	505	0.61	9,495	645	0.80	12,150
WSWH18x12	144	1,000	1,705	0.61	19,665	2,195	0.80	25,285	1,705	0.61	19,665	2,195	0.80	25,285
		4,000	1,705	0.61	19,665	2,195	0.80	25,285	1,705	0.61	19,665	2,195	0.80	25,285
		7,500	1,705	0.61	19,665	2,195	0.80	25,285	1,705	0.61	19,665	2,195	0.80	25,285
WSWH24x12	144	1,000	3,525	0.60	29,015	4,305	0.75	35,430	3,525	0.60	29,015	4,475	0.78	36,815
		4,000	3,525	0.60	29,015	4,100	0.72	33,715	3,525	0.60	29,015	4,475	0.78	36,815
		7,500	3,525	0.60	29,015	3,855	0.67	31,715	3,525	0.60	29,015	4,475	0.78	36,815
WSWH18x13	156	1,000	1,490	0.66	18,575	1,910	0.87	23,855	1,490	0.66	18,575	1,910	0.87	23,855
		4,000	1,490	0.66	18,575	1,910	0.87	23,855	1,490	0.66	18,575	1,910	0.87	23,855
		7,500	1,490	0.66	18,575	1,910	0.87	23,855	1,490	0.66	18,575	1,910	0.87	23,855
WSWH24x13	156	1,000	3,110	0.65	27,705	3,975	0.86	35,430	3,110	0.65	27,705	4,025	0.87	35,885
		4,000	3,110	0.65	27,705	3,780	0.81	33,715	3,110	0.65	27,705	4,025	0.87	35,885
		7,500	3,110	0.65	27,705	3,560	0.77	31,715	3,110	0.65	27,705	4,025	0.87	35,885
WSWH18x14	168	1,000	1,180	0.72	15,890	1,515	0.93	20,370	1,180	0.72	15,890	1,515	0.93	20,370
		4,000	1,180	0.72	15,890	1,515	0.93	20,370	1,180	0.72	15,890	1,515	0.93	20,370
WSWH24x14	168	1,000	2,620	0.71	25,160	3,365	0.93	32,290	2,620	0.71	25,160	3,365	0.93	32,290
		4,000	2,620	0.71	25,160	3,365	0.93	32,290	2,620	0.71	25,160	3,365	0.93	32,290
WSWH18x16	192	1,000	985	0.82	15,160	1,265	1.07	19,395	985	0.82	15,160	1,265	1.07	19,395
		4,000	985	0.82	15,160	1,265	1.07	19,395	985	0.82	15,160	1,265	1.07	19,395
WSWH24x16	192	1,000	2,130	0.82	23,345	2,735	1.07	29,990	2,130	0.82	23,345	2,735	1.07	29,990
		4,000	2,130	0.82	23,345	2,735	1.07	29,990	2,130	0.82	23,345	2,735	1.07	29,990
WSWH18x18	216	1,000	750	0.93	12,965	960	1.20	16,550	750	0.93	12,965	960	1.20	16,550
		4,000	750	0.93	12,965	960	1.20	16,550	750	0.93	12,965	960	1.20	16,550
WSWH24x18	216	1,000	1,655	0.93	20,400	2,110	1.20	26,060	1,655	0.93	20,400	2,110	1.20	26,060
		4,000	1,655	0.93	20,400	2,110	1.20	26,060	1,655	0.93	20,400	2,110	1.20	26,060
WSWH18x20	240	1,000	605	1.04	11,640	770	1.33	14,825	605	1.04	11,640	770	1.33	14,825
		4,000	605	1.04	11,640	770	1.33	14,825	605	1.04	11,640	770	1.33	14,825
WSWH24x20	240	1,000	1,350	1.04	18,500	1,720	1.33	23,590	1,350	1.04	18,500	1,720	1.33	23,590
		4,000	1,350	1.04	18,500	1,720	1.33	23,590	1,350	1.04	18,500	1,720	1.33	23,590

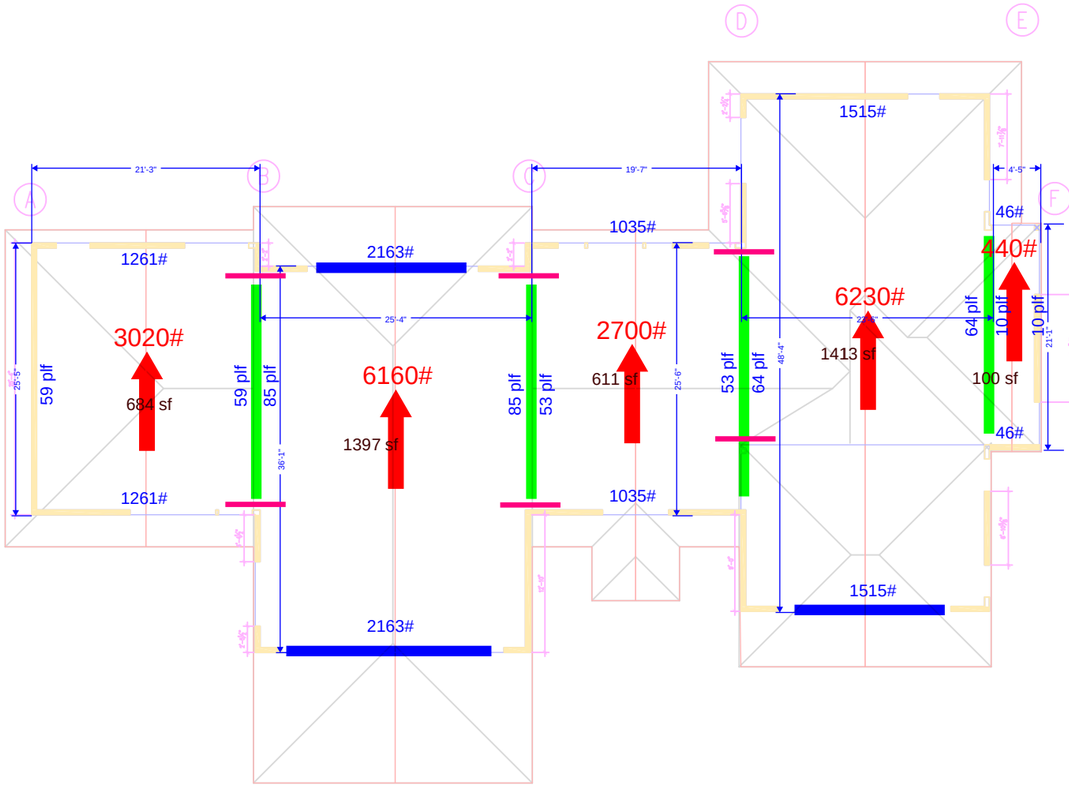
1. Allowable shear loads are applicable to installations on concrete with specifed compressive strengths as listed using the ASD basic (IBC Section 1605.3.1) or the alternative basic (IBC Section 1605.3.2) load combinations.
2. Load values include evaluation of bearing stresses on concrete foundations and do not require further evaluation by the designer. For installations on masonry foundations, bearing capacity shall be evaluated by the designer.
3. Seismic design based on 2018 IBC using R = 6.5. For other codes, use the seismic coeffcients corresponding to light-frame bearing walls with wood structural panels or sheet-steel panels.
4. Allowable vertical load denotes the total maximum concentric vertical load permitted on the panel acting in combination with the allowable shear loads.
5. Allowable shear, drift and anchor tension values may be interpolated for intermediate height or vertical loads. For panels 74½"–78" tall, use the values for a 78"-tall panel.
6. To achieve required WSWH panel evaluation height, trim next tallest full-height panel defined in table on p. 13.
7. Drifts at lower design shear may be linearly reduced.
8. See p. 16 for allowable out-of-plane and axial capacities.
9. Angled SDS screws may be omitted from the WSWH-TP top connection for all panels taller than 100"; see p. 16 as reduced allowable out-of-plane loads may apply.
10. High-strength anchor bolts are required for anchor tension forces exceeding the allowable load for standard-strength bolts tabulated on pp. 22–23. See pp. 21–29 for WSWH-AB anchor bolt information and anchorage solutions.
11. Tabulated anchor tension values assume no resisting vertical load. Anchor tension loads at design shear values and including the effect of vertical load may be determined using the following equation:
    $T = [(V \times H) / B] - P/2$, where:
    T = Anchor tension load (lb.)
    V = Design shear load (lb.)
    P = Applied vertical load (lb.)
    H = Panel height (in.)
    B = Moment arm (in.); 7.625" for WSWH12, 12.50" for WSWH18, 17.50" for WSWH24.



WEST ELEVATION



SOUTH ELEVATION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B
C
D
E
F
21'-3"
19'-7"
4'-5"
1515#
1035#
46#
440#
1261#
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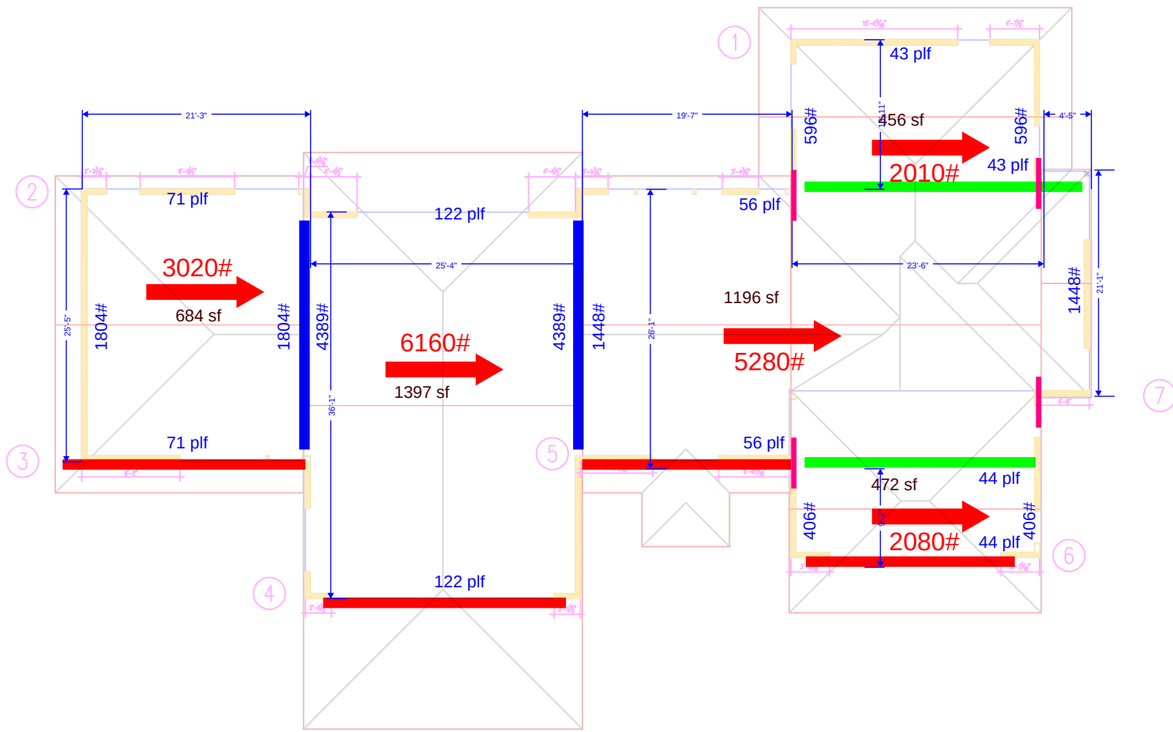
6230#
3020#
2700#
6160#
59 plf
59 plf
85 plf
85 plf
53 plf
64 plf
64 plf
10 plf
10 plf
684 sf
611 sf
1413 sf
100 sf
1397 sf
46#
1261#
1035#
1515#
2163#


1
2
3
4
5
6
7
21'-3"
19'-7"
4'-5"
43 plf
596#
596#
456 sf
2010#
43 plf
71 plf
122 plf
56 plf
3020#
1804#
1804#
4389#
4389#
1448#
1448#
684 sf
6160#
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5280#
1397 sf
71 plf
56 plf
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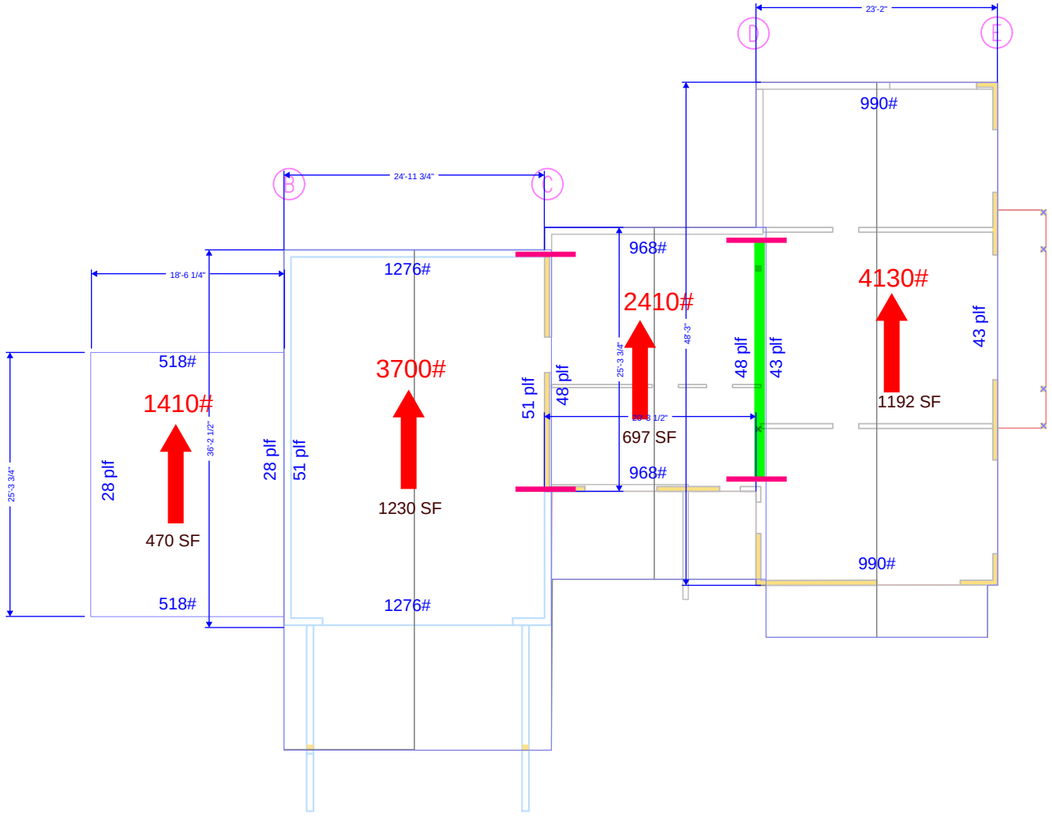
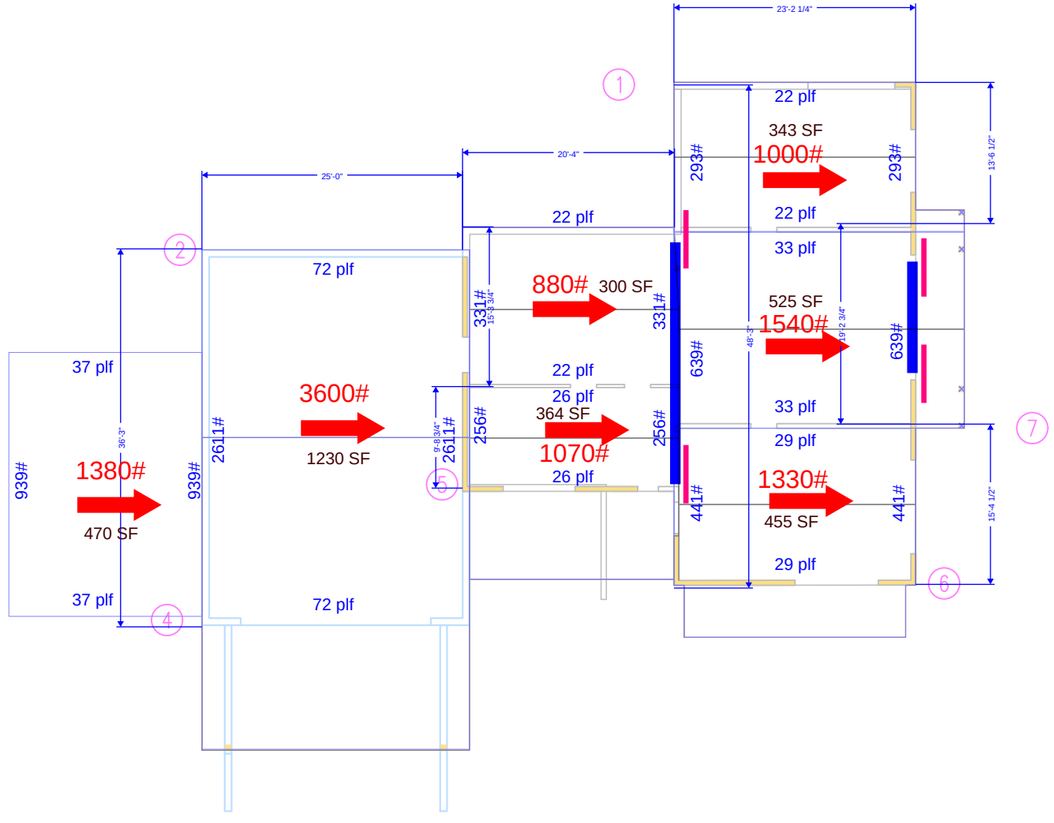
44 plf
406#
406#
2080#
44 plf
122 plf


23'-2"
D
E
990#
24'-11 3/4"
B
C
968#
1276#
4130#
2410#
18'-6 1/4"
518#
3700#
1410#
48 plf
43 plf
43 plf
51 plf
48 plf
25'-3 3/4"
48'-3"
1192 SF
697 SF
968#
28 plf
51 plf
1230 SF
470 SF
36'-2 1/2"
990#
518#
1276#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1
22 plf
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1000#
293#
293#
20'-4"
25'-0"
22 plf
2
72 plf
880#
300 SF
331#
331#
22 plf
33 plf
525 SF
1540#
639#
639#
22 plf
26 plf
364 SF
33 plf
3600#
256#
256#
1070#
26 plf
29 plf
1230 SF
37 plf
939#
1380#
939#
261#
261#
441#
441#
1330#
455 SF
29 plf
470 SF
37 plf
72 plf
4
5
6
7

Steel Strength
Concrete Breakout
Pullout Strength
Concrete Side-Face Blowout

ACI 17.2.3.4.4 (P. 228)

(a) Tension Steel $\phi N_{sa} = 0.75 A_{se,N} F_{uta}$

17.4.1.2 The nominal strength of an anchor in tension, N_{sa}, shall not exceed

$$N_{sa} = A_{se,N} f_{uta} \qquad (17.4.1.2)$$

where $A_{se,N}$ is the effective cross-sectional area of an anchor in tension, in.^{2}, and f_{uta} shall not be taken greater than the smaller of $1.9 f_{ya}$ and 125,000 psi.

(b) Concrete Breakout $0.75\phi N_{cb}$

17.4.2.1 The nominal concrete breakout strength in tension, N_{cb} of a single anchor or N_{cbg} of a group of anchors, shall not exceed:

(a) For a single anchor

$$N_{cb} = \frac{A_{Nc}}{A_{Nco}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \qquad (17.4.2.1a)$$

Factors 17.4.2.5, 17.4.2.6, and 17.4.2.7, respectively. A_{Nc} is the projected concrete failure area of a single anchor or group of anchors that shall be approximated as the base of the rectilinear geometrical figure that results from projecting the failure surface outward $1.5h_{ef}$ from the centerlines of the anchor, or in the case of a group of anchors, from a line through a row of adjacent anchors. A_{Nc} shall not exceed nA_{Nco}, where n is the number of anchors in the group that resist tension. A_{Nco} is the projected concrete failure area of a single anchor with an edge distance equal to or greater than $1.5h_{ef}$

$$A_{Nco} = 9h_{ef}^2 \qquad (17.4.2.1c)$$

17.4.2.4 The modification factor for anchor groups loaded eccentrically in tension, $\psi_{ec,N}$, shall be calculated as

$$\psi_{ec,N} = \frac{1}{\left(1 + \frac{2e'_N}{3h_{ef}}\right)} \qquad (17.4.2.4)$$

17.4.2.5 The modification factor for edge effects for single anchors or anchor groups loaded in tension, $\psi_{ed,N}$, shall be calculated as

If $c_{a,min} \geq 1.5h_{ef}$, then $\psi_{ed,N} = 1.0$ (17.4.2.5a)

If $c_{a,min} < 1.5h_{ef}$, then $\psi_{ed,N} = 0.7 + 0.3\frac{c_{a,min}}{1.5h_{ef}}$ (17.4.2.5b)

17.4.2.6 For anchors located in a region of a concrete member where analysis indicates no cracking at service load levels, the following modification factor shall be permitted:

(a) $\psi_{c,N} = 1.25$ for cast-in anchors
(b) $\psi_{c,N} = 1.4$ for post-installed anchors, where the value of k_c used in Eq. (17.4.2.2a) is 17

17.4.2.7 The modification factor for post-installed anchors designed for uncracked concrete in accordance with 17.4.2.6 without supplementary reinforcement to control splitting, $\psi_{cp,N}$, shall be calculated as follows using the critical distance c_{ac} as defined in 17.7.6

If $c_{a,min} \geq c_{ac}$, then $\psi_{cp,N} = 1.0$ (17.4.2.7a)

If $c_{a,min} < c_{ac}$, then $\psi_{cp,N} = \frac{c_{a,min}}{c_{ac}}$ (17.4.2.7b)

but $\psi_{cp,N}$ determined from Eq. (17.4.2.7b) shall not be taken less than $1.5h_{ef}/c_{ac}$, where the critical distance c_{ac} is defined in 17.7.6.

For all other cases, including cast-in anchors, $\psi_{cp,N}$ shall be taken as 1.0.

Table 2.2. Anchor Rod Materials

Material ASTM		Tensile Strength, F_u (ksi)	Nominal Tensile Stress,[a] $F_{nt} = 0.75F_u$ (ksi)	Nominal Shear Stress (X type),[a, b] $F_{nv} = 0.50F_u$ (ksi)	Nominal Shear Stress (N type),[a, c] $F_{nv} = 0.40F_u$ (ksi)	Maximum Diameter, in.
F1554	Gr 36 [d]	58	43.5	29.0	23.2	4
	Gr 55	75	56.3	37.5	30.0	4
	Gr 105	125	93.8	62.5	50.0	3
A449		120	90.0	60.0	48.0	1
		105	78.8	57.5	42.0	1½
		90	67.5	45.0	36.0	3
A36		58	43.5	29.0	23.2	4
A307		58	43.5	29.0	23.2	4
A354 Gr BD		150	112	75.0	60.0	2½
		140	105	70.0	56.0	4

[a] Nominal stress on unthreaded body for cut threads (based on major thread diameter for rolled threads)
[b] Threads excluded from shear plane
[c] Threads included in the shear plane
[d] Preferred material specification

Table 3.2. Anchor Rod Con

Rod Diameter, in.	Rod Area, A_r, in²	Bearing Area, in²
⅝	0.307	0.689
¾	0.442	0.906
⅞	0.601	1.22
1	0.785	1.50
1⅛	0.994	1.81
1¼	1.23	2.24
1½	1.77	3.13
1¾	2.41	4.17
2	3.14	5.35
2¼	3.98	6.69
2½	4.91	8.17
2¾	5.94	9.80
3	7.07	11.4
3⅛	8.30	13.3
3½	9.62	15.3
3¾	11.0	17.5
4	12.6	19.9

(c) Concrete Pullout $0.75\phi N_{pn}$

17.4.3.1 The nominal pullout strength of a single cast-in, post-installed expansion, and post-installed undercut anchor in tension, N_{pn}, shall not exceed

$$N_{pn} = \psi_{c,P} N_p \qquad (17.4.3.1)$$

where $\psi_{c,P}$ is defined in 17.4.3.6.

17.4.3.4 The pullout strength in tension of a single headed stud or headed bolt, N_p, for use in Eq. (17.4.3.1), shall not exceed

$$N_p = 8 A_{brg} f'_c \qquad (17.4.3.4)$$

(d) Concrete Side Blowout $0.75\phi N_{sb}$

17.4.4 *Concrete side-face blowout strength of a headed anchor in tension*

17.4.4.1 For a single headed anchor with deep embedment close to an edge ($h_{ef} > 2.5c_{a1}$), the nominal side-face blowout strength, N_{sb}, shall not exceed

$$N_{sb} = 160 c_{a1} \sqrt{A_{brg}}\, \lambda_a \sqrt{f'_c} \qquad (17.4.4.1)$$

If c_{a2} for the single headed anchor is less than $3c_{a1}$, the value of N_{sb} shall be multiplied by the factor $(1 + c_{a2}/c_{a1})/4$, where $1.0 \leq c_{a2}/c_{a1} \leq 3.0$.

Where anchor reincorcement is provided in accordance with 17.4.2.9, no r

17.4.2.9 Where anchor reinforcement is developed in accordance with Chapter 25 on both sides of the breakout surface, the design strength of the anchor reinforcement shall be permitted to be used instead of the concrete breakout strength in determining ϕN_a. A strength reduction factor of 0.75 shall be used in the design of the anchor reinforcement.

N_{sa}	17.79	Nominal Anchor Tensile Strength, K
d_o	0.625	Anchor Diamter, in
$A_{se,n}$	0.306796	Effective Cross Section Area of Anchor
f_{uta}	58,000	Specified Tensile Strength of Anchor, psi
A_{Nc}	480	Projected Concrete Failure Area of Single Anchor, in^2
A_{nco}	3,600	Projected Concrete Failure Area of Single Anchor if Not Limited by Edge Distance, in2
$\psi_{ec,N}$	1.0	Eccentric Modification Factor (17.4.2.4)
$\psi_{ed,N}$	0.7	Edge Effects Modification (17.4.2.5)
$\psi_{c,N}$	1.0	Post-Installed Anchor Modification (17.4.2.6)
$\psi_{cp,N}$	1.0	Cracked Concrete Modification Factor (17.4.3.6)
h_{ef}	20.0	Effective Embedment Depth of Anchor, in
e'_n	0.0	Eccentiricty of Resulting Tension Force and Centroid of Anchor Group, in
N_{cb}	14.2	Nominal Concrete Breakout Strength, K
N_b	144,000	Concrete Breakout Strength in Tension of Single Anchor in Cracked Concrete, lb
k_c	24	Modiciation Factor per 17.4.2.2
N_{pn}	24.8	Nominal Pullout Strength, K
N_p	24,804	Concrete Pryout Strength of a Single Anchor, lb
N_{sb}	35.6	Nominal Side-Face Blowout, K
A_{brg}	0.689	Net Bearing Area of Anchor bolt, in^2
f'_c	4,500	Concrete Strength, psi
λ_a	1.0	Lightweight Concrete Modification
c_{a1}	4.0	Minimum Edge Distance, in
c_{a2}	100.0	Maximum Edge Distance, in

		11.309	
(a) Tension Steel	$\phi N_{sa} = A_{se,n} F_{uta}$	13.35	K
(b) Concrete Breakout	ϕN_{cb}	10.66	K
	$A_{st,req}$	0.25	in^2
(c) Concrete Pullout	ϕN_{pn}	18.60	K
(d) Concrete Side Blowout	ϕN_{sb}	26.73	K

N_{sa}	17.79	Nominal Anchor Tensile Strength, K
d_o	0.625	Anchor Diamter, in
$A_{se,n}$	0.306796	Effective Cross Section Area of Anchor
f_{uta}	58,000	Specified Tensile Strength of Anchor, psi
A_{Nc}	480	Projected Concrete Failure Area of Single Anchor, in^2
A_{nco}	3,600	Projected Concrete Failure Area of Single Anchor if Not Limited by Edge Distance, in2
$\psi_{ec,N}$	1.0	Eccentric Modification Factor (17.4.2.4)
$\psi_{ed,N}$	0.7	Edge Effects Modification (17.4.2.5)
$\psi_{c,N}$	1.0	Post-Installed Anchor Modification (17.4.2.6)
$\psi_{cp,N}$	1.0	Cracked Concrete Modification Factor (17.4.3.6)
h_{ef}	20.0	Effective Embedment Depth of Anchor, in
e'_n	0.0	Eccentiricty of Resulting Tension Force and Centroid of Anchor Group, in
N_{cb}	14.2	Nominal Concrete Breakout Strength, K
N_b	144,000	Concrete Breakout Strength in Tension of Single Anchor in Cracked Concrete, lb
k_c	24	Modiciation Factor per 17.4.2.2
N_{pn}	24.8	Nominal Pullout Strength, K
N_p	24,804	Concrete Pryout Strength of a Single Anchor, lb
N_{sb}	35.6	Nominal Side-Face Blowout, K
A_{brg}	0.689	Net Bearing Area of Anchor bolt, in^2
f'_c	4,500	Concrete Strength, psi
λ_a	1.0	Lightweight Concrete Modification
c_{a1}	4.0	Minimum Edge Distance, in
c_{a2}	100.0	Maximum Edge Distance, in

		12.432	
(a) Tension Steel	$\phi N_{sa} = A_{se,n} F_{uta}$	13.35	K
(b) Concrete Breakout	ϕN_{cb}	10.66	K
	$A_{st,req}$	0.28	in^2
(c) Concrete Pullout	ϕN_{pn}	18.60	K
(d) Concrete Side Blowout	ϕN_{sb}	26.73	K

N_{sa}	34.88	Nominal Anchor Tensile Strength, K
d_o	0.875	Anchor Diamter, in
A_{brg}	1.22	Net Bearing Area of Anchor bolt, in^2
$A_{se,n}$	0.60132	Effective Cross Section Area of Anchor
f_{uta}	58,000	Specified Tensile Strength of Anchor, psi
A_{Nc}	480	Projected Concrete Failure Area of Single Anchor, in^2
A_{nco}	3,600	Projected Concrete Failure Area of Single Anchor if Not Limited by Edge Distance, in2
$\psi_{ec,N}$	1.0	Eccentric Modification Factor (17.4.2.4)
$\psi_{ed,N}$	0.7	Edge Effects Modification (17.4.2.5)
$\psi_{c,N}$	1.0	Post-Installed Anchor Modification (17.4.2.6)
$\psi_{cp,N}$	1.0	Cracked Concrete Modification Factor (17.4.3.6)
h_{ef}	20.0	Effective Embedment Depth of Anchor, in
e'_n	0.0	Eccentiricty of Resulting Tension Force and Centroid of Anchor Group, in
N_{cb}	14.2	Nominal Concrete Breakout Strength, K
N_b	144,000	Concrete Breakout Strength in Tension of Single Anchor in Cracked Concrete, lb
k_c	24	Modiciation Factor per 17.4.2.2
N_{pn}	43.9	Nominal Pullout Strength, K
N_p	43,920	Concrete Pryout Strength of a Single Anchor, lb
N_{sb}	47.4	Nominal Side-Face Blowout, K
f'_c	4,500	Concrete Strength, psi
λ_a	1.0	Lightweight Concrete Modification
c_{a1}	4.0	Minimum Edge Distance, in
c_{a2}	100.0	Maximum Edge Distance, in

		20.997	
(a) Tension Steel	$\phi N_{sa} = A_{se,n} F_{uta}$	26.16	K
(b) Concrete Breakout	ϕN_{cb}	10.66	K
	$A_{st,req}$	0.47	in^2
(c) Concrete Pullout	ϕN_{pn}	32.94	K
(d) Concrete Side Blowout	ϕN_{sb}	35.57	K

N_{sa}	45.55	Nominal Anchor Tensile Strength, K
d_o	1	Anchor Diamter, in
A_{brg}	1.5	Net Bearing Area of Anchor bolt, in^2
$A_{se,n}$	0.785398	Effective Cross Section Area of Anchor
f_{uta}	58,000	Specified Tensile Strength of Anchor, psi
A_{Nc}	480	Projected Concrete Failure Area of Single Anchor, in^2
A_{nco}	3,600	Projected Concrete Failure Area of Single Anchor if Not Limited by Edge Distance, in2
$\psi_{ec,N}$	1.0	Eccentric Modification Factor (17.4.2.4)
$\psi_{ed,N}$	0.7	Edge Effects Modification (17.4.2.5)
$\psi_{c,N}$	1.0	Post-Installed Anchor Modification (17.4.2.6)
$\psi_{cp,N}$	1.0	Cracked Concrete Modification Factor (17.4.3.6)
h_{ef}	20.0	Effective Embedment Depth of Anchor, in
e'_n	0.0	Eccentiricty of Resulting Tension Force and Centroid of Anchor Group, in
N_{cb}	14.2	Nominal Concrete Breakout Strength, K
N_b	144,000	Concrete Breakout Strength in Tension of Single Anchor in Cracked Concrete, lb
k_c	24	Modiciation Factor per 17.4.2.2
N_{pn}	54.0	Nominal Pullout Strength, K
N_p	54,000	Concrete Pryout Strength of a Single Anchor, lb
N_{sb}	52.6	Nominal Side-Face Blowout, K
f'_c	4,500	Concrete Strength, psi
λ_a	1.0	Lightweight Concrete Modification
c_{a1}	4.0	Minimum Edge Distance, in
c_{a2}	100.0	Maximum Edge Distance, in

		30.12	
(a) Tension Steel	$\phi N_{sa} = A_{se,n} F_{uta}$	34.16	K
(b) Concrete Breakout	ϕN_{cb}	10.66	K
	$A_{st,req}$	0.67	in^2
(c) Concrete Pullout	ϕN_{pn}	40.50	K
(d) Concrete Side Blowout	ϕN_{sb}	39.44	K

Force Transfer Around Openings Calculator

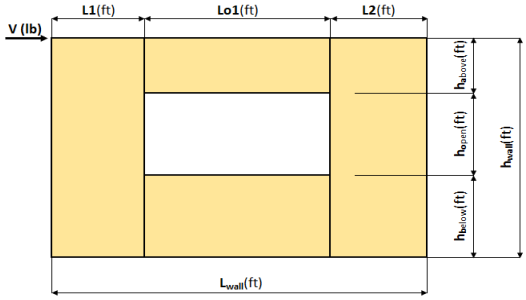
ONE OPENING

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:	2018 IBC
Designer:	JDA
Client:	CenterLine
Project:	Derkashani
Wall Line:	1 - Main to Roof

Date: 9/30/2021



Shear Wall Calculation Variables

V	1278 lbf	Opening 1	
L1	15.54 ft	ha1	4.00 ft
L2	4.63 ft	ho1	4.00 ft
h_{wall}	9.17 ft	hb1	1.17 ft
L_{wall}	23.17 ft	Lo1	3.00 ft

Adj. Factor Method =		2bs/h
Wall Pier Aspect Ratio		Adj. Factor
P1=ho1/L1=	0.26	N/A
P2=ho2/L2=	0.86	N/A

1. Hold-down forces: $H = Vh_{wall}/L_{wall}$ 506 lbf

2. Unit shear above + below opening

First opening: va1 = vb1 = H/(ha1+hb1) = 98 plf

3. Total boundary force above + below openings

First opening: O1 = va1 x (Lo1) = 294 lbf

4. Corner forces

F1 = O1(L1)/(L1+L2) = 226 lbf

F2 = O1(L2)/(L1+L2) = 67 lbf

5. Tributary length of openings

T1 = (L1*Lo1)/(L1+L2) = 2.31 ft

T2 = (L2*Lo1)/(L1+L2) = 0.69 ft

6. Unit shear beside opening

V1 = (V/L)(L1+T1)/L1 = 63 plf

V2 = (V/L)(T2+L2)/L2 = 63 plf

Check V1*L1+V2*L2=V? 1278 lbf **OK**

7. Resistance to corner forces

R1 = V1*L1 = 985 lbf

R2 = V2*L2 = 293 lbf

8. Difference corner force + resistance

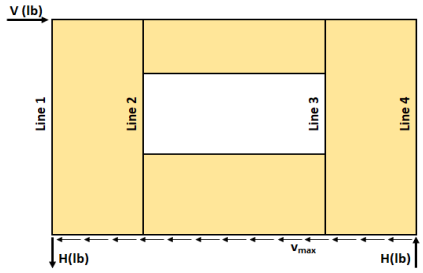
R1-F1 = 758 lbf

R2-F2 = 226 lbf

9. Unit shear in corner zones

vc1 = (R1-F1)/L1 = 49 plf

vc2 = (R2-F2)/L2 = 49 plf



Check Summary of Shear Values for One Opening

Line 1: vc1(ha1+hb1)+V1(ho1)=H?		252	253	506 lbf
Line 2: va1(ha1+hb1)-vc1(ha1+hb1)-V1(ho1)=0?	506	252	253	0
Line 3: va1(ha1+hb1)-vc2(ha1+hb1)-V1(ho1)=0?	506	252	253	0
Line 4: vc2(ha1+hb1)+V2(ho1)=H?		252	253	506 lbf

Design Summary*

Req. Sheathing Capacity	98 plf
Req. Strap Force	226 lbf
Req. HD Force (H)	506 lbf
Req. Shear Wall Anchorage Force (v_{max})	55 plf

4-Term Deflection	0.035 in.
4-Term Story Drift %	0.001 %

See Page 2

3-Term Deflection	0.005 in.
3-Term Story Drift %	0.000 %

See Page 3

Sheathing and Nail Type are not a valid combination. Please review Nail Type input.

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

Project Information

Code:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	1 - Main to Roof		

Shear Wall Deflection Calculation Variables

Induced Shear Load $V_{induced}$: 1826 (lbf)

Sheathing:

Plywood	Sheathing Material
19/32	Performance Category
APA Rated Sheathing	Grade
	Gt Override
	Ga Overide

Wood End Post Values:

Species:	Doug Fir	
E:	1.70E+06	(psi)
	Qty	Stud Size
Dimensions:	2	2x6
A:	16.5	($in.^2$)
A Override:		($in.^2$)

Nail Type: 8d common (penny weight)

	Pier 1	Pier 2	
Nail Spacing:	6	6	(in.)
HD Capacity:	2655	2655	(lbf)
HD Deflection:	0.0071	0.0071	(in.)

Four-Term Equation Deflection Check

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a\frac{h}{b} \qquad \text{(Equation 23-2)}$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
Sheathing:	19/32	19/32	19/32	19/32	
Nail:	8d common	8d common	8d common	8d common	
$v_{induced}$:	91	91	91	91	(plf)
E:	1.70E+06	1.70E+06	1.70E+06	1.70E+06	(psi)
h:	9.17	8.00	8.00	9.17	(ft)
A:	16.5	16.5	16.5	16.5	($in.^2$)
Gt:	28,500	28,500	28,500	28,500	(lbf/in.)
Nail Spacing:	6	6	6	6	(in.)
Vn:	45	45	45	45	(plf)
e_n:	0.0005	0.0005	0.0005	0.0005	(in.)
b:	15.54	15.54	4.63	4.63	(ft)
HD Capacity:	2655	2655	2655	2655	(lbf)
HD Defl:	0.0071	0.0071	0.0071	0.0071	(in.)

Check Total Deflection of Wall System

Pier 1 (left)				Pier 1 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.001	0.029	0.003	0.001	0.001	0.025	0.003	0.001
		Sum	0.035			Sum	0.030
Pier 2 (left)				Pier 2 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.003	0.025	0.003	0.003	0.004	0.029	0.003	0.004
		Sum	0.034			Sum	0.041

Total Defl.	
0.035	(in.)
0.0013	%drift

Project Information

Code:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	1 - Main to Roof		

Three-Term Equation Deflection Check

$$\delta_{sw} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b} \qquad (4.3\text{-}1)$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
Sheathing:	19/32	19/32	19/32	19/32	
Nail:	8d common	8d common	8d common	8d common	
$v_{induced}$:	91	91	91	91	(plf)
E:	1.70E+06	1.70E+06	1.70E+06	1.70E+06	(psi)
h:	9.17	8.00	8.00	9.17	(ft)
A:	16.5	16.5	16.5	16.5	($in.^2$)
Ga:	N/A	N/A	N/A	N/A	(kips/in.)
b:	15.54	15.54	4.63	4.63	(ft)
HD Capacity:	2655	2655	2655	2655	(lbf)
HD Defl:	0.0071	0.0071	0.0071	0.0071	(in.)

Sheathing and Nail Type are not a valid combination. Please review Nail Type input.

Check Total Deflection of Wall System

Pier 1 (left)			Pier 1 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.001		0.001	0.001		0.001
	Sum	0.003		Sum	0.002
Pier 2 (left)			Pier 2 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.003		0.003	0.004		0.004
	Sum	0.006		Sum	0.009

Total Defl.	
0.005	(in.)
0.0002	%drift

Comment: The 3-term equation is calibrated to be approximately equal to 4-term equation at 1.4*ASD capacity.

Force Transfer Around Openings Calculator

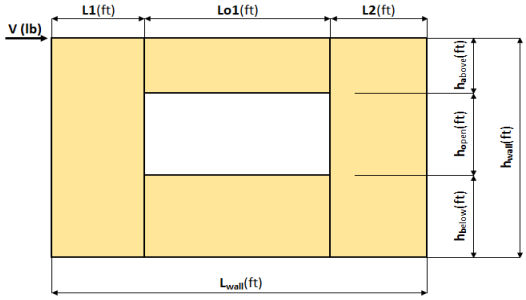
ONE OPENING

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:	2018 IBC
Designer:	JDA
Client:	CenterLine
Project:	Derkashani
Wall Line:	6 - Lower to Main

Date: 9/30/2021



Shear Wall Calculation Variables

V	1997 lbf	Opening 1	
L1	11.58 ft	ha1	1.67 ft
L2	3.58 ft	ho1	4.83 ft
h_{wall}	8.50 ft	hb1	2.00 ft
L_{wall}	23.17 ft	Lo1	8.01 ft

Adj. Factor Method =		2bs/h
Wall Pier Aspect Ratio		Adj. Factor
P1=ho1/L1=	0.42	N/A
P2=ho2/L2=	1.35	N/A

1. Hold-down forces: H = Vh_{wall}/L_{wall} 733 lbf

2. Unit shear above + below opening

First opening: va1 = vb1 = H/(ha1+hb1) = 200 plf

3. Total boundary force above + below openings

First opening: O1 = va1 x (Lo1) = 1600 lbf

4. Corner forces

F1 = O1(L1)/(L1+L2) = 1222 lbf

F2 = O1(L2)/(L1+L2) = 378 lbf

5. Tributary length of openings

T1 = (L1*Lo1)/(L1+L2) = 6.12 ft

T2 = (L2*Lo1)/(L1+L2) = 1.89 ft

6. Unit shear beside opening

V1 = (V/L)(L1+T1)/L1 = 132 plf

V2 = (V/L)(T2+L2)/L2 = 132 plf

Check V1*L1+V2*L2=V? 1997 lbf **OK**

7. Resistance to corner forces

R1 = V1*L1 = 1525 lbf

R2 = V2*L2 = 472 lbf

8. Difference corner force + resistance

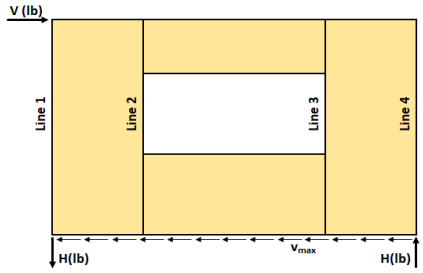
R1-F1 = 303 lbf

R2-F2 = 94 lbf

9. Unit shear in corner zones

vc1 = (R1-F1)/L1 = 26 plf

vc2 = (R2-F2)/L2 = 26 plf



Check Summary of Shear Values for One Opening

Line 1: vc1(ha1+hb1)+V1(ho1)=H?		96	637	733 lbf
Line 2: va1(ha1+hb1)-vc1(ha1+hb1)-V1(ho1)=0?	733	96	637	0
Line 3: va1(ha1+hb1)-vc2(ha1+hb1)-V1(ho1)=0?	733	96	637	0
Line 4: vc2(ha1+hb1)+V2(ho1)=H?		96	637	733 lbf

Design Summary*

Req. Sheathing Capacity	200 plf
Req. Strap Force	1222 lbf
Req. HD Force (H)	733 lbf
Req. Shear Wall Anchorage Force (v_{max})	86 plf

4-Term Deflection	0.166 in.
4-Term Story Drift %	0.007 %

See Page 2

3-Term Deflection	0.094 in.
3-Term Story Drift %	0.004 %

See Page 3

Sheathing and Nail Type are not a valid combination. Please review Nail Type input.

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

Project Information

Code:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	6 - Lower to Main		

Shear Wall Deflection Calculation Variables

Induced Shear Load $V_{induced}$: 2853 (lbf)

Sheathing:

Plywood	Sheathing Material
19/32	Performance Category
APA Rated Sheathing	Grade
	Gt Override
	Ga Overide

Wood End Post Values:

Species:	Doug Fir	
E:	1.70E+06	(psi)
	Qty	Stud Size
Dimensions:	2	2x6
A:	16.5	($in.^2$)
A Override:		($in.^2$)

Nail Type: 8d common (penny weight)

	Pier 1	Pier 2	
Nail Spacing:	6	6	(in.)
HD Capacity:	2500	2500	(lbf)
HD Deflection:	0.1134	0.1134	(in.)

Four-Term Equation Deflection Check

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a\frac{h}{b} \qquad \text{(Equation 23-2)}$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
Sheathing:	19/32	19/32	19/32	19/32	
Nail:	8d common	8d common	8d common	8d common	
$v_{induced}$:	188	188	188	188	(plf)
E:	1.70E+06	1.70E+06	1.70E+06	1.70E+06	(psi)
h:	8.50	6.50	6.50	8.50	(ft)
A:	16.5	16.5	16.5	16.5	($in.^2$)
Gt:	28,500	28,500	28,500	28,500	(lbf/in.)
Nail Spacing:	6	6	6	6	(in.)
Vn:	94	94	94	94	(plf)
e_n:	0.0041	0.0041	0.0041	0.0041	(in.)
b:	11.58	11.58	3.58	3.58	(ft)
HD Capacity:	2500	2500	2500	2500	(lbf)
HD Defl:	0.1134	0.1134	0.1134	0.1134	(in.)

Check Total Deflection of Wall System

Pier 1 (left)				Pier 1 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.003	0.056	0.026	0.053	0.001	0.043	0.020	0.031
		Sum	0.139			Sum	0.095
Pier 2 (left)				Pier 2 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.004	0.043	0.020	0.101	0.009	0.056	0.026	0.172
		Sum	0.168			Sum	0.264

Total Defl.	
0.166	(in.)
0.0065	%drift

Project Information

Code:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	6 - Lower to Main		

Three-Term Equation Deflection Check

$$\delta_{sw} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b} \qquad (4.3\text{-}1)$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
Sheathing:	19/32	19/32	19/32	19/32	
Nail:	8d common	8d common	8d common	8d common	
$v_{induced}$:	188	188	188	188	(plf)
E:	1.70E+06	1.70E+06	1.70E+06	1.70E+06	(psi)
h:	8.50	6.50	6.50	8.50	(ft)
A:	16.5	16.5	16.5	16.5	($in.^2$)
Ga:	N/A	N/A	N/A	N/A	(kips/in.)
b:	11.58	11.58	3.58	3.58	(ft)
HD Capacity:	2500	2500	2500	2500	(lbf)
HD Defl:	0.1134	0.1134	0.1134	0.1134	(in.)

Sheathing and Nail Type are not a valid combination. Please review Nail Type input.

Check Total Deflection of Wall System

Pier 1 (left)			Pier 1 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.003		0.053	0.001		0.031
	Sum	0.056		Sum	0.032
Pier 2 (left)			Pier 2 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.004		0.101	0.009		0.172
	Sum	0.105		Sum	0.181

Total Defl.	
0.094	(in.)
0.0037	%drift

Comment: The 3-term equation is calibrated to be approximately equal to 4-term equation at 1.4*ASD capacity.

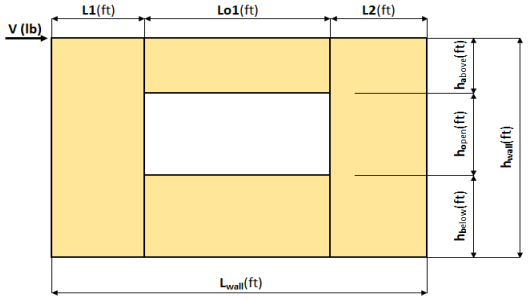
Force Transfer Around Openings Calculator

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:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	E - Lower to Main (1)		



Shear Wall Calculation Variables

V	2826 lbf		Opening 1
L1	4.50 ft	ha1	1.67 ft
L2	6.00 ft	ho1	4.83 ft
h_{wall}	8.50 ft	hb1	2.00 ft
L_{wall}	16.50 ft	Lo1	6.00 ft

Adj. Factor Method =		2bs/h
Wall Pier Aspect Ratio		Adj. Factor
P1=ho1/L1=	1.07	N/A
P2=ho2/L2=	0.81	N/A

1. Hold-down forces: H = Vh_{wall}/L_{wall} 1456 lbf

2. Unit shear above + below opening

First opening: va1 = vb1 = H/(ha1+hb1) = 397 plf

3. Total boundary force above + below openings

First opening: O1 = va1 x (Lo1) = 2382 lbf

4. Corner forces

F1 = O1(L1)/(L1+L2) = 1021 lbf

F2 = O1(L2)/(L1+L2) = 1361 lbf

5. Tributary length of openings

T1 = (L1*Lo1)/(L1+L2) = 2.57 ft

T2 = (L2*Lo1)/(L1+L2) = 3.43 ft

6. Unit shear beside opening

V1 = (V/L)(L1+T1)/L1 = 269 plf

V2 = (V/L)(T2+L2)/L2 = 269 plf

Check V1*L1+V2*L2=V? 2826 lbf **OK**

7. Resistance to corner forces

R1 = V1*L1 = 1211 lbf

R2 = V2*L2 = 1615 lbf

8. Difference corner force + resistance

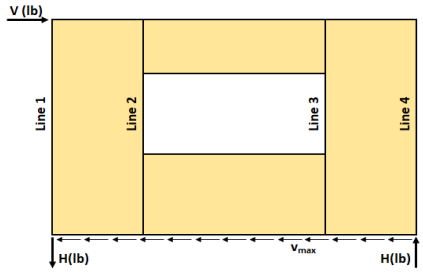
R1-F1 = 190 lbf

R2-F2 = 254 lbf

9. Unit shear in corner zones

vc1 = (R1-F1)/L1 = 42 plf

vc2 = (R2-F2)/L2 = 42 plf



Check Summary of Shear Values for One Opening

Line 1: vc1(ha1+hb1)+V1(ho1)=H?		155	1301	1456 lbf
Line 2: va1(ha1+hb1)-vc1(ha1+hb1)-V1(ho1)=0?	1456	155	1301	0
Line 3: va1(ha1+hb1)-vc2(ha1+hb1)-V1(ho1)=0?	1456	155	1301	0
Line 4: vc2(ha1+hb1)+V2(ho1)=H?		155	1301	1456 lbf

Design Summary*

Req. Sheathing Capacity	397 plf	**4-Term Deflection**	0.506 in.	**3-Term Deflection**	0.204 in.
Req. Strap Force	1361 lbf	**4-Term Story Drift %**	0.020 %	**3-Term Story Drift %**	0.008 %
Req. HD Force (H)	1456 lbf		See Page 2		See Page 3
Req. Shear Wall Anchorage Force (v_{max})	171 plf				

Sheathing and Nail Type are not a valid combination. Please review Nail Type input.

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

Project Information

Code:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	E - Lower to Main (1)		

Shear Wall Deflection Calculation Variables

Induced Shear Load $V_{induced}$: 4037 (lbf)

Sheathing:

Plywood	Sheathing Material
19/32	Performance Category
APA Rated Sheathing	Grade
	Gt Override
	Ga Overide

Wood End Post Values:

Species:	Doug Fir		
E:	1.70E+06	(psi)	
	Qty	Stud Size	
Dimensions:	2	2x6	
A:	16.5	($in.^2$)	
A Override:		($in.^2$)	

Nail Type: 8d common (penny weight)

	Pier 1	Pier 2	
Nail Spacing:	6	6	(in.)
HD Capacity:	2500	2500	(lbf)
HD Deflection:	0.1134	0.1134	(in.)

Four-Term Equation Deflection Check

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a\frac{h}{b} \qquad \text{(Equation 23-2)}$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
Sheathing:	19/32	19/32	19/32	19/32	
Nail:	8d common	8d common	8d common	8d common	
$v_{induced}$:	384	384	384	384	(plf)
E:	1.70E+06	1.70E+06	1.70E+06	1.70E+06	(psi)
h:	8.50	6.50	6.50	8.50	(ft)
A:	16.5	16.5	16.5	16.5	($in.^2$)
Gt:	28,500	28,500	28,500	28,500	(lbf/in.)
Nail Spacing:	6	6	6	6	(in.)
Vn:	192	192	192	192	(plf)
e_n:	0.0357	0.0357	0.0357	0.0357	(in.)
b:	4.50	4.50	6.00	6.00	(ft)
HD Capacity:	2500	2500	2500	2500	(lbf)
HD Defl:	0.1134	0.1134	0.1134	0.1134	(in.)

Check Total Deflection of Wall System

Pier 1 (left)				Pier 1 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.015	0.115	0.228	0.280	0.007	0.088	0.174	0.164
		Sum	0.637			Sum	0.432
Pier 2 (left)				Pier 2 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.005	0.088	0.174	0.123	0.011	0.115	0.228	0.210
		Sum	0.390			Sum	0.564

Total Defl.	
0.506	(in.)
0.0198	%drift

Project Information

Code:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	E - Lower to Main (1)		

Three-Term Equation Deflection Check

$$\delta_{sw} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b} \qquad (4.3\text{-}1)$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
Sheathing:	19/32	19/32	19/32	19/32	
Nail:	8d common	8d common	8d common	8d common	
$v_{induced}$:	384	384	384	384	(plf)
E:	1.70E+06	1.70E+06	1.70E+06	1.70E+06	(psi)
h:	8.50	6.50	6.50	8.50	(ft)
A:	16.5	16.5	16.5	16.5	($in.^2$)
Ga:	N/A	N/A	N/A	N/A	(kips/in.)
b:	4.50	4.50	6.00	6.00	(ft)
HD Capacity:	2500	2500	2500	2500	(lbf)
HD Defl:	0.1134	0.1134	0.1134	0.1134	(in.)

Sheathing and Nail Type are not a valid combination. Please review Nail Type input.

Check Total Deflection of Wall System

Pier 1 (left)			Pier 1 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.015		0.280	0.007		0.164
	Sum	0.295		Sum	0.170
Pier 2 (left)			Pier 2 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.005		0.123	0.011		0.210
	Sum	0.128		Sum	0.221

Total Defl.	
0.204	(in.)
0.0080	%drift

Comment: The 3-term equation is calibrated to be approximately equal to 4-term equation at 1.4*ASD capacity.

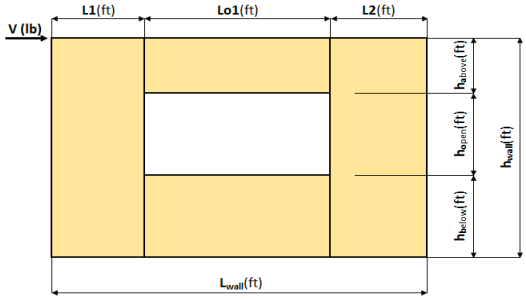
Force Transfer Around Openings Calculator

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:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	E - Lower to Main (2)		



Shear Wall Calculation Variables

V	2871 lbf		Opening 1
L1	7.67 ft	ha1	1.67 ft
L2	3.00 ft	ho1	4.83 ft
h_{wall}	8.50 ft	hb1	2.00 ft
L_{wall}	19.67 ft	Lo1	9.00 ft

Adj. Factor Method =		2bs/h
Wall Pier Aspect Ratio		Adj. Factor
P1=ho1/L1=	0.63	N/A
P2=ho2/L2=	1.61	N/A

1. Hold-down forces: $H = Vh_{wall}/L_{wall}$ 1241 lbf

2. Unit shear above + below opening

First opening: va1 = vb1 = H/(ha1+hb1) = 338 plf

3. Total boundary force above + below openings

First opening: O1 = va1 x (Lo1) = 3045 lbf

4. Corner forces

F1 = O1(L1)/(L1+L2) = 2189 lbf

F2 = O1(L2)/(L1+L2) = 856 lbf

5. Tributary length of openings

T1 = (L1*Lo1)/(L1+L2) = 6.47 ft

T2 = (L2*Lo1)/(L1+L2) = 2.53 ft

6. Unit shear beside opening

V1 = (V/L)(L1+T1)/L1 = 269 plf

V2 = (V/L)(T2+L2)/L2 = 269 plf

Check V1*L1+V2*L2=V? 2871 lbf **OK**

7. Resistance to corner forces

R1 = V1*L1 = 2064 lbf

R2 = V2*L2 = 807 lbf

8. Difference corner force + resistance

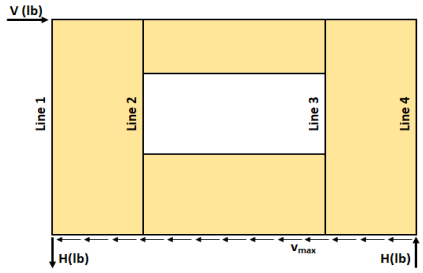
R1-F1 = -125 lbf

R2-F2 = -49 lbf

9. Unit shear in corner zones

vc1 = (R1-F1)/L1 = -16 plf

vc2 = (R2-F2)/L2 = -16 plf



Check Summary of Shear Values for One Opening

Line 1: vc1(ha1+hb1)+V1(ho1)=H?		-60	1301	1241 lbf
Line 2: va1(ha1+hb1)-vc1(ha1+hb1)-V1(ho1)=0?	1241	-60	1301	0
Line 3: va1(ha1+hb1)-vc2(ha1+hb1)-V1(ho1)=0?	1241	-60	1301	0
Line 4: vc2(ha1+hb1)+V2(ho1)=H?		-60	1301	1241 lbf

Design Summary*

Req. Sheathing Capacity	338 plf	**4-Term Deflection**	0.545 in.	**3-Term Deflection**	0.243 in.
Req. Strap Force	2189 lbf	**4-Term Story Drift %**	0.021 %	**3-Term Story Drift %**	0.010 %
Req. HD Force (H)	1241 lbf		See Page 2		See Page 3
Req. Shear Wall Anchorage Force (v_{max})	146 plf				

Sheathing and Nail Type are not a valid combination. Please review Nail Type input.

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

Project Information

Code:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	E - Lower to Main (2)		

Shear Wall Deflection Calculation Variables

Induced Shear Load $V_{induced}$: 4101 (lbf)

Sheathing:

Plywood	Sheathing Material
19/32	Performance Category
APA Rated Sheathing	Grade
	Gt Override
	Ga Overide

Wood End Post Values:

Species:	Doug Fir	
E:	1.70E+06	(psi)
	Qty	Stud Size
Dimensions:	2	2x6
A:	16.5	($in.^2$)
A Override:		($in.^2$)

Nail Type: 8d common (penny weight)

	Pier 1	Pier 2	
Nail Spacing:	6	6	(in.)
HD Capacity:	2500	2500	(lbf)
HD Deflection:	0.1134	0.1134	(in.)

Four-Term Equation Deflection Check

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a\frac{h}{b} \qquad \text{(Equation 23-2)}$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
Sheathing:	19/32	19/32	19/32	19/32	
Nail:	8d common	8d common	8d common	8d common	
$v_{induced}$:	384	384	384	384	(plf)
E:	1.70E+06	1.70E+06	1.70E+06	1.70E+06	(psi)
h:	8.50	6.50	6.50	8.50	(ft)
A:	16.5	16.5	16.5	16.5	($in.^2$)
Gt:	28,500	28,500	28,500	28,500	(lbf/in.)
Nail Spacing:	6	6	6	6	(in.)
Vn:	192	192	192	192	(plf)
e_n:	0.0357	0.0357	0.0357	0.0357	(in.)
b:	7.67	7.67	3.00	3.00	(ft)
HD Capacity:	2500	2500	2500	2500	(lbf)
HD Defl:	0.1134	0.1134	0.1134	0.1134	(in.)

Check Total Deflection of Wall System

Pier 1 (left)				Pier 1 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.009	0.115	0.228	0.164	0.004	0.088	0.174	0.096
		Sum	0.515			Sum	0.362
Pier 2 (left)				Pier 2 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.010	0.088	0.174	0.246	0.022	0.115	0.228	0.420
		Sum	0.517			Sum	0.785

Total Defl.	
0.545	(in.)
0.0214	%drift

Project Information

Code:	2018 IBC	**Date:**	9/30/2021
Designer:	JDA		
Client:	CenterLine		
Project:	Derkashani		
Wall Line:	E - Lower to Main (2)		

Three-Term Equation Deflection Check

$$\delta_{sw} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b} \qquad (4.3\text{-}1)$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
Sheathing:	19/32	19/32	19/32	19/32	
Nail:	8d common	8d common	8d common	8d common	
$v_{induced}$:	384	384	384	384	(plf)
E:	1.70E+06	1.70E+06	1.70E+06	1.70E+06	(psi)
h:	8.50	6.50	6.50	8.50	(ft)
A:	16.5	16.5	16.5	16.5	($in.^2$)
Ga:	N/A	N/A	N/A	N/A	(kips/in.)
b:	7.67	7.67	3.00	3.00	(ft)
HD Capacity:	2500	2500	2500	2500	(lbf)
HD Defl:	0.1134	0.1134	0.1134	0.1134	(in.)

Sheathing and Nail Type are not a valid combination. Please review Nail Type input.

Check Total Deflection of Wall System

Pier 1 (left)			Pier 1 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.009		0.164	0.004		0.096
	Sum	0.173		Sum	0.100
Pier 2 (left)			Pier 2 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.010		0.246	0.022		0.420
	Sum	0.256		Sum	0.442

Total Defl.	
0.243	(in.)
0.0095	%drift

Comment: The 3-term equation is calibrated to be approximately equal to 4-term equation at 1.4*ASD capacity.

Roof			
Member Name	Results	Current Solution	Comments
1	Passed	2 piece(s) 2 x 6 DF No.1	
2	Failed	2 piece(s) 1 3/4" x 18" 2.0E Microllam® LVL	Multiple Failures/Errors
3	Passed	2 piece(s) 2 x 8 DF No.1	
4	Passed	1 piece(s) 3 1/2" x 7 1/2" 24F-V4 DF Glulam	
5	Failed	3 piece(s) 1 3/4" x 20" 2.0E Microllam® LVL	Multiple Failures/Errors
6	Passed	3 piece(s) 1 3/4" x 14" 2.0E Microllam® LVL	
7	Passed	2 piece(s) 1 3/4" x 18" 2.0E Microllam® LVL	
8	Passed	1 piece(s) 3 1/2" x 10 1/2" 24F-V4 DF Glulam	
9	Passed	2 piece(s) 2 x 8 DF No.1	
10	Passed	2 piece(s) 2 x 10 DF No.1	
11	Passed	1 piece(s) 3 1/2" x 10 1/2" 24F-V4 DF Glulam	
12	Passed	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
13	Passed	2 piece(s) 2 x 4 DF No.1	
14	Passed	2 piece(s) 2 x 6 DF No.1	
15	Passed	2 piece(s) 2 x 6 DF No.1	

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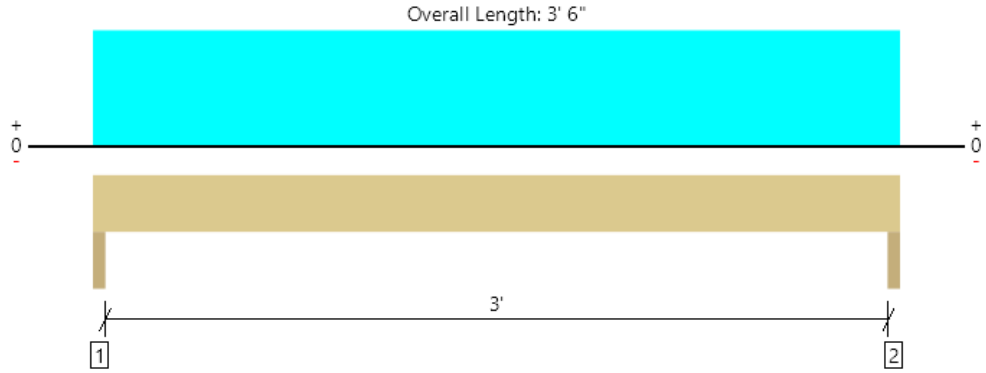
Roof, 1

2 piece(s) 2 x 6 DF No.1



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)	1036 @ 1 1/2"	5625 (3.00")	Passed (18%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	616 @ 8 1/2"	2277	Passed (27%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	781 @ 1' 9"	1884	Passed (41%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.013 @ 1' 9"	0.108	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.021 @ 1' 9"	0.162	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	419	617	1036	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	419	617	1036	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 6" o/c	
Bottom Edge (Lu)	3' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 3' 6"	N/A	4.2	--	
1 - Uniform (PSF)	0 to 3' 6"	11' 9"	20.0	30.0	Default Load

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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
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

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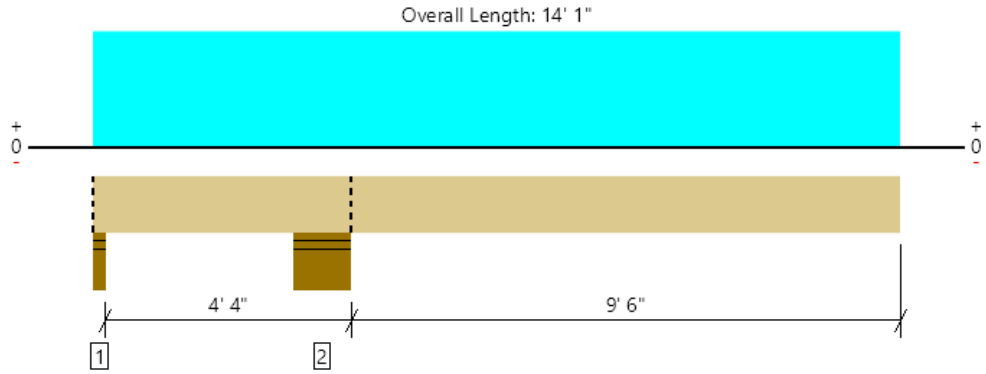
Roof, 2

2 piece(s) 1 3/4" x 18" 2.0E Microllam® LVL

Right cantilever exceeds the maximum braced cantilever length of 7'. ok, braced by sheathing/framing

An excessive uplift of -7063 lbs at support located at 1 1/2" failed this product. detail accordingly



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)	15233 @ 4'	30625 (14.00")	Passed (50%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	7887 @ 1' 11"	13766	Passed (57%)	1.15	1.0 D + 1.0 S (Alt Spans)
Moment (Ft-lbs)	-30803 @ 4'	33424	Passed (92%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.380 @ 14' 1"	1.008	Passed (2L/636)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.652 @ 14' 1"	1.344	Passed (2L/370)	--	1.0 D + 1.0 S (Alt Spans)

System : Roof
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/240) and TL (L/180).
- Overhang deflection criteria: LL (2L/240) and TL (2L/180).
- Right cantilever length exceeds 1/3 member length or 1/2 back span length. Additional bracing should be considered.
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Moment capacity over cantilever support 2 has been reduced by 25% to lessen the effects of buckling.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Stud wall - DF	3.00"	3.00"	1.50"	-2802	-4261	-7063	Blocking
2 - Stud wall - DF	14.00"	14.00"	6.96"	6371	8862	15233	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	14' 1" o/c	
Bottom Edge (Lu)	5' 10" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 14' 1"	N/A	18.4	--	
1 - Uniform (PSF)	0 to 14' 1" (Front)	11' 9"	20.0	30.0	Default Load

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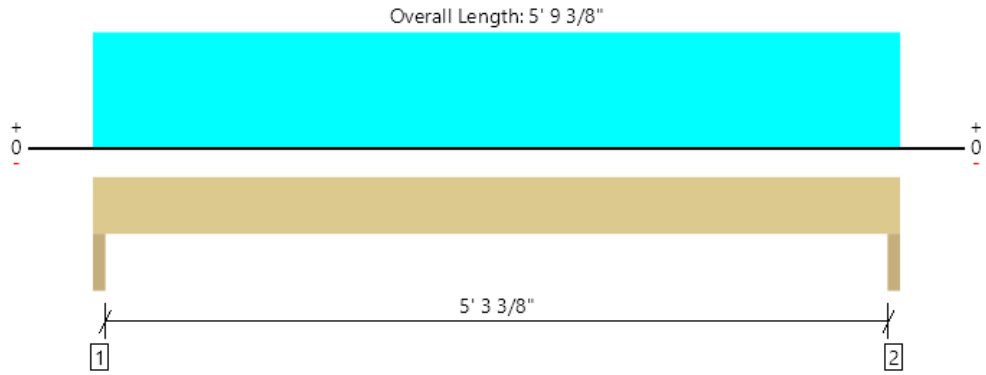
Roof, 3
2 piece(s) 2 x 8 DF No.1



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)	1714 @ 1 1/2"	5625 (3.00")	Passed (30%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1208 @ 10 1/4"	3002	Passed (40%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	2268 @ 2' 10 11/16"	3022	Passed (75%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.046 @ 2' 10 11/16"	0.184	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.077 @ 2' 10 11/16"	0.277	Passed (L/861)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	695	1019	1714	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	695	1019	1714	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 9" o/c	
Bottom Edge (Lu)	5' 9" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 5' 9 3/8"	N/A	5.5	--	
1 - Uniform (PSF)	0 to 5' 9 3/8"	11' 9"	20.0	30.0	Default Load

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ForteWEB Software Operator	Job Notes
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

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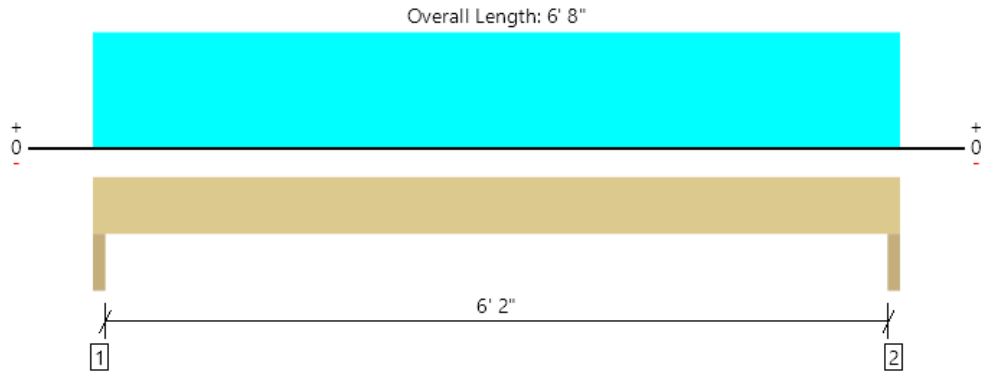
Roof, 4

1 piece(s) 3 1/2" x 7 1/2" 24F-V4 DF Glulam



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)	3568 @ 1 1/2"	6825 (3.00")	Passed (52%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	2632 @ 10 1/2"	5333	Passed (49%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	5510 @ 3' 4"	7547	Passed (73%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.110 @ 3' 4"	0.214	Passed (L/700)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.184 @ 3' 4"	0.321	Passed (L/418)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 6' 5".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.57"	1440	2128	3568	None
2 - Trimmer - DF	3.00"	3.00"	1.57"	1440	2128	3568	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	6' 8" o/c	
Bottom Edge (Lu)	6' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 6' 8"	N/A	6.4	--	
1 - Uniform (PSF)	0 to 6' 8"	21' 3 3/8"	20.0	30.0	Default Load

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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
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

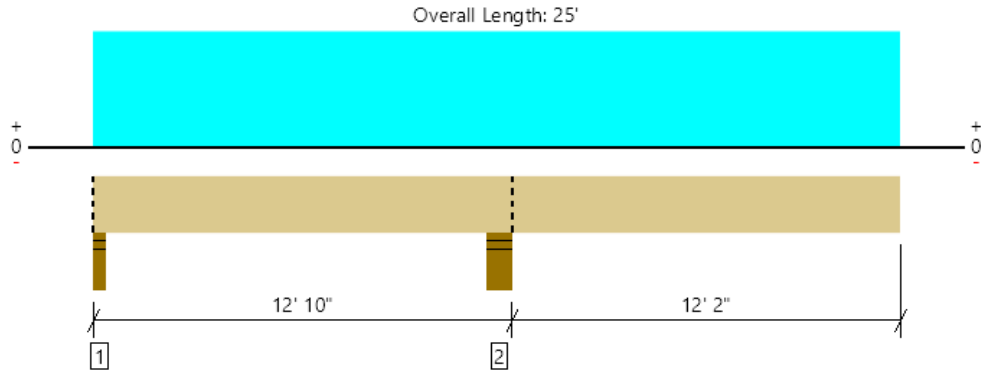
Weyerhaeuser

Roof, 5

3 piece(s) 1 3/4" x 20" 2.0E Microllam® LVL

Right cantilever exceeds the maximum braced cantilever length of 7'. ok, braced by sheathing/framing

An excessive uplift of -1126 lbs at support located at 1 1/2" failed this product. detail accordingly



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)	16904 @ 12' 7"	19688 (6.00")	Passed (86%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	7147 @ 10' 8"	22943	Passed (31%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	-52472 @ 12' 7"	61017	Passed (86%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.654 @ 25'	1.242	Passed (2L/456)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	1.105 @ 25'	1.656	Passed (2L/270)	--	1.0 D + 1.0 S (Alt Spans)

System : Roof
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/240) and TL (L/180).
- Overhang deflection criteria: LL (2L/240) and TL (2L/180).
- Right cantilever length exceeds 1/3 member length or 1/2 back span length. Additional bracing should be considered.
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Moment capacity over cantilever support 2 has been reduced by 25% to lessen the effects of buckling.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Stud wall - SPF	3.00"	3.00"	1.50"	48	1272/-1174	1320/-1174	Blocking
2 - Stud wall - DF	6.00"	6.00"	5.15"	7219	9685	16904	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	25' o/c	
Bottom Edge (Lu)	7' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 25'	N/A	30.6	--	
1 - Uniform (PSF)	0 to 25' (Front)	13'	20.0	30.0	Default Load

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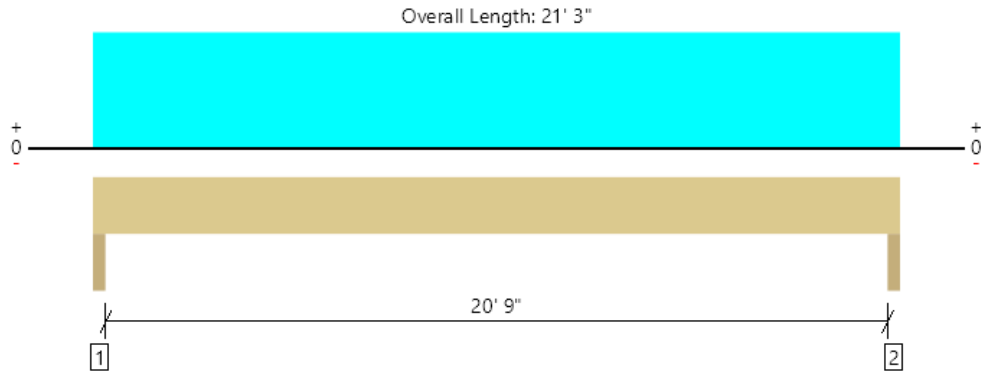
ForteWEB Software Operator	Job Notes
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

Weyerhaeuser

Roof, 6

3 piece(s) 1 3/4" x 14" 2.0E Microllam® LVL



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)	3787 @ 1 1/2"	11813 (3.00")	Passed (32%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	2730 @ 1' 5"	12569	Passed (22%)	0.90	1.0 D (All Spans)
Moment (Ft-lbs)	16342 @ 10' 7 1/2"	32749	Passed (50%)	0.90	1.0 D (All Spans)
Live Load Defl. (in)	0.115 @ 10' 7 1/2"	0.700	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.680 @ 10' 7 1/2"	1.050	Passed (L/370)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	3150	638	3788	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	3150	638	3788	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	17' 2" o/c	
Bottom Edge (Lu)	21' 3" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 21' 3"	N/A	21.5	--	
1 - Uniform (PSF)	0 to 21' 3"	2'	20.0	30.0	Default Load
2 - Uniform (PSF)	0 to 21' 3"	11' 9"	20.0	-	Weight of Hung Door

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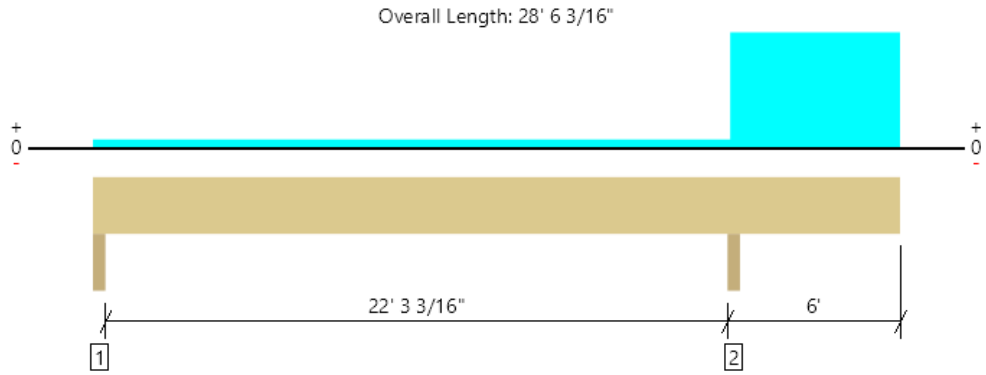
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

Weyerhaeuser

Roof, 7

2 piece(s) 1 3/4" x 18" 2.0E Microllam® LVL



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)	5622 @ 22' 7 11/16"	7875 (3.00")	Passed (71%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3053 @ 24' 3 3/16"	13766	Passed (22%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	-12399 @ 22' 7 11/16"	44566	Passed (28%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.186 @ 28' 6 3/16"	0.392	Passed (2L/758)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.279 @ 28' 6 3/16"	0.587	Passed (2L/506)	--	1.0 D + 1.0 S (Alt Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Overhang deflection criteria: LL (2L/360) and TL (2L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	208	181/-151	389/-151	None
2 - Trimmer - DF	3.00"	3.00"	2.14"	2447	3176	5623	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	28' 6" o/c	
Bottom Edge (Lu)	17' 1" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 28' 6 3/16"	N/A	18.4	--	
1 - Uniform (PSF)	0 to 28' 6 3/16"	1'	20.0	30.0	Default Load
2 - Uniform (PSF)	22' 6 3/16" to 28' 6 3/16"	13'	20.0	30.0	

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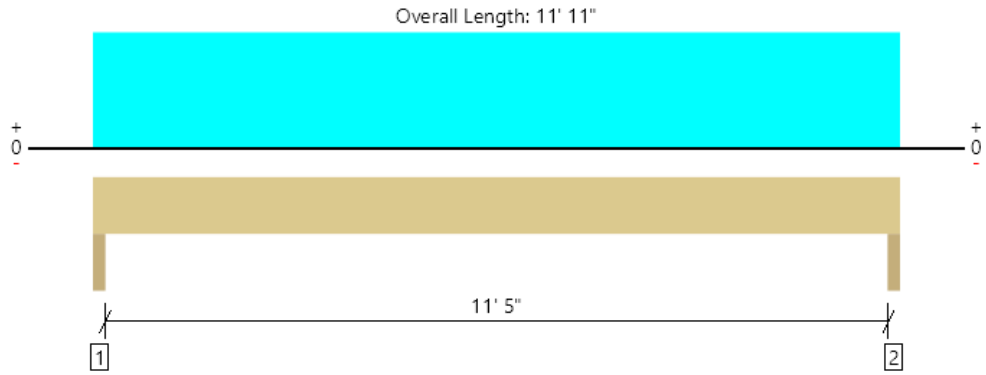
Roof, 8

1 piece(s) 3 1/2" x 10 1/2" 24F-V4 DF Glulam



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)	4460 @ 1 1/2"	6825 (3.00")	Passed (65%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3618 @ 1' 1 1/2"	7466	Passed (48%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	12736 @ 5' 11 1/2"	14792	Passed (86%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.304 @ 5' 11 1/2"	0.389	Passed (L/460)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.513 @ 5' 11 1/2"	0.583	Passed (L/273)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 11' 8".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.96"	1816	2644	4460	None
2 - Trimmer - DF	3.00"	3.00"	1.96"	1816	2644	4460	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	11' 11" o/c	
Bottom Edge (Lu)	11' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 11' 11"	N/A	8.9	--	
1 - Uniform (PSF)	0 to 11' 11"	14' 9 1/2"	20.0	30.0	Default Load

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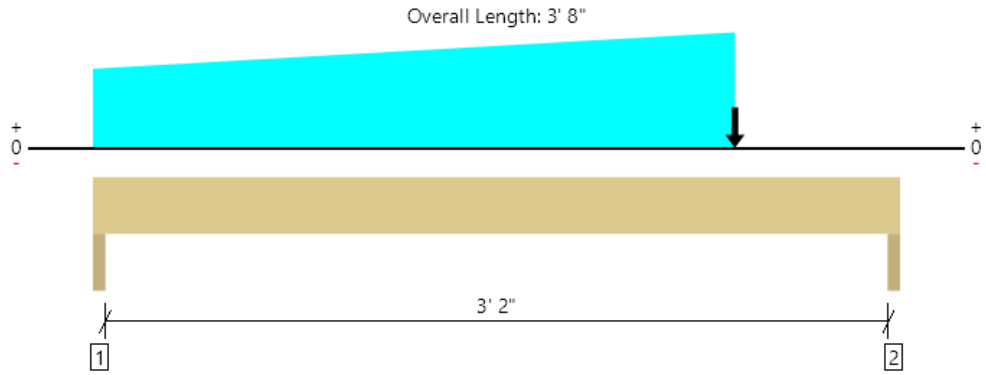
ForteWEB Software Operator	Job Notes
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

Weyerhaeuser

Roof, 9

2 piece(s) 2 x 8 DF No.1



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)	3625 @ 3' 6 1/2"	5625 (3.00")	Passed (64%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	2883 @ 2' 9 3/4"	3002	Passed (96%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	2264 @ 2' 11"	3022	Passed (75%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.014 @ 1' 11 5/16"	0.114	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.023 @ 1' 11 5/16"	0.171	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	439	643	1082	None
2 - Trimmer - DF	3.00"	3.00"	1.93"	1456	2169	3625	None

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

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 3' 8"	N/A	5.5	--	
1 - Tapered (PSF)	0 to 2' 11"	3' to 4' 4 1/2"	20.0	30.0	Default Load
2 - Point (lb)	2' 11"	N/A	1660	2490	83 SF from Truss Girder

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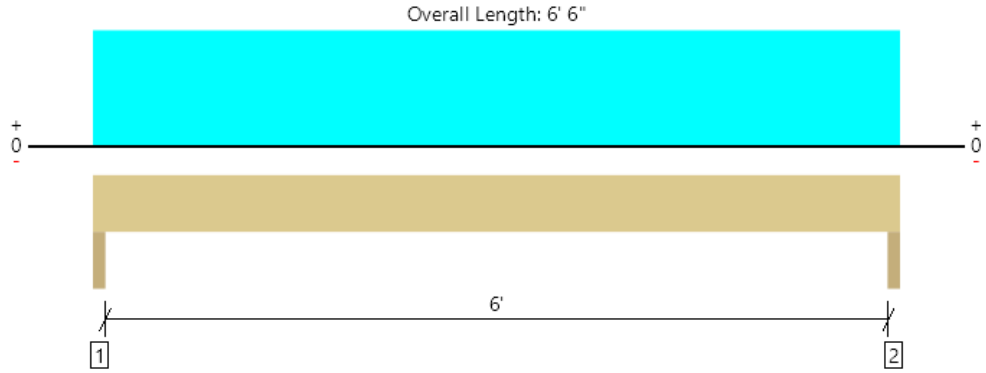
Roof, 10
2 piece(s) 2 x 10 DF No.1



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)	2433 @ 1 1/2"	5625 (3.00")	Passed (43%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1669 @ 1' 1/4"	3830	Passed (44%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	3656 @ 3' 3"	4510	Passed (81%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.045 @ 3' 3"	0.208	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.076 @ 3' 3"	0.313	Passed (L/981)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	987	1446	2433	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	987	1446	2433	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	6' 6" o/c	
Bottom Edge (Lu)	6' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 6' 6"	N/A	7.0	--	
1 - Uniform (PSF)	0 to 6' 6"	14' 10"	20.0	30.0	Default Load

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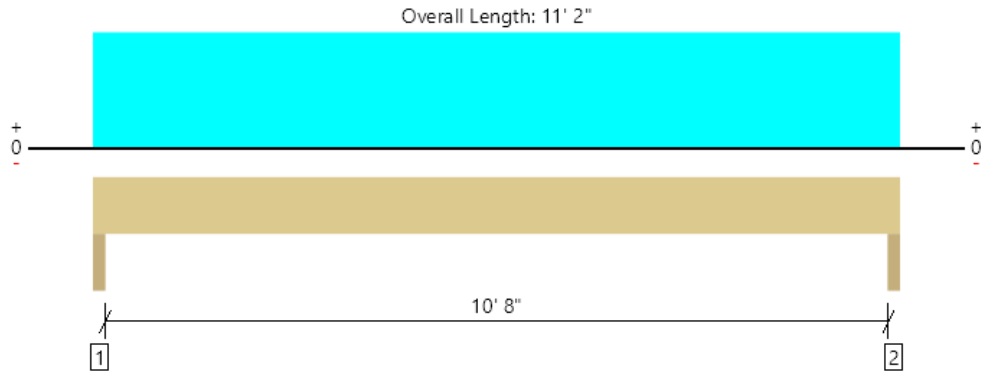
ForteWEB Software Operator	Job Notes
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

Weyerhaeuser

Roof, 11

1 piece(s) 3 1/2" x 10 1/2" 24F-V4 DF Glulam



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)	4191 @ 1 1/2"	6825 (3.00")	Passed (61%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3347 @ 1' 1 1/2"	7466	Passed (45%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	11182 @ 5' 7"	14792	Passed (76%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.234 @ 5' 7"	0.364	Passed (L/560)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.395 @ 5' 7"	0.546	Passed (L/332)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 10' 11".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.84"	1707	2485	4192	None
2 - Trimmer - DF	3.00"	3.00"	1.84"	1707	2485	4192	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	11' 2" o/c	
Bottom Edge (Lu)	11' 2" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 11' 2"	N/A	8.9	--	
1 - Uniform (PSF)	0 to 11' 2"	14' 10"	20.0	30.0	Default Load

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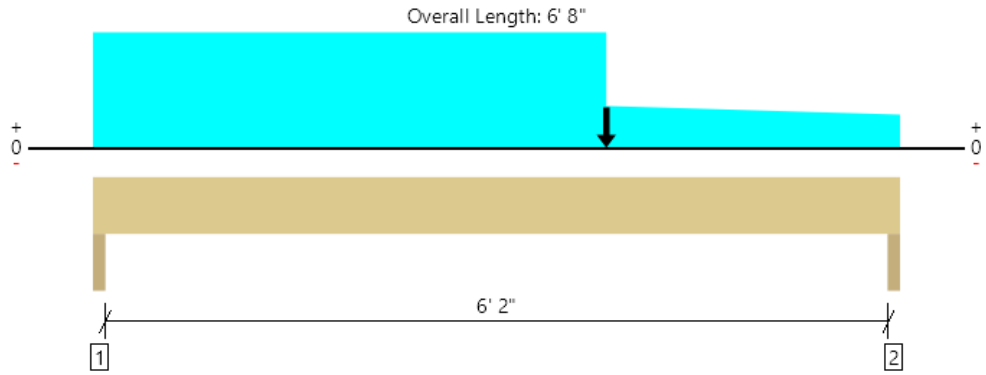
Roof, 12

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



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)	4059 @ 6' 6 1/2"	6825 (3.00")	Passed (59%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3830 @ 5' 8"	6400	Passed (60%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	8650 @ 4' 2 7/8"	10868	Passed (80%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.089 @ 3' 5 1/16"	0.214	Passed (L/861)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.150 @ 3' 5 1/16"	0.321	Passed (L/514)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 6' 5".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.63"	1500	2211	3711	None
2 - Trimmer - DF	3.00"	3.00"	1.78"	1639	2420	4059	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	6' 8" o/c	
Bottom Edge (Lu)	6' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 6' 8"	N/A	7.7	--	
1 - Uniform (PSF)	0 to 4' 2 7/8"	14' 7"	20.0	30.0	Default Load
2 - Point (lb)	4' 2 7/8"	N/A	1620	2430	81 SF from truss girder
3 - Tapered (PSF)	4' 2 7/8" to 6' 8"	5' 3 9/16" to 4' 2 1/2"	20.0	30.0	Default Load

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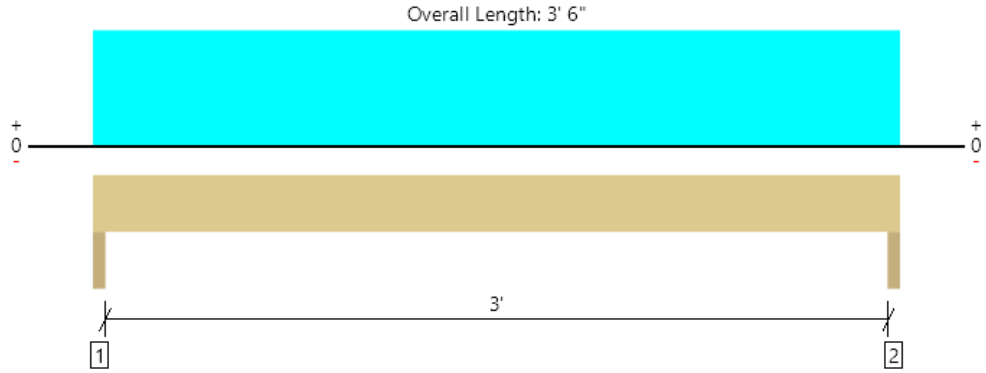
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

Weyerhaeuser

Roof, 13
2 piece(s) 2 x 4 DF No.1



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)	479 @ 1 1/2"	5625 (3.00")	Passed (9%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	330 @ 6 1/2"	1449	Passed (23%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	361 @ 1' 9"	880	Passed (41%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.022 @ 1' 9"	0.108	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.038 @ 1' 9"	0.162	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	194	284	478	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	194	284	478	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 6" o/c	
Bottom Edge (Lu)	3' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 3' 6"	N/A	2.7	--	
1 - Uniform (PSF)	0 to 3' 6"	5' 5"	20.0	30.0	Default Load

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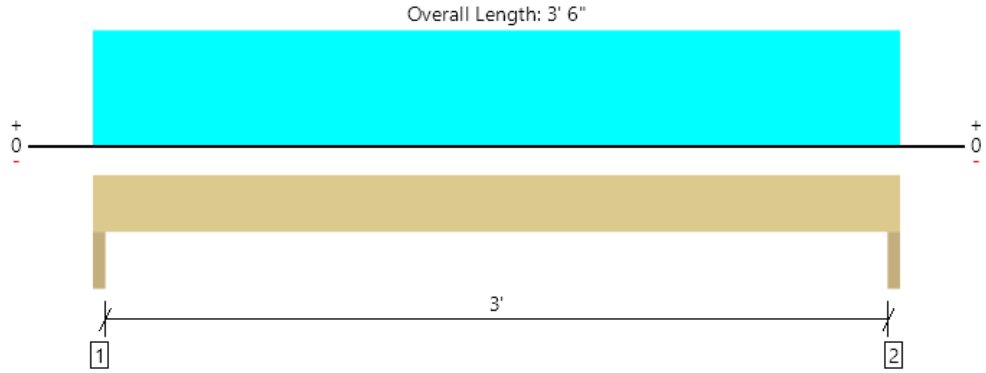
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

Weyerhaeuser

Roof, 14
2 piece(s) 2 x 6 DF No.1



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)	1283 @ 1 1/2"	5625 (3.00")	Passed (23%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	764 @ 8 1/2"	2277	Passed (34%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	968 @ 1' 9"	1884	Passed (51%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.016 @ 1' 9"	0.108	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.026 @ 1' 9"	0.162	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	518	766	1284	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	518	766	1284	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	3' 6" o/c	
Bottom Edge (Lu)	3' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 3' 6"	N/A	4.2	--	
1 - Uniform (PSF)	0 to 3' 6"	14' 7"	20.0	30.0	Default Load

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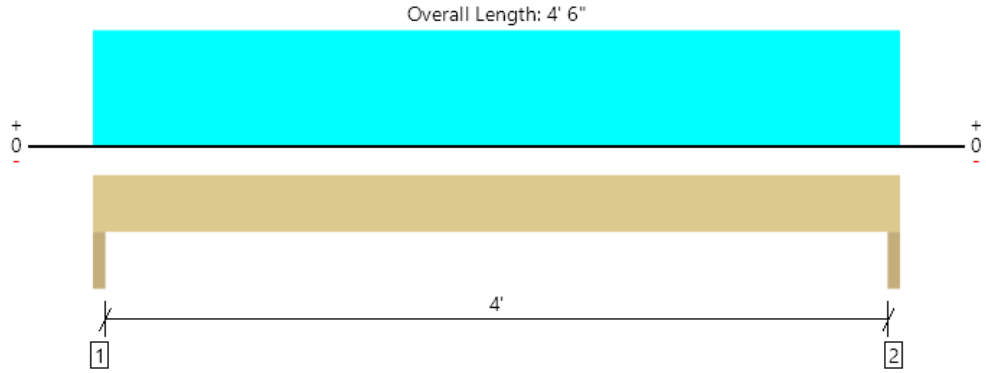
ForteWEB Software Operator	Job Notes
Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

Weyerhaeuser

Roof, 15
2 piece(s) 2 x 6 DF No.1



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)	1210 @ 1 1/2"	5625 (3.00")	Passed (22%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	829 @ 8 1/2"	2277	Passed (36%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	1214 @ 2' 3"	1884	Passed (64%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.033 @ 2' 3"	0.142	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.056 @ 2' 3"	0.213	Passed (L/914)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Total	
1 - Trimmer - DF	3.00"	3.00"	1.50"	490	720	1210	None
2 - Trimmer - DF	3.00"	3.00"	1.50"	490	720	1210	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	4' 6" o/c	
Bottom Edge (Lu)	4' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 4' 6"	N/A	4.2	--	
1 - Uniform (PSF)	0 to 4' 6"	10' 8"	20.0	30.0	Default Load

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Javid Abdi Atlas Consulting Engineers (206) 427-7233 javiddabdi@yahoo.com	

Weyerhaeuser

FORTE WEB

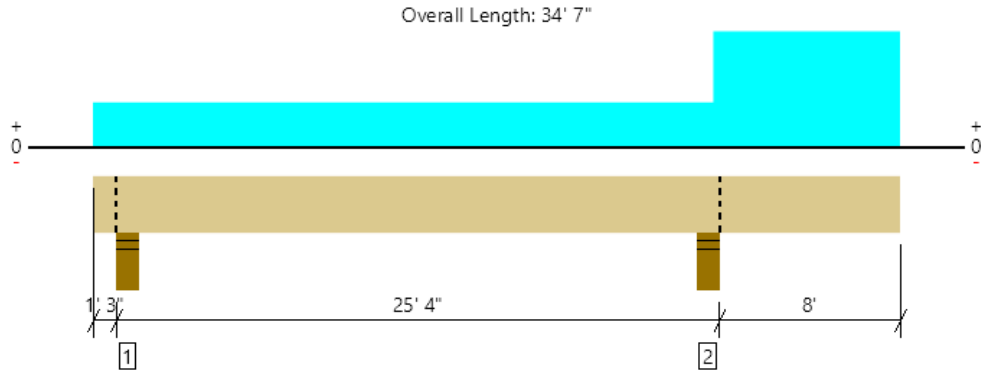
MEMBER REPORT

FAILED

Roof, Truss Uplift Overhang

1 piece(s) 1 3/4" x 14" 2.0E Microllam® LVL @ 24" OC

Right cantilever exceeds the maximum braced cantilever length of 7'. OK, braced by sheathing



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)	2634 @ 26' 4 1/4"	6016 (5.50")	Passed (44%)	--	1.0 D + 1.0 S (Adj Spans)
Shear (lbs)	1154 @ 24' 11 1/2"	5353	Passed (22%)	1.15	1.0 D + 1.0 S (Adj Spans)
Moment (Ft-lbs)	-5686 @ 26' 4 1/4"	10880	Passed (52%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.429 @ 34' 7"	0.823	Passed (2L/460)	--	1.0 D + 1.0 S (Alt Spans)
Total Load Defl. (in)	0.464 @ 34' 7"	1.097	Passed (2L/426)	--	1.0 D + 1.0 S (Alt Spans)

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 0/12

- Deflection criteria: LL (L/240) and TL (L/180).
- Overhang deflection criteria: LL (2L/240) and TL (2L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A 4% increase in the moment capacity has been added to account for repetitive member usage.
- Moment capacity over cantilever support 2 has been reduced by 25% to lessen the effects of buckling.
- -207 lbs uplift at support located at 1' 5 3/4". Strapping or other restraint may be required.
- -243 lbs uplift at support located at 26' 4 1/4". Strapping or other restraint may be required.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Snow	Wind	Total	
1 - Stud wall - DF	5.50"	5.50"	1.50"	270	756	20/-614	1046/-614	Blocking
2 - Stud wall - DF	5.50"	5.50"	2.41"	752	1882	-1156	2634/-1156	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' 11" o/c	
Bottom Edge (Lu)	8' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Spacing	Dead (0.90)	Snow (1.15)	Wind (1.60)	Comments
1 - Uniform (PSF)	0 to 34' 7"	24"	12.0	30.0	-22.0	Default Load
2 - Uniform (PSF)	26' 7" to 34' 7"	24"	12.0	30.0	-10.0	Default Load

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ForteWEB Software Operator	Job Notes
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Weyerhaeuser

9/30/2021 2:38:17 PM UTC

ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16

File Name: Derkashani

CANTILEVER RETAINING WALL EXTERNAL STABILITY

limitations: uses Rankine coefficients for noncohesive soils, external moment at top of wall does not contribute to restoring moment (overturning only), no deflection or service load checks, soil on low side of wall does not brace wall against overturning (sliding only)

reference: Nilson & Winter, Design of Concrete Structures, 11th Edition, page 680

file author: S. Frech last modified: 4/25/2002

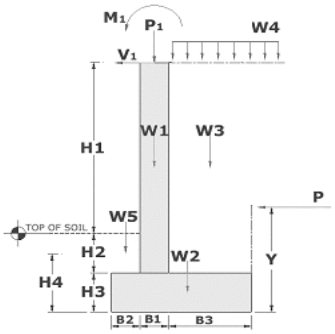
SOIL DATA

w	130	(pcf)	soil unit weight
phi	35	(deg)	soil internal angle of friction
del	0	(deg)	surface angle incline
	0.5		coeff. friction w/Concrete
	0.819		cosine(phi)
	1.000		cosine(del)
Ca	0.271	*35.23 psf*	coeff. of active pressure
Cp	2.307	*299.91 psf*	coeff. of passive pressure

Coeff. Friction			
Unit Weight	Int Friction	w. Conc	Soil
110-120	33-40	0.5-0.6	Sand or gravel, no fines
120-130	25-35	0.4-0.5	Sand or gravel, w/ fines
110-120	23-30	0.3-0.4	Silty sand, high clay
100-120	25-35	0.2-0.4	Medium or stiff clay
90-110	20-25	0.2-0.3	Soft clay, silt

WALL GEOMETRY

H1	4.3333333	(ft)	soil retained
H2	0.1666667	(ft)	soil depth above toe
H3	0.8333333	(ft)	footing thickness
H4	1	(ft)	passive pressure soil depth
B1	0.6666667	(ft)	wall width
B2	2	(ft)	toe width
B3	0	(ft)	heel width
H	5.3333333	(ft)	total height
B	2.6666667	(ft)	total base
	150	(pcf)	concrete unit weight



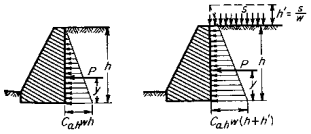
EXTERNAL LOADS

$P_{applied}$	0	(lb/ft)	
$V_{applied}$	187.5	(lb/ft)	0.5
$M_{applied}$	0	(lb-ft / ft)	
Surcharge	36	(psf)	

LOAD CALCULATIONS

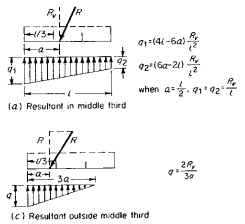
lateral soil force and overturning moment

H_{prime}	0.28	(ft)	converted surcharge
Y	1.86	(ft)	distance to soil load resultant
P	554	(lbs)	soil load resultant
	1030	(lb-ft)	Mo, soil + surcharge
	-62.50313	(lb-ft)	Mo, external load
	970	(lb-ft)	total overturning Moment



wall restoring forces

component	weight (#)	arm (ft)	moment (#-ft)
w1 (concrete)	450	2.33	1050
w2 (concrete)	333	1.33	444
w3 (heel soil)	0	2.67	0
w4 (surcharge)	0	2.67	0
w5 (toe soil)	43	1.00	43
P applied	0	2.33	0
vert. force	827	moment	1,538

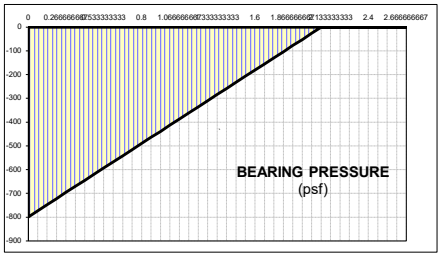


lateral sliding resistance

150	(lb)	passive pressure sliding resistance
414	(lb)	soil friction force
564	(lb)	total sliding resistance

STABILITY FACTOR OF SAFETY CHECKS

	1.5		F.S. overturning
	1.5		F.S. sliding
overturning	1.59	OK	Mr / Mo
sliding	1.54	OK	(PP+F)/(Ph+V)



SOIL BEARING

a	0.69	(ft)	distance to resultant
	0.89' to 1.78'		middle third of footing
q1	799	(psf)	bearing pressure @ toe
q2	N.A.	(psf)	bearing pressure @ heel

FACTORED (1.7) STEM LOAD FORCES

4.5	(ft)	H1 + H2
1.58	(ft)	line of action (above base)
401	(lbs)	P (arm only)
401	(lbs)	Ph (arm only)
2.5	(kip-ft)	Mu (arm moment)

FACTORED (1.7) FOOTING LOADS

5.5	(kip-ft)	Mu @ Toe (Bot Reinf)
0.0	(kip-ft)	Mu @ Heel (Top Reinf)
4.22	(kip)	Vu @ Toe
0.00	(kip)	Vu @ Heel

Footing			**Wall**		
ØVc	7,969	10" thick	ØVc	5,692	8" thick
As	0.2	#4 @ 12"	As	0.15	#4 @ 16"
a	0.0003		a	0.0002	
ØMn	6.30	k-ft	ØMn	4.05	k-ft
	0.6	3-#4			
	0.001875	Reinf. Ratio			

LRFD soil	0 psf @	-0.07 ft from Wall
	1358.3 'psf @ Toe	
	4217.5215 # in Toe @	1.31 ft from Wall

CANTILEVER RETAINING WALL EXTERNAL STABILITY

limitations: uses Rankine coefficients for noncohesive soils, external moment at top of wall does not contribute to restoring moment (overturning only), no deflection or service load checks, soil on low side of wall does not brace wall against overturning (sliding only)

reference: Nilson & Winter, Design of Concrete Structures, 11th Edition, page 680

file author: S. Frech last modified: 4/25/2002

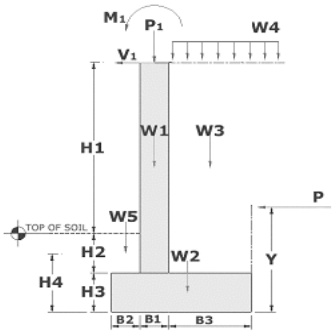
SOIL DATA

w	130	(pcf)	soil unit weight
phi	35	(deg)	soil internal angle of friction
del	0	(deg)	surface angle incline
	0.5		coeff. friction w/Concrete
	0.819		cosine(phi)
	1.000		cosine(del)
Ca	0.271	*35.23 psf*	coeff. of active pressure
Cp	2.307	*299.91 psf*	coeff. of passive pressure

Coeff. Friction			
Unit Weight	Int Friction	w. Conc	Soil
110-120	33-40	0.5-0.6	Sand or gravel, no fines
120-130	25-35	0.4-0.5	Sand or gravel, w/ fines
110-120	23-30	0.3-0.4	Silty sand, high clay
100-120	25-35	0.2-0.4	Medium or stiff clay
90-110	20-25	0.2-0.3	Soft clay, silt

WALL GEOMETRY

H1	5.3333333	(ft)	soil retained
H2	0.1666667	(ft)	soil depth above toe
H3	0.8333333	(ft)	footing thickness
H4	1	(ft)	passive pressure soil depth
B1	0.6666667	(ft)	wall width
B2	3.25	(ft)	toe width
B3	0	(ft)	heel width
H	6.3333333	(ft)	total height
B	3.9166667	(ft)	total base
	150	(pcf)	concrete unit weight



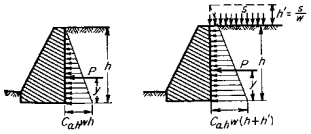
EXTERNAL LOADS

$P_{applied}$	100	(lb/ft)	
$V_{applied}$	450	(lb/ft)	1
$M_{applied}$	0	(lb-ft / ft)	
Surcharge	44	(psf)	

LOAD CALCULATIONS

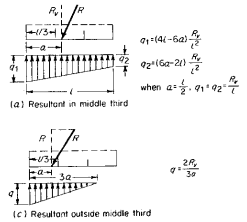
lateral soil force and overturning moment

H_{prime}	0.34	(ft)	converted surcharge
Y	2.21	(ft)	distance to soil load resultant
P	782	(lbs)	soil load resultant
	1730	(lb-ft)	Mo, soil + surcharge
	-300.015	(lb-ft)	Mo, external load
	1,430	(lb-ft)	total overturning Moment



wall restoring forces

component	weight (#)	arm (ft)	moment (#-ft)
w1 (concrete)	550	3.58	1971
w2 (concrete)	490	1.96	959
w3 (heel soil)	0	3.92	0
w4 (surcharge)	0	3.92	0
w5 (toe soil)	70	1.63	114
P applied	100	0.33	33
vert. force	1,210	moment	3,077

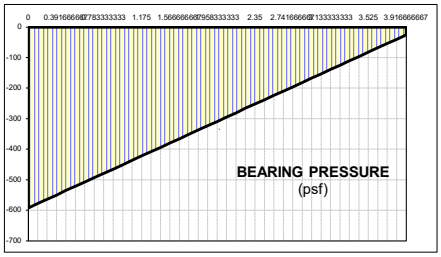


lateral sliding resistance

150	(lb)	passive pressure sliding resistance
605	(lb)	soil friction force
755	(lb)	total sliding resistance

STABILITY FACTOR OF SAFETY CHECKS

	1.5		F.S. overturning
	1.5		F.S. sliding
overturning	2.15	OK	Mr / Mo
sliding	2.27	OK	(PP+F)/(Ph+V)



SOIL BEARING

a	1.36	(ft)	distance to resultant
	1.31' to 2.61'		middle third of footing
q1	592	(psf)	bearing pressure @ toe
q2	26	(psf)	bearing pressure @ heel

FACTORED (1.7) STEM LOAD FORCES

5.5	(ft)	H1 + H2
1.93	(ft)	line of action (above base)
599	(lbs)	P (arm only)
599	(lbs)	Ph (arm only)
6.2	(kip-ft)	Mu (arm moment)

FACTORED (1.7) FOOTING LOADS

3.9	(kip-ft)	Mu @ Toe (Bot Reinf)
0.0	(kip-ft)	Mu @ Heel (Top Reinf)
1.97	(kip)	Vu @ Toe
0.00	(kip)	Vu @ Heel

Footing			**Wall**		
ØVc	7,969	10" thick	ØVc	5,692	8" thick
As	0.2	#4 @ 12"	As	0.24	#4 @ 10"
a	0.0003		a	0.0004	
ØMn	6.30	k-ft	ØMn	6.48	k-ft
	1	5-#4			
	0.0021277	Reinf. Ratio			

LRFD soil 207.97872 psf @ Wall interface
1006.4 'psf @ Toe

1297.4346 # in Toe @ 2.166666667 ft from Wall
675.93085 # in Toe @ 1.625 ft from Wall

CANTILEVER RETAINING WALL EXTERNAL STABILITY

limitations: uses Rankine coefficients for noncohesive soils, external moment at top of wall does not contribute to restoring moment (overturning only), no deflection or service load checks, soil on low side of wall does not brace wall against overturning (sliding only)

reference: Nilson & Winter, Design of Concrete Structures, 11th Edition, page 680

file author: S. Frech last modified: 4/25/2002

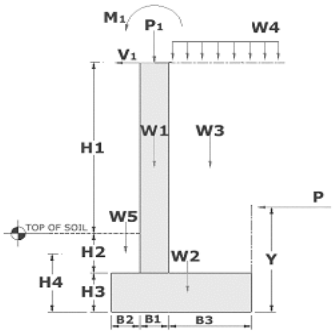
SOIL DATA

w	130	(pcf)	soil unit weight
phi	35	(deg)	soil internal angle of friction
del	0	(deg)	surface angle incline
	0.5		coeff. friction w/Concrete
	0.819		cosine(phi)
	1.000		cosine(del)
Ca	0.271	*35.23 psf*	coeff. of active pressure
Cp	2.307	*299.91 psf*	coeff. of passive pressure

Coeff. Friction			
Unit Weight	Int Friction	w. Conc	Soil
110-120	33-40	0.5-0.6	Sand or gravel, no fines
120-130	25-35	0.4-0.5	Sand or gravel, w/ fines
110-120	23-30	0.3-0.4	Silty sand, high clay
100-120	25-35	0.2-0.4	Medium or stiff clay
90-110	20-25	0.2-0.3	Soft clay, silt

WALL GEOMETRY

H1	6.3333333	(ft)	soil retained
H2	0.1666667	(ft)	soil depth above toe
H3	0.8333333	(ft)	footing thickness
H4	1	(ft)	passive pressure soil depth
B1	0.6666667	(ft)	wall width
B2	4.25	(ft)	toe width
B3	0	(ft)	heel width
H	7.3333333	(ft)	total height
B	4.9166667	(ft)	total base
	150	(pcf)	concrete unit weight



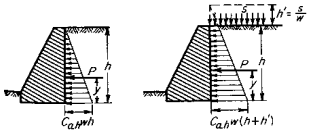
EXTERNAL LOADS

$P_{applied}$	150	(lb/ft)	
$V_{applied}$	787.5	(lb/ft)	1.5
$M_{applied}$	0	(lb-ft / ft)	
Surcharge	52	(psf)	

LOAD CALCULATIONS

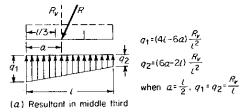
lateral soil force and overturning moment

H_{prime}	0.40	(ft)	converted surcharge
Y	2.56	(ft)	distance to soil load resultant
P	1051	(lbs)	soil load resultant
	2690	(lb-ft)	Mo, soil + surcharge
	-787.5394	(lb-ft)	Mo, external load
	1,900	(lb-ft)	total overturning Moment



wall restoring forces

component	weight (#)	arm (ft)	moment (#-ft)
w1 (concrete)	650	4.58	2979
w2 (concrete)	615	2.46	1511
w3 (heel soil)	0	4.92	0
w4 (surcharge)	0	4.92	0
w5 (toe soil)	92	2.13	196
P applied	150	0.33	50
vert. force	1,507	moment	4,736

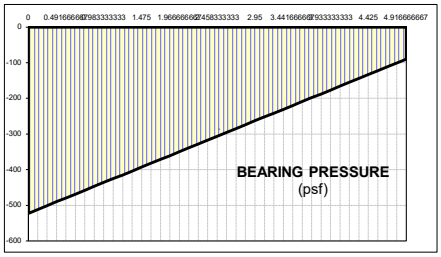


lateral sliding resistance

150	(lb)	passive pressure sliding resistance
754	(lb)	soil friction force
904	(lb)	total sliding resistance

STABILITY FACTOR OF SAFETY CHECKS

	1.5		F.S. overturning
	1.5		F.S. sliding
overturning	2.49	OK	Mr / Mo
sliding	3.43	OK	(PP+F)/(Ph+V)



SOIL BEARING

a	1.88	(ft)	distance to resultant
	1.64' to 3.28'		middle third of footing
q1	523	(psf)	bearing pressure @ toe
q2	90	(psf)	bearing pressure @ heel

FACTORED (1.7) STEM LOAD FORCES

6.5	(ft)	H1 + H2
2.29	(ft)	line of action (above base)
836	(lbs)	P (arm only)
836	(lbs)	Ph (arm only)
12.0	(kip-ft)	Mu (arm moment)

FACTORED (1.7) FOOTING LOADS

6.1	(kip-ft)	Mu @ Toe (Bot Reinf)
0.0	(kip-ft)	Mu @ Heel (Top Reinf)
2.43	(kip)	Vu @ Toe
0.00	(kip)	Vu @ Heel

Footing			**Wall**		
ØVc	7,969	10" thick	ØVc	5,692	8" thick
As	0.2325	#5 @ 16"	As	0.372	#5 @ 10"
a	0.0003		a	0.0005	
ØMn	7.32	k-ft	ØMn	10.04	k-ft
	1.55	5-#5			
	0.0026271	Reinf. Ratio			

LRFD soil 252.81017 psf @ Wall interface
889.1 'psf @ Toe

1352.1159 # in Toe @ 2.833333333 ft from Wall
1074.4432 # in Toe @ 2.125 ft from Wall

CANTILEVER RETAINING WALL EXTERNAL STABILITY

limitations: uses Rankine coefficients for noncohesive soils, external moment at top of wall does not contribute to restoring moment (overturning only), no deflection or service load checks, soil on low side of wall does not brace wall against overturning (sliding only)

reference: Nilson & Winter, Design of Concrete Structures, 11th Edition, page 680

file author: S. Frech last modified: 4/25/2002

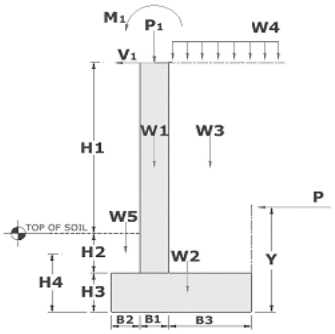
SOIL DATA

w	130	(pcf)	soil unit weight
phi	35	(deg)	soil internal angle of friction
del	0	(deg)	surface angle incline
	0.5		coeff. friction w/Concrete
	0.819		cosine(phi)
	1.000		cosine(del)
Ca	0.271	*35.23 psf*	coeff. of active pressure
Cp	2.307	*299.91 psf*	coeff. of passive pressure

Coeff. Friction			
Unit Weight	Int Friction	w. Conc	Soil
110-120	33-40	0.5-0.6	Sand or gravel, no fines
120-130	25-35	0.4-0.5	Sand or gravel, w/ fines
110-120	23-30	0.3-0.4	Silty sand, high clay
100-120	25-35	0.2-0.4	Medium or stiff clay
90-110	20-25	0.2-0.3	Soft clay, silt

WALL GEOMETRY

H1	7.3333333	(ft)	soil retained
H2	0.1666667	(ft)	soil depth above toe
H3	0.8333333	(ft)	footing thickness
H4	1	(ft)	passive pressure soil depth
B1	0.6666667	(ft)	wall width
B2	5.5	(ft)	toe width
B3	0	(ft)	heel width
H	8.3333333	(ft)	total height
B	6.1666667	(ft)	total base
	150	(pcf)	concrete unit weight



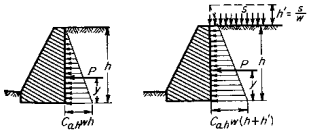
EXTERNAL LOADS

$P_{applied}$	150	(lb/ft)	
$V_{applied}$	787.5	(lb/ft)	1.5
$M_{applied}$	0	(lb-ft / ft)	
Surcharge	60	(psf)	

LOAD CALCULATIONS

lateral soil force and overturning moment

H_{prime}	0.46	(ft)	converted surcharge
Y	2.92	(ft)	distance to soil load resultant
P	1358	(lbs)	soil load resultant
	3970	(lb-ft)	Mo, soil + surcharge
	-787.5394	(lb-ft)	Mo, external load
	3,180	(lb-ft)	total overturning Moment

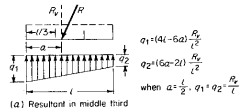


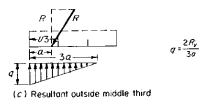
$y = \frac{h}{3}$ $\qquad$ $y = \frac{h^2+3hh'}{3(h+2h')}$

$P = \frac{1}{2}C_{ah}wh^2$ $\qquad$ $P = \frac{1}{2}C_{ah}wh(h+2h')$

wall restoring forces

component	weight (#)	arm (ft)	moment (#-ft)
w1 (concrete)	750	5.83	4375
w2 (concrete)	771	3.08	2377
w3 (heel soil)	0	6.17	0
w4 (surcharge)	0	6.17	0
w5 (toe soil)	119	2.75	328
P applied	150	0.33	50
vert. force	1,790	moment	7,129



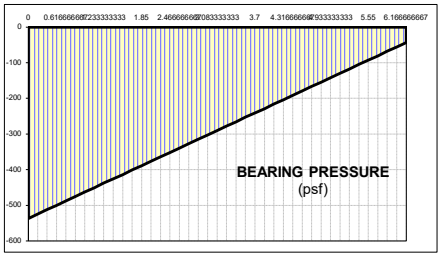


lateral sliding resistance

150	(lb)	passive pressure sliding resistance
895	(lb)	soil friction force
1045	(lb)	total sliding resistance

STABILITY FACTOR OF SAFETY CHECKS

	1.5		F.S. overturning
	1.5		F.S. sliding
overturning	2.24	OK	Mr / Mo
sliding	1.83	OK	(PP+F)/(Ph+V)



SOIL BEARING

a	2.21	(ft)	distance to resultant
	2.06' to 4.11'		middle third of footing
q1	537	(psf)	bearing pressure @ toe
q2	44	(psf)	bearing pressure @ heel

FACTORED (1.7) STEM LOAD FORCES

7.5	(ft)	H1 + H2
2.64	(ft)	line of action (above base)
1112	(lbs)	P (arm only)
1112	(lbs)	Ph (arm only)
15.0	(kip-ft)	Mu (arm moment)

FACTORED (1.7) FOOTING LOADS

10.0	(kip-ft)	Mu @ Toe (Bot Reinf)
0.0	(kip-ft)	Mu @ Heel (Top Reinf)
2.97	(kip)	Vu @ Toe
0.00	(kip)	Vu @ Heel

Footing			**Wall**		
ØVc	7,969	10" thick	ØVc	5,692	8" thick
As	0.372	#5 @ 10"	As	0.465	#5 @ 8"
a	0.0005		a	0.0007	
ØMn	11.72	k-ft	ØMn	12.55	k-ft
	1.55	5-#5			
	0.0020946	Reinf. Ratio			

LRFD soil 165.40541 psf @ Wall interface
912.9 'psf @ Toe

2055.6101 # in Toe @ 3.666666667 ft from Wall
909.72973 # in Toe @ 2.75 ft from Wall

CANTILEVER RETAINING WALL EXTERNAL STABILITY

limitations: uses Rankine coefficients for noncohesive soils, external moment at top of wall does not contribute to restoring moment (overturning only), no deflection or service load checks, soil on low side of wall does not brace wall against overturning (sliding only)

reference: Nilson & Winter, Design of Concrete Structures, 11th Edition, page 680

file author: S. Frech last modified: 4/25/2002

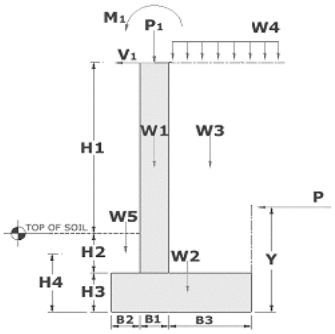
SOIL DATA

w	130	(pcf)	soil unit weight
phi	35	(deg)	soil internal angle of friction
del	0	(deg)	surface angle incline
	0.5		coeff. friction w/Concrete
	0.819		cosine(phi)
	1.000		cosine(del)
Ca	0.271	*35.23 psf*	coeff. of active pressure
Cp	2.307	*299.91 psf*	coeff. of passive pressure

Coeff. Friction			
Unit Weight	Int Friction	w. Conc	Soil
110-120	33-40	0.5-0.6	Sand or gravel, no fines
120-130	25-35	0.4-0.5	Sand or gravel, w/ fines
110-120	23-30	0.3-0.4	Silty sand, high clay
100-120	25-35	0.2-0.4	Medium or stiff clay
90-110	20-25	0.2-0.3	Soft clay, silt

WALL GEOMETRY

H1	8.3333333	(ft)	soil retained
H2	0.1666667	(ft)	soil depth above toe
H3	0.8333333	(ft)	footing thickness
H4	1	(ft)	passive pressure soil depth
B1	0.6666667	(ft)	wall width
B2	6.5	(ft)	toe width
B3	0	(ft)	heel width
H	9.3333333	(ft)	total height
B	7.1666667	(ft)	total base
	150	(pcf)	concrete unit weight



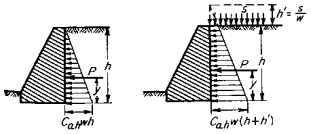
EXTERNAL LOADS

$P_{applied}$	200	(lb/ft)	
$V_{applied}$	1200	(lb/ft)	2
$M_{applied}$	0	(lb-ft / ft)	
Surcharge	68	(psf)	

LOAD CALCULATIONS

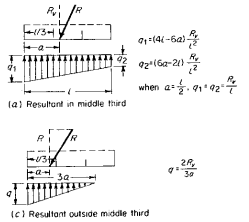
lateral soil force and overturning moment

H_{prime}	0.52	(ft)	converted surcharge
Y	3.27	(ft)	distance to soil load resultant
P	1705	(lbs)	soil load resultant
	5580	(lb-ft)	Mo, soil + surcharge
	-1600.08	(lb-ft)	Mo, external load
	3,980	(lb-ft)	total overturning Moment



wall restoring forces

component	weight (#)	arm (ft)	moment (#-ft)
w1 (concrete)	850	6.83	5808
w2 (concrete)	896	3.58	3210
w3 (heel soil)	0	7.17	0
w4 (surcharge)	0	7.17	0
w5 (toe soil)	141	3.25	458
P applied	200	0.33	67
vert. force	2,087	moment	9,543

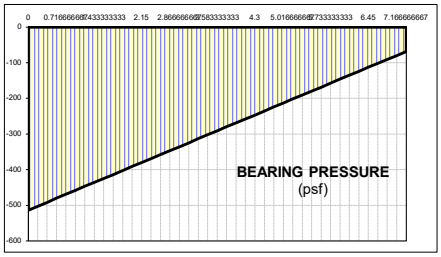


lateral sliding resistance

	150	(lb)	passive pressure sliding resistance
	1044	(lb)	soil friction force
	1194	(lb)	total sliding resistance

STABILITY FACTOR OF SAFETY CHECKS

	1.5		F.S. overturning
	1.5		F.S. sliding
overturning	2.40	OK	Mr / Mo
sliding	2.36	OK	(PP+F)/(Ph+V)



SOIL BEARING

a	2.67	(ft)	distance to resultant
	2.39' to 4.78'		middle third of footing
q1	514	(psf)	bearing pressure @ toe
q2	69	(psf)	bearing pressure @ heel

FACTORED (1.7) STEM LOAD FORCES

	8.5	(ft)	H1 + H2
	2.99	(ft)	line of action (above base)
	1428	(lbs)	P (arm only)
	1428	(lbs)	Ph (arm only)
	24.6	(kip-ft)	Mu (arm moment)

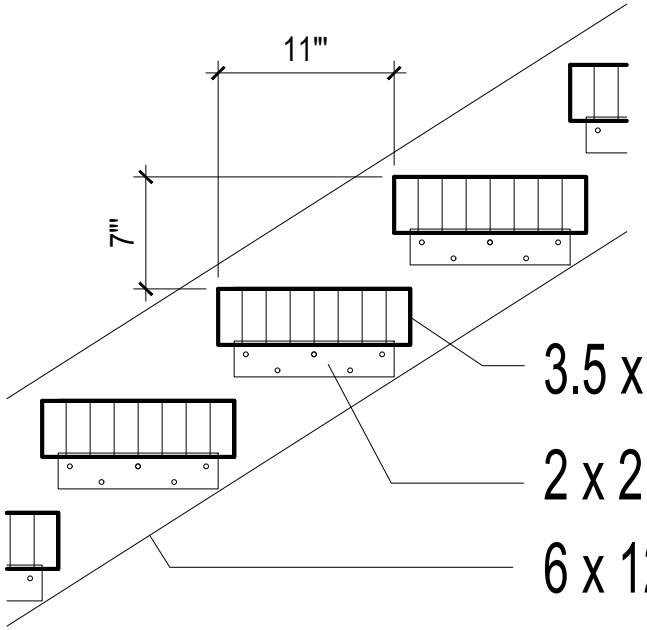
FACTORED (1.7) FOOTING LOADS

	13.6	(kip-ft)	Mu @ Toe (Bot Reinf)
	0.0	(kip-ft)	Mu @ Heel (Top Reinf)
	3.45	(kip)	Vu @ Toe
	0.00	(kip)	Vu @ Heel

Footing			**Wall**		
ØVc	7,969	10" thick	ØVc	5,692	8" thick
As	0.465	#5 @ 8"	As	0.62	#5 @ 6"
a	0.0007		a	0.0009	
ØMn	14.65	k-ft	ØMn	16.74	k-ft
	1.55	5-#5			
	0.0018023	Reinf. Ratio			

LRFD soil 187.67209 psf @ Wall interface
873.8 'psf @ Toe

2229.9157 # in Toe @ 4.333333333 ft from Wall
1219.8686 # in Toe @ 3.25 ft from Wall



3.5 x 12 TRT GLB

2 x 2 x 1/4 L, POWDER COAT

6 x 12 GLB STRINGER

Tread beam has a reaction of 360# at each side...use SDS screws and dapped angle as shown to connect tread to stringer. At base of stringer, use an embed plate to create separation at ground and use slotted holes to allow stringer to move in earthquake. Need a 1686# capacity hanger from stringer to cross beam,

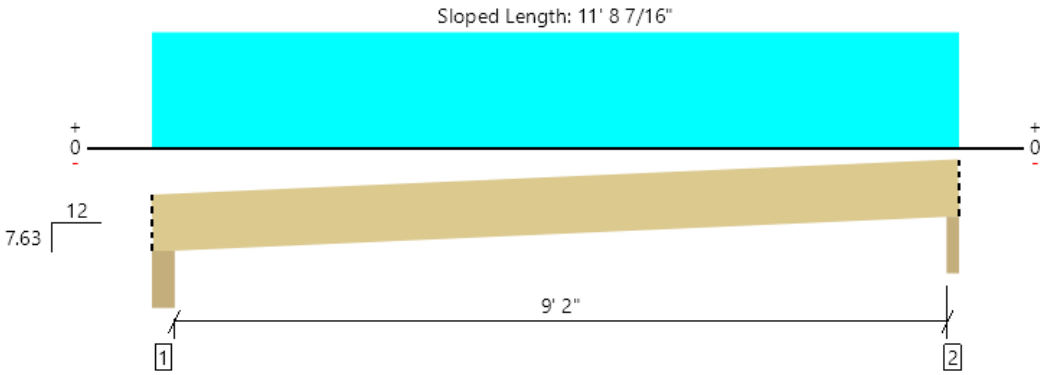
FORTE WEB

MEMBER REPORT

PASSED

Main Floor, Stringer

1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam



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

Member Length : 12' 4 1/16"

System : Roof
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2015
Design Methodology : ASD
Member Pitch : 7.63/12

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1687 @ 9' 9"	10725 (3.00")	Passed (16%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	1305 @ 1' 3 5/8"	11660	Passed (11%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	3868 @ 5' 1/2"	26400	Passed (15%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.054 @ 5' 1/2"	0.558	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.061 @ 5' 1/2"	0.744	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 11' 1 15/16".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Total	
1 - Beveled Plate - DF	5.50"	5.50"	1.50"	205	1555	389	2149	Blocking
2 - Beam - GLB	3.00"	3.00"	1.50"	196	1490	373	2059	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	11' 8" o/c	
Bottom Edge (Lu)	11' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 9' 10 1/2"	N/A	16.0	--	--	
1 - Uniform (PSF)	0 to 9' 10 1/2"	3' 1"	5.9	100.0	25.0	Default Load

Weyerhaeuser Notes

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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
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Weyerhaeuser

10/4/2021 3:21:05 PM UTC

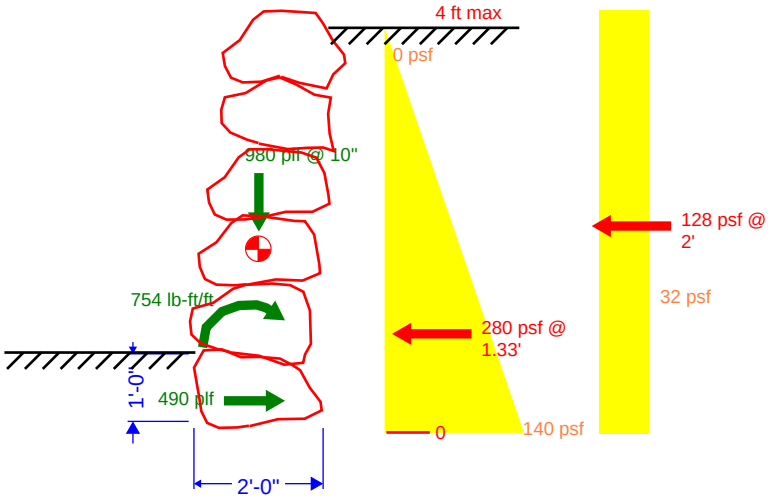
ForteWEB v3.2, Engine: V8.2.0.17, Data: V8.1.0.16

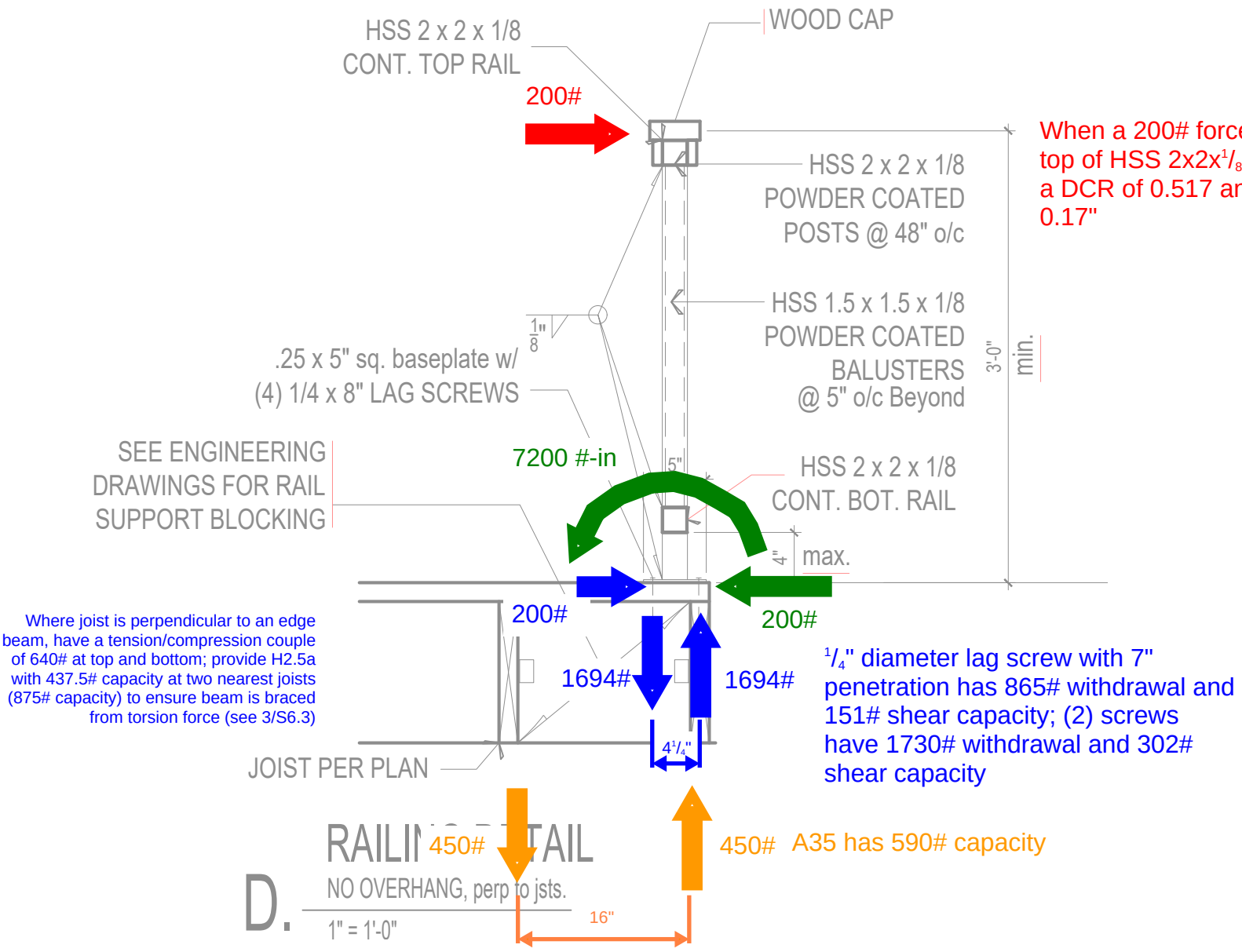
File Name: Derkashani

Project:	Derkashani Residence (8151 SE 48th St)	By:	JDA
Proj No:	167-2020	Date:	9/29/2021

Summary

Rockery wall will be used up to a maximum 4'-0" tall. Wall will have a 35 psf active soil pressure and 8h seismic surcharge pressure as shown below. Use a friction coefficient of 0.5 and negate passive earth pressure.
Wall FBD looks as shown below. Worst case condition is active soil pressure and seismic surcharge with a factor of safety of 1.2 for sliding and overturning. Based on the geometry and loading condition shown below, a gravity force of 980# per foot would be required at 10" from the inside corner to provide a FOS of 1.2 for overturning and sliding. Use a rock weight of 125 pcf and an interior friction factor of 0.55.
Rockery wall should use a minimum width of 2'-0"; be embedded 1' into dirt;





When a 200# force is applied at top of HSS 2x2x$^{1}/_{8}$, member has a DCR of 0.517 and deflects 0.17"

Where joist is perpendicular to an edge beam, have a tension/compression couple of 640# at top and bottom; provide H2.5a with 437.5# capacity at two nearest joists (875# capacity) to ensure beam is braced from torsion force (see 3/S6.3)

$^{1}/_{4}$" diameter lag screw with 7" penetration has 865# withdrawal and 151# shear capacity; (2) screws have 1730# withdrawal and 302# shear capacity