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Engineering

1. LATERAL DESIGN

1.1 Seismic Design

Criteria	Basic Seismic-Force-Resisting System			Diaphragms / Shear Walls	
	Medium Building Height	H	=	15 ft	
	Seimic Use Group			II	
	Importance Factor	I_e	=	1.0	
	Site Class			D	
	Seismic Design Category			D	
	Response Factor	R	=	6.5 (light frame wood building)	
	Mapped Acceleration	S_s	=	1.5	
		S_1	=	0.61	
	Design Acceleration	SD_s	=	1.14	
		SD_1	=	NA	
	Seismic Response Coefficient	C_s	=	SDs / (R/I)	
			=	1.14 / (6.5/1.0) =	0.175, say 0.18

Building Weight

The weight of the walls is applied by adding 5 psf to the roof DL (upper half of walls) and 10 psf to the floor DL (full story height)

	W	=	(20 + 10) x 2,000 sqft	=	60,000 lbs
Base Shear	V_{Base}	=	C_s x W = 0.18 x 60,000	=	10,800 lbs
Design Shear:	To convert from strength level to ASD, Base Shear is multiplied by 0.7				
	V_{Design}	=	0.7 x 10,800	=	7,560 lbs
Uniform load:	Front/rear		7,560 / 50	=	150 plf
	Right/left		7,560 / 35	=	220 plf

REPORT SUMMARY

Site Information

Address:	*7701 SE 39th St, Mercer Island, Washington, 98040*
Elevation:	0 ft (NAVD 88)
Lat:	47.575096
Long:	-122.236706
Standard:	ASCE/SEI 7-22
Risk Category:	II
Soil Class:	D - Stiff Soil

Seismic Data

S_S	1.58
S_1	0.64
S_{MS}	1.71
S_{M1}	1.33
S_{DS}	1.14
S_{D1}	0.89
T_L	6
PGA_M	0.72
V_{S30}	260
Seismic Design Category	D
Note	Where values of the multi-period 5%-damped MCER response spectrum are not available from the USGS Seismic Design Geodatabase, the design response spectrum shall be permitted to be determined in accordance with Section 11.4.5.2

1.2 Wind Design

Directional Procedure, Part 2 (simplified method) per ASCE 7-16, Chapter 27.5

Design Criteria:

Enclosed Simple Diaphragm Building	
Risk Category II	
Basic Wind Speed per Table 26.5-1A	110 MpH
Directionality Factor K_d	0.85
Exposure Category	B
Wind Speed up factor K_{zt}	1.0 per DPD wind map
Enclosure Classification	enclosed
Net pressure at top of wall p_h , Table 27.6-1	17.5 psf
(conservatively also used for bottom of wall)	

As the shear wall design is performed for ASD, the load is multiplied with 0.7

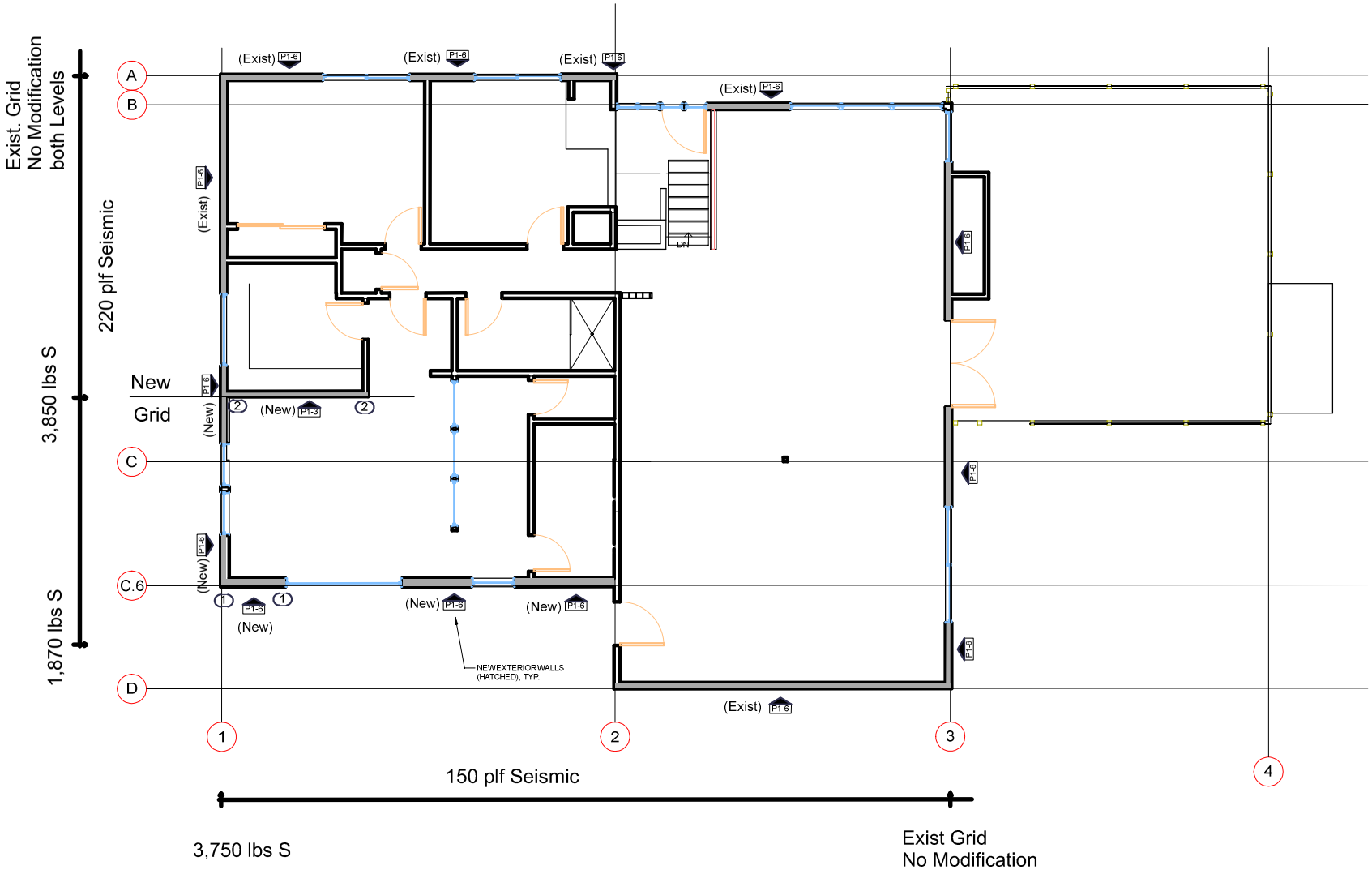
Applied wind pressure 0.7 x 17.5 = 12.25, say 13 psf

Uniform wind load on roof diaphagms

w/ trib h 10 ft w = 10 x 10 = 130 plf

With seismic load greater in both directions, no further wind evluation was performed

Shear Wall Layout



Shear Wall Types

SW type	OSB	Nails	Nails edge @ (in o.c.)	Nails field @ (in o.c.)	Boundary Member	Seismic list x .94 (to adjust for HF)	Wind x 1.4 (NA) plf	Anchor Bolt 5/8" @ (in o.c.)
P1-6	7/16"	8d	6"	12"	2x	225	315	48"
P1-3	7/16"	8d	3"	12"	3x	425	590	30"
Roof	7/16"	8d	6"	12"	2x	226	316	
Floor	3/4" CDX	10d	6"	12"	2x	300	420	

Holdowns

Callout	HD	All T (lbs)	Wood Member	Bolt type	Embedment
1	HDU2	2215	(2) 2x	SB5/8x24	18"
2	HDU4	3285	(2) 2x	SB5/8x24	18"

Seismic loads

	Shear design				Overturning										
Grid	**Shear**	**Length** total	**Shear** uniform	**SW** Type	**Panel**	**L**	**h**	**Aspect Ratio**	**M ot**	**Wall** trib.H	**R/Fl** trib.L	**M res** Restr.	**M tot**	**Uplift** T	**HW**
	V (lbs)	L (ft)	v (plf)			(ft)	(ft)	k/L	(lb-ft)	(ft)	(ft)	(lb-ft)	(lb-ft)	(lbs	
1	3750	35.0	107	P1-6	1-1 p	35.00	8	0.23	30000	8	8	57960	-27960	-799	not rqd
C6/D	1870	42.0	45	P1-6	CD1	4.50	8	1.78	1603	8	6	756	847	188	HDU2
				P1-6	CD2 p	14.50	8	0.55	5165	8	6	8526	-3361	-232	not rqd
				P1-6	* CD3	23.00	8	0.35	8192	8	6	21735	-13543	-589	not rqd
					* Existing Wall										
New Grid	3850	10.0	385	P1-3	NG1 p	10.00	8	0.8	30800	8	2	2850	27950	2795	HDU4

p

perforated panel

Panel	**Unit Shear**	**h op / h total**	**Σ Li**	**L total**	**Sheathing ΣLi / L**	**Co**	**q'**	**Nailing**
	v (plf)	%	**(ft)**	(ft)	%		(plf)	
1-1	107	h/3	24	35	69	1	156	P1-6
CD2	37	h/2	16	27	59	0.82	76	P1-6

Correction Notes

Key No. 10 Beam, DF No. 2, 6x10”

Span:	L		=	10 ft
Load:	floor w/ trib 6 ft, wall w/ h 10 ft			
	DL	6 x 20 + 10 x 10	=	220 plf
	LL	6 x 40	=	240 plf

For calculation see design sheets

Key No. 11 Post in Bmnt, DF No. 2, 4x4”

Height:	H		=	8 ft
Loads:	from post 07 above, reaction from beam 10, Downforce from seismic design (soil bearing capacity increased by 1/3 for transient load)			
	PDL	1,130 + 1,110	=	2,240 lbs
	PLL	1,130 + 1,210	=	2,340 lbs
	P seismic		=	2,800 lbs

For calculation see design sheets

Key No. 12 Spread Footing, fc = 2,500 psi, 24x24x8”

Load	from post 11			
	P Gravity		=	4,580 lbs
	P Seismic		=	2,800 lbs
Soil pressure gravity alone		4,580 / 4	=	1,145 psf < 1,500 psf
Soil pressure including seismic		7,380 / 4	=	1,845 psf < 1,500 x 1.33 = 1,995 psf

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7701 SE 39th St
Mercer Island
10 Beam
Mar. 14, 2023 13:34

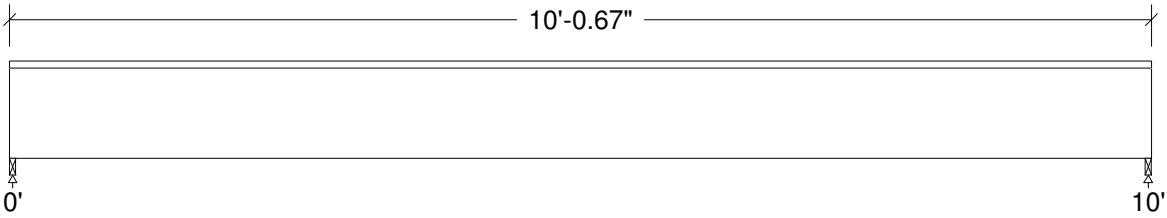
Design Check Calculation Sheet

WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
DL	Dead	Full UDL				220.0		plf
LL	Live	Full UDL				240.0		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:			
Dead	1106		1106
Live	1207		1207
Factored:			
Total	2313		2313
Bearing:			
Capacity			
Beam	2313		2313
Support	2471		2471
Des ratio			
Beam	1.00		1.00
Support	0.94		0.94
Load comb	#2		#2
Length	0.67		0.67
Min req'd	0.67		0.67
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.07		1.07
Fcp sup	625		625

Timber-soft, D.Fir-L (N), No.2, 6x10 (5-1/2"x9-1/2")

Supports: All - Timber-soft Beam, D.Fir-L (N) No.2
Total length: 10'-0.69"; Clear span: 9'-11.31"; Volume = 3.6 cu.ft.; Beam or stringer
Lateral support: top = continuous, bottom = at supports;
This section PASSES the design code check.

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 55	Fv' = 170	psi	fv/Fv' = 0.32
Bending(+)	fb = 834	Fb' = 875	psi	fb/Fb' = 0.95
Dead Defl'n	0.05 = < L/999			
Live Defl'n	0.11 = < L/999	0.33 = L/360	in	0.32
Total Defl'n	0.15 = L/778	0.50 = L/240	in	0.31

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	170	1.00	1.00	1.00	-	-	-	-	1.00	1.00	2
Fb'+	875	1.00	1.00	1.00	1.000	1.000	-	1.00	1.00	1.00	2
Fcp'	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-
E'	1.3 million	1.00	1.00	1.00	-	-	-	-	1.00	1.00	2

CRITICAL LOAD COMBINATIONS:

```
 Shear     : LC #2  = D + L
 Bending(+): LC #2  = D + L
 Deflection: LC #2  = D + L  (live)
             LC #2  = D + L  (total)
 Bearing   : Support 1 - LC #2 = D + L
             Support 2 - LC #2 = D + L
 D=dead L=live
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```

CALCULATIONS:

```
 V max = 2300, V design = 1923 lbs; M(+) = 5750 lbs-ft
   EIy = 510.84 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 0.5 dead + "live"
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.

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11 Post
Mar. 14, 2023 13:08

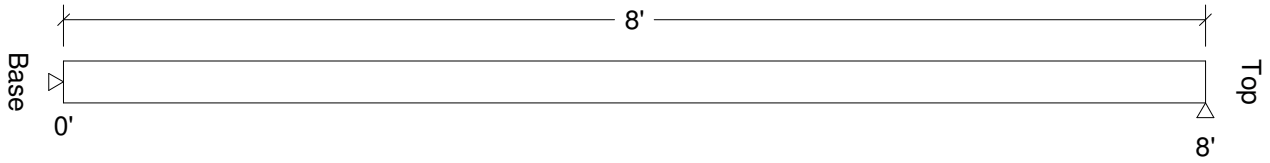
Design Check Calculation Sheet

WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Location [ft] Start	End	Magnitude Start	End	Unit
PDL	Dead	Axial	(Ecc. = 0.00")		2240		lbs
PLL	Live	Axial	(Ecc. = 0.00")		2340		lbs
P seismic	Earthquake	Axial	(Ecc. = 0.00")		2800		lbs

Reactions (lbs):



Unfactored:			
Lateral:			
Dead			
Live			
Earthquake			
Axial:			
Dead	2240		2240
Live	2340		2340
Earthquake	2800		2800
Factored:			
L->R			
Load comb	#1		#1

Lumber Post, D.Fir-L (N), No.1/No.2, 4x4 (3-1/2"x3-1/2")

Support: Non-wood

Total length: 8'; Volume = 0.7 cu.ft.

Pinned base; Ke x Lb: 1.0 x 8.0 = 8.0 ft; Ke x Ld: 1.0 x 8.0 = 8.0 ft;

This section PASSES the design code check.

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Axial	fc = 446	Fc' = 598	psi	fc/Fc' = 0.75
Axial Bearing	fc = 446	Fc* = 2576	psi	fc/Fc* = 0.17

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL/CP	CF	Cfu	Cr	Cfrt	Ci	LC#
Fc'	1400	1.60	1.00	1.00	0.232	1.150	-	-	1.00	1.00	3
Fc*	1400	1.60	1.00	1.00	-	1.150	-	-	1.00	1.00	3

CRITICAL LOAD COMBINATIONS:

Axial : LC #3 = D + 0.75(L + 0.7E)

D=dead L=live E=earthquake

All LC's are listed in the Analysis output

Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.