Type of construction: REMODEL/ADDITION
Applicable Building Codes: IBC 2018, ASCE 7/SEI 7-16
Location: 6550 80th Ave SE, Mercer Island, WA 98040

Work performed :

Lateral & Gravity Design

WIND DESIGN:

$P_s = \lambda I_w P_{s30} K_{zt}$

Exposure :	C	Wind Exposure Category as set forth in Section 26.7 of ASCE 7-16
Wind Speed =	85 MPH	Basic Wind Speed (LRFD) as used in Figure 28.5 of ASCE 7-16 and converted to (ASD)
P_{s30} =		Simplified design wind pressure for Exposure B, at h = 30 feet and for I = 1.0, from Figure 28.5-1
I_w =	1	Importance factor as defined in Table 1.5-2 of ASCE 7-16
λ =	1.29	Adjustment factor for building height and exposure from Figure 28.5-1 of ASCE 7-16
K_{ZT} =	1.67	Adjustment factor for increased wind speed due to a hill or escarpment from Section 26.8 of ASCE 7-16

Roof slope :

		rise		run		
Front/Rear	$\tan^{-1}$ (	4	/	12	)	= 18.4 degrees
Left/Right	$\tan^{-1}$ (	4	/	12	)	= 18.4 degrees

Number of floors: 2

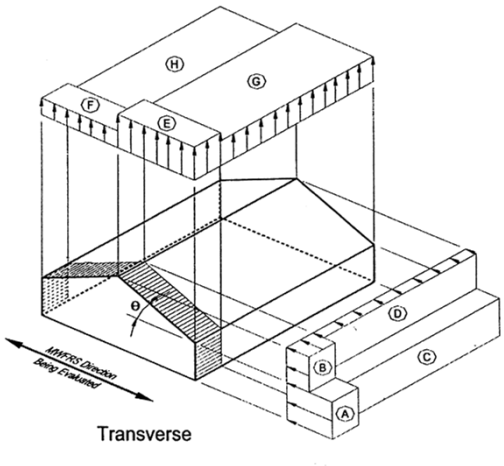
20 ft Mean Elevation

0

Average uplift (F/R)= -18.0 psf Based on wind zones 'G' and 'H'
Average uplift (R/L)= -18.0 psf Based on wind zones 'G' and 'H'

	End zone of wall	Front/Rear	End zone of roof	
		Left/Right	Front/Rear	Left/Right
P_{s30} =	A = 15.4 psf	15.4 psf	B = -4.4 psf	-4.4 psf
P_s =	33.2 psf	33.2 psf	-9.4 psf	-9.4 psf

	Interior zone of wall		Interior zone of roof	
	Front/Rear	Left/Right	Front/Rear	Left/Right
P_{s30} =	C = 10.3 psf	10.3 psf	D = -2.4 psf	-2.4 psf
P_s =	22.1 psf	22.1 psf	-5.2 psf	-5.2 psf



WIND LOAD CALCULATIONS

FRONT ⟶ REAR

ΣV 2ND FLOOR =

WIND ZONE	B	D	D		A	C						
AVE. HEIGHT	6	6	6		4	4						
AVE. WIDTH	11	26	35		11	26						
Ps	0.00	0.00	0.00	0.00	33.18	22.12	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	0	0	0	0	1460	2301	0	0	0	0	0	0

TOTAL 5,800 lbs Minimum net pressure controls. The calc. pressure is less than the min. net pressure, equal to 16psf(A-C), and 8psf(B-D) applied over the entire area. (ASCE 7-16 28.5.3)

ΣV 1ST FLOOR =

WIND ZONE	A	C										
AVE. HEIGHT	9	9										
AVE. WIDTH	11	57										
Ps	33.18	22.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	3285	11348	0	0	0	0	0	0	0	0	0	0

TOTAL 14,633 lbs

NOT USED

WIND ZONE												
AVE. HEIGHT												
AVE. WIDTH												
Ps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0	0

TOTAL 0 lbs

WIND LOAD CALCULATIONS

LEFT ⟶ RIGHT

ΣV 2ND FLOOR =

WIND ZONE	B	D	C			A	C					
AVE. HEIGHT	4	5.5	6			4	4					
AVE. WIDTH	8	13	18			8	41					
Ps	0.00	0.00	22.12	0.00	0.00	33.18	22.12	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	0	0	2389	0	0	1062	3628	0	0	0	0	0
TOTAL	7,078 lbs											

ΣV 1ST FLOOR =

WIND ZONE	A	C	A	C								
AVE. HEIGHT	5	5	4	4								
AVE. WIDTH	8	41	9	68								
Ps	33.18	22.12	33.18	22.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	1327	4535	1194	6017	0	0	0	0	0	0	0	0
TOTAL	13,073 lbs											

NOT USED

WIND ZONE												
AVE. HEIGHT												
AVE. WIDTH												
Ps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0 lbs											

ρ CALCS:

2ND FLOOR CALCULATIONS:

Plate Height:	8.00 ft
Total length of Shearwall in Shortest Line:	12.00 ft
Length of Shortest Segment within Shear Line:	3.00 ft
Length of Longest Segment in Shear Line:	3.00 ft

Tributary Area: 1.0
Total Area: 2.0

ρ = 1.00
ASCE 7-16 12.3.4.2 b

MAIN FLOOR CALCULATIONS:

Plate Height:	8.00 ft
Total length of Shearwall in Shortest Line:	9.00 ft
Length of Shortest Shearwall within Shear Line:	3.00 ft
Length of Longest Wall in Shear Line:	3.00 ft

Tributary Area: 1.0
Total Area: 2.0

ρ = 1.00
ASCE 7-16 12.3.4.2 b

NOT USED:

Plate Height:	10.00 ft
Total length of Shearwall in Shortest Line:	10.00 ft
Length of Shortest Shearwall within Shear Line:	4.50 ft
Length of Longest Wall in Shear Line:	5.50 ft

Tributary Area: 1.0
Total Area: 2.0

ρ = NA

All loads in pounds per square foot

WALL DEAD LOAD =	10 psf	ROOF DEAD LOAD =	15.0 psf
FLAT ROOF SNOW LOAD =	25 psf	UPPER FLOOR D.L. =	15.0 psf
RED. S.L. (20%*S.L.) =	0	LOWER FLOOR D.L. =	15.0 psf
		FLOOR LIVE LOAD =	40.0 psf

SEISMIC DESIGN:

$E = E_h + E_v$

$E = \rho Q_{E+.2S_{DS}D}$ $\quad Q_E = V = C_sW$

ρ =	1.00						
Site Class =	D	Geotech Report	No	20% Seismic Load Increase			
I_E =	1	Importance factor as defined in Table 11.5-1					
R =	6.5						
h_n =	24	Total height of structure					

$V = 0.7S_{DS}I_EW / R$	$S_{DS} = 2/3\ S_{MS}$	Ss =	146.7%	S_{MS} = 176.0%	V =	0.126	W
$V_{max} = S_{D1}I_EW / T_aR$	$S_{MS} = (Fa)(Ss)$	Fa =	1.20	S_{DS} = 117.4%	E =	0.126	W
$T_a = 0.02h_n^{0.75}$	$S_{D1} = 2/3\ S_{M1}$	S_1 =	50.8%	S_{M1} = 76.2%			
T_a = 0.22 s	$S_{M1} = (Fv)(S_1)$	Fv =	1.50	S_{D1} = 50.8%	Cs =	0.126	

2ND FLOOR DIAPHRAGM LOADING:

W (ROOF) =

LENGTH	WIDTH	LOAD	TOTAL
52	28	15.0	21840
17	3	15.0	765
		15.0	0
		15.0	0
		15.0	0

Area = 1507 Sub-Total= 22605

W (FLOOR) =

LENGTH	WIDTH	LOAD	TOTAL
		15.0	0
		15.0	0
		15.0	0
		15.0	0
		15.0	0

Area = 0 Sub-Total= 0

W (WALL) =

LENGTH	TRIB. HT.	LOAD	TOTAL
150	4	10.0	6000
75	4	10.0	3000
		10.0	0
		10.0	0
		10.0	0

Area = 900 Sub-Total= 9000

TOTAL = 31605 lb

1ST FLOOR DIAPHRAGM LOADING:

W (ROOF) =

LENGTH	WIDTH	LOAD	TOTAL
41	30	15.0	18450
		15.0	0
		15.0	0
		15.0	0
		15.0	0

Area = 1230 Sub-Total= 18450

W (FLOOR) =

LENGTH	WIDTH	LOAD	TOTAL
49	25	15.0	18375
13	3	15.0	585
		15.0	0
		15.0	0
		15.0	0

Area = 1264 Sub-Total= 18960

W (WALL) =

LENGTH	TRIB. HT.	LOAD	TOTAL
150	8	10.0	12000
150	8	10.0	12000
		10.0	0
		10.0	0
		10.0	0

Area = 2400 Sub-Total= 24000

TOTAL = 61410 lb

NOT APPLICABLE

W (ROOF) =

LENGTH	WIDTH	LOAD	TOTAL
		15.0	0
		15.0	0
		15.0	0
		15.0	0
		15.0	0

Area = 0 Sub-Total= 0

W (FLOOR) =

LENGTH	WIDTH	LOAD	TOTAL
		15.0	0
		15.0	0
		15.0	0
		15.0	0
		15.0	0

Area = 0 Sub-Total= 0

W (WALL) =

LENGTH	TRIB. HT.	LOAD	TOTAL
		10.0	0
		10.0	0
		10.0	0
		10.0	0
		10.0	0

Area = 0 Sub-Total= 0

TOTAL = lb

V (2ND FLOOR) = .126 x 31605 lb = 3994 lbs

V (1ST FLOOR) = .126 x 61410 lb = 7761 lbs

V ( ) = .126 x lb = lbs

REDISTRIBUTE:

ΣV x ρ	height	ΣV x height
3994 lb	17	67906
7761 lb	8	62092
lb		0
TOTAL = 11756 lb		TOTAL = 129998

$$E\ (2ND) = \frac{\Sigma V \times height \times \Sigma V\ TOTAL}{\Sigma V \times height\ TOTAL} = 6141\ lbs$$

$$E\ (1ST) = \frac{\Sigma V \times height \times \Sigma V\ TOTAL}{\Sigma V \times height\ TOTAL} = 5615\ lbs$$

$$E\ () = \frac{NOT\ USED}{} = 0\ lbs$$

SUMMARY:

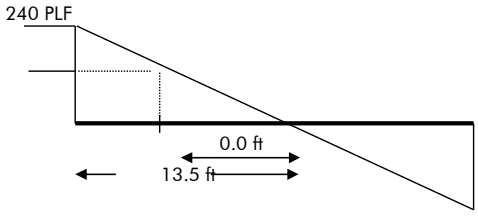
	WIND (front-rear)	WIND (left-right)	SEISMIC
ΣV (2ND) =	5800 lbs	7078 lbs	7369 lbs
ΣV (MAIN) =	14633 lbs	13073 lbs	6738 lbs
NOT APPLICABLE	0 lbs	0 lbs	0 lbs
TOTAL =	20433 lbs	20152 lbs	14107 lbs

DIAPHRAGM SHEAR:

Total diaphragm length = 64.0 ft Sub-diaphragm length = 39.0 ft
Diaphragm width = 27.0 ft ΣV (MAIN) = 14,633 lbs

$$v = \frac{\Sigma V(2nd)}{(2)(width)} = \frac{8917\ lb}{54\ ft} = 165\ PLF$$

IBC Table 2306.3.1 ⟶ 240 PLF



USE 15/32 CDX ROOF SHEATHING OR 3/4 T&G CDX SUBFLOORING w/8d AT 6 in o/c(PANEL EDGE), END 8d AT 12in o/c(PANEL FIELD)

CHORD:

Sub-diaphragm length = 39.0 ft Total-diaphragm length = 64.0 ft
Sub-diaphragm width = 27.0 ft

$$T = \frac{M}{B} = \frac{\Sigma V \times (\text{diaphragm length})}{8 \times (\text{diaphragm width})} = \frac{8917 \times 39\ ft}{8 \times 27\ ft} = 1610\ lbs$$

Top Plate Size: 2x4 Species/Grade: HF #2

Area = 5.25 in^2 F_t = 525 psi
Load duration (C_D) = 1.33 $T_{allowable}$ = Area x C_D x F_t = 3,666 lbs

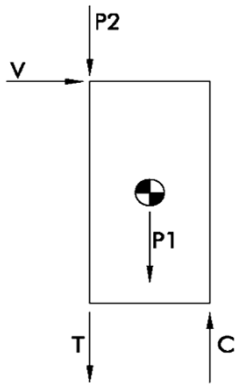
Since T allowable is greater than T applied, OK.

SHEAR CAPACITY OF 10d COMMON NAIL = 102 lbs 102 x Cd x p = 136 lbs 2018 NDS

$$\#\ OF\ NAILS\ PER\ 4\ FT\ SPLICE = \frac{1610\ lbs}{136\ lbs} = 12$$

USE 2x4 HF #2 TOP PLATE W/ (2) 10d NAILS @ 8 in O/C.

Lateral Calculation Key



V = Shear, plf
H = Height of shearwall
L = Length of shearwall
P1 = Weight of shearwall and connected framing
P2 = Weight of adjacent wall

T = V x H - 0.5P1 - P2 = Tension reaction to be resisted by holdown
C = V x H + 0.5P1 = Compression reaction

ASD Basic Load Combinations

For calculation of tension and compression forces in compliance with ASCE 7-16 2.4.1

Tension Equations (Uplift)

7. 0.6D + W
8. $(0.6 - 0.14S_{DS})D + E$ → 0.44 D + E

*8. $(0.6 - 0.14S_{DS})D + 2.5\ E$ → 0.44 D + 2.5 E

Compression Equations

5. D + W
5. $(1 + 0.14S_{DS})D + E$ → 1.16 D + E
6. D + 0.75W + 0.75L + 0.75S
6. $(1.0 + 0.105S_{DS})D + 0.75E + 0.75L + 0.75S$ → 1.12 D + 0.75 E + 0.75 L + 0.75 S

*5. $(1 + 0.14S_{DS})D + 2.5E$ → 1.16 D + 2.5 E
*6. $(1.0 + 0.105S_{DS})D + 1.875E + 0.75L + 0.75S$ → 1.12 D +1.875 E + 0.75 L + 0.75 S

** Equations include overstrength factor.*

Note: The 0.7 factor for Earthquake loading has already been incorporated into the calculation of the lateral design force E_h, but not E_v. Therefore this factor has been omitted from equations 5, 6 and 8 where appropriate.