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4214 86th Ave SE
Mercer Island, WA 98040

Job No. 21133
11/24/21

Structural Calculations

Dead and Live Loads

ROOF LOADS

2.5	ROOFING
2.5	SHEATHING
3.0	MEP + Solar
2.0	INSULATION
1.0	MISC
2.0	CEILING
2.0	RAFTERS
15.0	PSF TO RAFTERS
2.0	BEAMS AND GIRDERS
17.0	PSF TO GIRDERS
20.0	PSF LIVE LOAD
25.0	PSF ROOF SNOW LOAD
25.0	PSF GROUND SNOW LOAD

FLOOR LOADS

2.5	FLOORING
3.0	SHEATHING
0.5	MEP
0.7	MISC
2.3	CEILING
1.0	JOISTS
10.0	PSF TO JOISTS
2.0	BEAMS AND GIRDERS
12.0	PSF TO GIRDERS
40.0	PSF TYPICAL LIVE LOAD
60.0	PSF LIVE LOAD ON DECKS

WALL LOADS

2.0	SIDING
2.1	SHEATHING
2.0	INSULATION
0.4	MISC
2.8	GYP BOARD
1.7	STUDS
11.0	PSF

Risk Category =	II	ASCE 7-16 Table 1.5.1
I snow =	1.00	
I ice =	1.00	
I wind =	1.00	
I seismic =	1.00	

Seismic Loads Per Section ASCE 7-16, Section 12.14: Simplified Alternative Structural Design Criteria for Simple Bearing Wall or Building Frame Systems

			S1 =	0.493
Sds =	1.135	Default Soil Type D	Sd1 =	NA
Seismic Design Category =	D2	Table 11.6-1 (Design Category E if S1>0.75)		
Resp. Mod. Coef R=	6.5	Table 12.14-1 Light Frame Sheathed Wood Walls		
Number of Stories above Grade =	1			
F =	1	Section 12.14.18.1, F=1.0 for 1 story, 1.1 for 2, 1.2 for 3		
(V/W) ULT =	0.17	12.14-12 (V=F*Sds/R)		
(V/W) ASD =	**0.12**	**0.7 *ULT**		

Wind Loads - Per ASCE 7-16 Chapter 28, Envelope Procedure for Low Rise Buildings
Part 2: Enclosed Simple Diaphragm Low-Rise Buildings

Basic Wind Speed =	98	Vmph - per ASCE 7 Hazards Report (ASCE7-16)
Wind Directionality Kd =	0.85	Section 26.6 and Table 26.6-1
Exposure Category =	B	Section 26.7
Topagraphic Factor Kzt =	1.00	Section 26.8 or Seattle DPD
Ground Elevation Factor Ke =	1.00	Section 26.9 and Table 26.9-1
Enclosure Classification =	Enclosed	
Int Press Coef. Gcpi =	±0.18	Table 26.13-1
Vel. Press. Exp. Coef Kh or Kz =	0.70	Table 26.10
Vel. Press. Qz or Qh =	14.63	Eq 26.10-1 Qz=0.00256*Kz*Kzt*Kd*Ke*(V^2)
Roof Angle =	43	11:12
Mean Roof Height =	14	feet
Adj Factor Height and Exp λ =	1.00	Figure 28.5-1

PS30 Wind Pressures - Base

Load Case	Zones: Horizontal Pressures					Vertical Pressures			Overhangs	
	A	B	C	D	E	F	G	H	Eoh	Goh
1	17.8	12.2	14.2	9.8	1.4	-10.8	0.5	-9.3	-6.3	-7.2
2	17.8	12.2	14.2	9.8	6.9	-5.3	5.9	-3.8	-6.3	-7.2

Design Wind Pressures per Equation 28.5-1 Ps = I * λ * Kzt * PS30 * 0.6 (ASD factor)

Load Case	Zones: Horizontal Pressures					Vertical Pressures			Overhangs	
	A	B	C	D	E	F	G	H	Eoh	Goh
1	10.7	7.3	8.5	5.9	0.8	-6.5	0.3	-5.6	-3.8	-4.3
2	10.7	7.3	8.5	5.9	4.1	-3.2	3.5	-2.3	-3.8	-4.3

Minimum Design Wind Loads 28.5.4

Zones A & C =	16	Ultimate	Zones B & D =	8	Ultimate
	10	ASD(Ultimate* 0.6)		5	ASD(Ultimate * 0.6)

Horizontal Design Pressure Walls = 10 PSF (max LC1, LC2 or Minimum)
Horizontal Design Pressure Roofs = 6 PSF (max LC1, LC2 or Minimum)

POST CAPACITY CALCULATIONS LDF = 1.0 Page 3

https://courses.cit.cornell.edu/arch264/calculators/

DF #1

SIZE	8 FT	9 FT	10 FT	11 FT	12 FT
2 X 4	643	510	414	343	288
2 X 6	1,010	801	650	539	453
2 2 X 4	2,921	2,348	1,924	1,603	1,355
2 2 X 6	4,572	3,679	3,017	2,515	2,126
4 X 4	7,479	6,068	5,001	4,183	3,545
4 X 6	11,681	9,494	7,833	6,556	5,560
6 X 6	24,795	22,955	20,918	18,829	16,823
6 X 8	32,685	30,259	27,574	24,821	22,176
8 X 8	47,767	46,175	56,473	45,034	39,533

HF#1

2 X 4	571	453	367	304	256
2 X 6	896	711	577	478	402
2 2 X 4	2,594	2,085	1,708	1,423	1,202
2 2 X 6	4,061	3,267	2,678	2,232	1,887
4 X 4	6,647	5,390	4,441	3,713	3,147
4 X 6	10,383	8,434	6,956	5,821	4,935
6 X 6	20,791	19,146	17,350	15,541	13,830
6 X 8	27,407	25,237	22,871	20,486	18,230
8 X 8	40,361	38,918	37,189	35,184	32,953

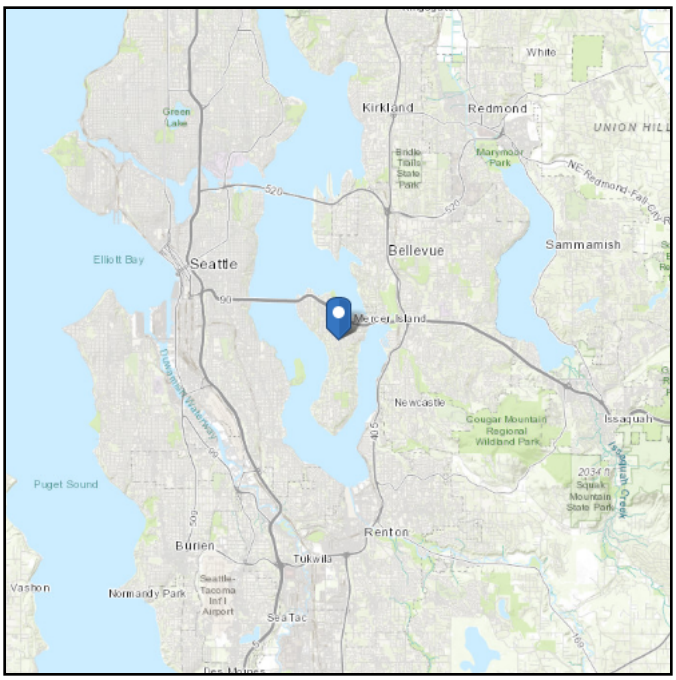
Note: Verified by comparision AWC Table M4.5-2a
All values are pounds

ASCE 7 Hazards Report

Address:
4214 86th Ave SE
Mercer Island, Washington
98040

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Default (see Section 11.4.3)

Elevation: 340.02 ft (NAVD 88)
Latitude: 47.570412
Longitude: -122.223875



Wind

Results:

Wind Speed:	98 Vmph
10-year MRI	67 Vmph
25-year MRI	74 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph

Data Source:	ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed:	Wed Nov 24 2021

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

Seismic

Site Soil Class: D - Default (see Section 11.4.3)

Results:

S_S :	1.419	S_{D1} :	N/A
S_1 :	0.493	T_L :	6
F_a :	1.2	PGA :	0.607
F_v :	N/A	PGA_M :	0.729
S_{MS} :	1.703	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.135	C_v :	1.384

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Wed Nov 24 2021

Date Source: USGS Seismic Design Maps

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ROOF FRAMING

RAFTERS $W = 2(15+25) = 80^{\#}/'$ $L = 15.4'$

$M = 80 \times 15.4^2/8 = 2372^{'\#}$
$I = 80 \times 15.4^3/2889 = 101$

USE 2x12 @ 24" oc $M_A = 2577$ (NF #2 @ 1.15)
$I = 178$

LOFT JOISTS $L = 13.4'$

$W = 1.33(10+40) = 67^{\#}/'$
$M = 67 \times 13.4^2/8 = 1504$
$I = 53 \times 13.4^3/2223 = 57$

USE 2x10 @ 16" oc $M = 1667$ $I = 95$

CEILING FRAMING $L = 15.4'$ $W = 1.33(5+10) = 20$

$M = 20 \times 15.4^2/8 = 593$
$I = 13 \times 15.4^3/2223 = 21$ USE 2x6 @ 16" oc

$M = 676$ $I = 21$

LOFT SUPPORT BEAM

$W = \frac{27.7}{2}(15+25) + 6 \times 11 + \frac{13.1}{2}(10+40) + \frac{13.1}{2}(5)$
$= 1033^{\#}/'$ $L = 24.1'$

$M = 1033 \times 24.1^2/8 = 75,997/1.15 = 65,214$
$I = 1033 \times 24.1^3/4000 = 3615$ USE 5½ x 21 GLB

$M = 80,650$
$I = 4245$

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11/24/21

Posts for LSB $P = \frac{24.1}{2} * 1033 = 12,448$

⇒ 6x6 PT @ 8'-4" = 24"

FTG $A = 12,448/1500 = 8.29$ ⇒ 3' Φ or 2' x 5'

HEADERS

GARAGE DOOR

$w = (15+25) * 9' = 360\#/'$ $L = 16'$

$m = 360 * 16^2/8 = 11,520/1.15 = 10,017$

$I = 360 * 16^3/4000 = 369$

USE 5½ x 10½ GLB $m = 20,205$ $I = 531$

EAST WALL

$w = (15+25) * 8' + (12+40) * 7' = 624\#/'$ $L = 8.1'$

$m = 5610$

$I = 91$ ⇒ DBL 2x12 $m = 6064$ $I = 356$

NORTH WALL USE DBL 2x8

LATERAL

SEISMIC

$W_{ROOF} = 15^{\#} \times 27' \times 32' = 12960$
$W_{LOFT} = 10^{\#} \times 25' \times 14' = 3500$
$W_{CLG} = 5^{\#} \times 25' \times 15' = 1875$

$18,335^{\#}$

$V = 0.12 \times 18335 = 2200^{\#}$

REA WALL $= 1100^{\#}$

WIND

$W_{EW} = \left(\frac{10.67}{2} \times 10^{\#} + 10' \times 6^{\#}\right) \times 24.6' = 2788^{\#}$

$R_N = R_S = 2788/2 = 1394^{\#}$

$W_{NS} = \left(10^{\#} \times 331.5'\right) = 3310^{\#}$

$R_E = R_W = 1655^{\#}$

DEAD LOADS

$R_N = 15^{\#} \times 2' + (11/2 + 9) \times 11^{\#} = 190^{\#}/'$ (USE ALSO CONSERV)

$R_W = 15^{\#} \times 16' + 10' \times 11^{\#} = 350^{\#}/'$ USE RE ALSO CONSERV

SHEAR WALL DESIGN SPREADSHEET
AWS SDPWS 2015 EDITION

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TABLE 4.3A BASE DESIGN VALUES

MARK	SHEATHING	FASTENER	Vs (PLF)	Vw (PLF)	Gs OR Gac (K/" - OSB)	K
MK1	15/32	8D @ 6	560	785	14	
MK2	15/32	8D @ 4	860	1205	18	
MK3	15/32	8D@ 3	1100	1540	24	
MK4	15/32	8D @ 2	1460	2045	37	
MK5	15/32 EA SIDE	8D @ 3	2200	3080	48	46
MK6	15/32 EA SIDE	8D @ 2	2920	4090	74	39

BASE ASD SHEAR WALL CAPACITY = 4.3A/2*0.93 (HEM FIR)

MARK	Vs (PLF)	Vw (PLF)
MK1	260	365
MK2	400	560
MK3	512	716
MK4	679	951
MK5	1023	1432
MK6	1358	1902

HOLD DOWN CAPACITIES

STRAPS

CS22	845	LBS
CS20	1030	LBS
CS18	1370	LBS
CS16	1705	LBS
CS14	2490	LBS
CMSTC16	4585	LBS
CMST14	6490	LBS
CMST12	9215	LBS
MSTC48B3	3930	LBS
MSTC66B3	4440	LBS

FOUNDATION ANCHORS

LSTHD8	2125	LBS
STHD10	2940	LBS
STHD14	3815	LBS
HDU2	2215	LBS
HDU4	3285	LBS
HDU5	4065	LBS
HDU8 DF POST	6970	LBS
HDU11 DF POST	9535	LBS
HDU14 DF POST	14375	LBS

ANCHOR BOLT CAPACITY - PT HF SILL PLATES
WWW.AWC.ORG/CONNECTORS

6" EMBED, PARALLEL TO GRAIN, LDF=1.0

BOLT SIZE	2X SILL	3x SILL	4X SILL
1/2"	595	732	732
5/8"	863	1071	1144
3/4"	1196	1647	1647
1"	1800	2233	2551

6" EMBED, PARALLEL TO GRAIN, LDF=1.60

BOLT SIZE	2X SILL	3x SILL	4X SILL
1/2"	952	1171	1171
5/8"	1381	1714	1830
3/4"	1914	2635	2635
1"	2880	3573	4082

SHEAR TRANSFER

MARK	V DESIGN	AB SIZE	PLATE	AB SPACING	USE	16D		A35	USE
MK1	365	5/8"	2X	45	32"	6	INCHES	19	16"
MK2	560	5/8"	2X	30	24"	4	INCHES	12	12"
MK3	716	3/4"	2X	32	32"	3	INCHES	10	8"
MK4	951	3/4"	2X	24	24"	2	INCHES	7	6"
MK5	1432	1"	3X	30	24"	2	INCHES	5	4"
MK6	1902	1"	3X	23	16"	1	INCHES	4	4"

VALL 16D= 122*1.6 = 195 LBS
VALL A35= (AT 1.6) = 575 LBS

MK1 Vs all = 260 Vw all = 365
MK2 Vs all = 400 Vw all = 560
MK3 Vs all = 512 Vw all = 716
MK4 Vs all = 679 Vw all = 951
MK5 Vs all = 1023 Vw all = 1432
MK6 Vs all = 1358 Vw all = 1902
Exist Vs all = 180 Vw all = 250

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SHEAR WALL DESIGN

WALL MARK: North — Vs RF = 1100 LBS — Vw RF = 1394 LBS — H RF = 8.5 FT ABV 2ND — Lmin = 2.43 FT

ABOVE GROUND

Shear Analysis

PIER #	LENGTH (FT)	2Bs/H		Vs PIER	Vs LBS/FT	Vw PIER	Vw LBS/FT	Vs/(2Bs/H)	Vw/(2Bs/H)
1	5.5	1	33%	367	67	465	84	67	84
2	5.5	1	33%	367	67	465	84	67	84
3	5.5	1	33%	367	67	465	84	67	84
4	0	0	0%	0	NA	0	NA	NA	NA
5	0	0	0%	0	NA	0	NA	NA	NA
L TOT =	16.5		100%	1100			MAX =	**67**	**84**
								MK1	MK1

Overturning Analysis — WDL= 190 LBS/FT — **USE MK1 Vs all = 260 Vw all = 365**

PIER #	OTM SEIS (FT LBS)	OTM WIND (FT LBS)	DLRM (FT LBS)	HD SEIS (LBS)	HD WIND (LBS)	
1	3117	3950	2873.75	49	217	
2	3117	3950	2873.75	49	217	
3	3117	3950	2873.75	49	217	
4	0	0	0	NA	NA	
5	0	0	0	NA	NA	
			MAX =	49	217	**217**

USE LSTHD8 Tall = 2125

SHEAR WALL DESIGN

WALL MARK: South — Vs RF = 1100 LBS — Vw RF = 1394 LBS — H RF = 8.5 FT ABV 2ND — Lmin = 2.43 FT

ABOVE GROUND

Shear Analysis

PIER #	LENGTH (FT)	2Bs/H		Vs PIER	Vs LBS/FT	Vw PIER	Vw LBS/FT	Vs/(2Bs/H)	Vw/(2Bs/H)
1	23.6	1	77%	851	36	1079	46	36	46
2	6.9	1	23%	249	36	315	46	36	46
3	0	0	0%	0	NA	0	NA	NA	NA
4	0	0	0%	0	NA	0	NA	NA	NA
5	0	0	0%	0	NA	0	NA	NA	NA
L TOT =	30.5		100%	1100			MAX =	**36**	**46**
								MK1	MK1

Overturning Analysis — WDL= 190 LBS/FT — **USE MK1 Vs all = 260 Vw all = 365** or existing sheathing

PIER #	OTM SEIS (FT LBS)	OTM WIND (FT LBS)	DLRM (FT LBS)	HD SEIS (LBS)	HD WIND (LBS)	
1	7235	9168	52911.2	-2150	-2059	
2	2115	2681	4522.95	-388	-297	
3	0	0	0	NA	NA	
4	0	0	0	NA	NA	
5	0	0	0	NA	NA	
			MAX =	NO HD REQD	NO HD REQD	**0**

USE No HD Req'd

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SHEAR WALL DESIGN

WALL MARK: East — Vs RF = 1100 LBS — Vw RF = 1655 LBS — H RF = 8.3 FT ABV 2ND — Lmin = 2.37 FT

ABOVE GROUND

Shear Analysis

PIER #	LENGTH (FT)	2Bs/H		Vs PIER	Vs LBS/FT	Vw PIER	Vw LBS/FT	Vs/(2Bs/H)	Vw/(2Bs/H)
1	3.8	0.915662651	35%	380	100	572	150	109	164
2	4.1	0.987951807	37%	410	100	617	150	101	152
3	3.1	0.746987952	28%	310	100	466	150	134	201
4	0	0	0%	0	NA	0	NA	NA	NA
5	0	0	0%	0	NA	0	NA	NA	NA
L TOT =	11		100%	1100			MAX =	**134**	**201**
								MK1	MK1

Overturning Analysis — WDL= 350 LBS/FT — **USE MK1 Vs all = 260 Vw all = 365**

PIER #	OTM SEIS (FT LBS)	OTM WIND (FT LBS)	DLRM (FT LBS)	HD SEIS (LBS)	HD WIND (LBS)
1	3154	4745	2527	183	649
2	3403	5120	2941.75	125	590
3	2573	3871	1681.75	319	785
4	0	0	0	NA	NA
5	0	0	0	NA	NA
		MAX =		319	785

785

USE LSTHD8 Tall = 2125

SHEAR WALL DESIGN

WALL MARK: West — Vs RF = 1100 LBS — Vw RF = 1655 LBS — H RF = 10 FT ABV 2ND — Lmin = 2.86 FT

ABOVE GROUND

Shear Analysis

PIER #	LENGTH (FT)	2Bs/H		Vs PIER	Vs LBS/FT	Vw PIER	Vw LBS/FT	Vs/(2Bs/H)	Vw/(2Bs/H)
1	3.9	0.78	46%	511	131	768	197	168	253
2	4.5	0.9	54%	589	131	887	197	146	219
3	0	0	0%	0	NA	0	NA	NA	NA
4	0	0	0%	0	NA	0	NA	NA	NA
5	0	0	0%	0	NA	0	NA	NA	NA
L TOT =	8.4		100%	1100			MAX =	**168**	**253**
								MK1	MK1

Overturning Analysis — WDL= 350 LBS/FT — **USE MK1 Vs all = 260 Vw all = 365**

PIER #	OTM SEIS (FT LBS)	OTM WIND (FT LBS)	DLRM (FT LBS)	HD SEIS (LBS)	HD WIND (LBS)
1	5107	7684	2661.75	697	1431
2	5893	8866	3543.75	580	1314
3	0	0	0	NA	NA
4	0	0	0	NA	NA
5	0	0	0	NA	NA
		MAX =		697	1431

1431

USE LSTHD8 Tall = 2125

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