

STRUCTURAL CALCULATIONS

FOR THE

PARMENTER RESIDENCE

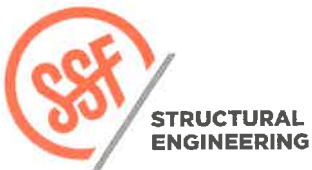
7340 ISLAND CREST WAY
WERCER IS, WA 98040

ARCHITECT

NIMBLE DESIGN



5/28/25



PARMENTER
PROJECT

DATE

DESIGN
Blay Cover

SHEET

Criteria Sheet

Codes

Structural IBC 2021
 Loading ASCE 7-16
 Wood: NDS 2018 / SDPWS 2021
 Steel: AISC 360-16
 Concrete: ACI 318-19
 Masonry: TMS 402/602-16

Project Location

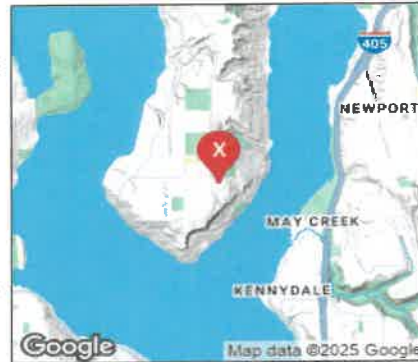
Street & Number 7340 island crest way
 City: mercer island State: WA
 ZIP: 98040
 Latitude: 47.5373 N
 Longitude: -122.2200 W
 Ground Elevation 323 ft

Occupancy Category

Risk Category: II ASCE 7 Table 1.5-1

Seismic Load Summary:

Analysis Procedure: Equivalent Lateral Force Procedure
 Lateral System: Light-frame (wood) Walls Sheathed with Wood
 Structural Panels Rated for Shear Resistance
 R: 6.50 $C_d = 4$
 Base Shear $V = 10.8$ $\Omega_g = 2.5$
 $S_s = 1.458$ $S_r = 0.504$
 $S_{DS} = 1.00$ $S_{D1} = 0.86$
 $C_s = 0.154$ $I_e = 1.0$



Story Information

Stories Above Grade (Including Mezzanine Levels) 2

Horizontal and Vertical Irregularities:

Is the building a "Regular Structure"? (No horizontal or vertical irregularities) Yes

Wind Load Summary:

$V = 98$ $K_{zt} = 1.00$
 Exposure = B

Dead Loads:

Roof		Floor	
Roofing	3 psf	Finish Floor	2 psf
1/2" Sheathing	1.5 psf	3/4" Sheathing	2.3 psf
Framing	2.5 psf	Joists @ 16" oc	2 psf
Misc./Mech.	1 psf	Misc./Mech.	1 psf
Ceiling Finish	2.5 psf	Ceiling Finish	2.5 psf
(if applicable) Solar Panels	5 psf		9.8 psf
	15.5 psf	Use	10 psf
Use	15 psf	Add'l Seismic Weight	10 psf
Add'l Seismic Weight	5 psf	Seismic Weight	20 psf
Seismic Weight	20 psf		

Live Loads:

Roof	20 psf
Floor	40 psf

Snow Loading Criteria:

Ground Snow, p_g	25 psf	Flat Roof Snow Load, p_f	25.0 psf	Importance Factor, I_s	1.00
Exposure Factor, C_e	1.00	Sloped Roof Snow Load, p_s	25.0 psf		
Thermal Factor, C_t	1.00	Slope Factor, C_s	1.00		

Soils:

Allowable Bearing	1500 psf	Active	55'35 pcf (Restrained/Unrestrained)
Sliding, μ	0.3	Seismic Surcharge	8H
Passive	250 pcf		

Soils Report Provided? No To be approved by the authority having jurisdiction, per 11.8.2 exception.

Site Specific Ground Motion Hazard Analysis Provided? No



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Seismic Design

ASCE 7-16 Seismic Analysis

Equivalent Lateral Force Procedure

Apply Section 12.8.1.3 (Where Applicable)? **Yes**

Seismic Force Resisting System Per Table 12.2-1	System	Bearing Wall Systems
	Type:	Light-frame (wood) Walls Sheathed with Wood Structural Panels Rated for Shear Resistance

Seismic Design Cat.	D
Risk Category	II
Site Class	D (Default)
Diaphragm Flexibility	Flexible

I, II, or III, or IV per Table 1.5-1
Assumed default soil properties, per 11.4.3.

S_S	1.458 g	2% in 50 yr, Latitude & Longitude lookup
S_1	0.504 g	2% in 50 yr, Latitude & Longitude lookup
R	6.50	
C_d	4.0	
Ω_o	2.5	
I_e	1.00	Table 1.5-2
h_n	16.0 ft	
Ct	0.02	Table 12.8-2
x	0.75	Table 12.8-2
T_a	0.16 sec	
T	0.16 sec	Eq. 12.8-7
T_o	0.17 sec	
T_s	0.86 sec	
T_L	6.00 sec	
F_a	1.20	Table 11.4-1
F_v	1.70	Table 11.4-2
S_{MS}	1.75 g	Eq. 11.4-1
S_{M1}	1.29 g	Eq. 11.4-2
S_{DS}	1.000 g	Eq. 11.4-3
S_{D1}	0.857 g	Eq. 11.4-4
C_s	0.154 Controls	Eq. 12.8-2
	0.824	Eq. 12.8-3 need not exceed, $T < T_L$
	0.010	Eq. 12.8-5 or 12.8-6 minimum
$C_{s, design}$	0.154	
Bldg. Weight	70.0 k	
$V = C_s W$	10.8 k	Eq. 12.8-1, Strength Level Base Shear
$V = C_{s, ASD} W$	7.5 k	Eq. 12.8-1 ASD Base Shear

Building Period Per Alternate Analysis

T (sec)

Per Geotech Report

F_a

F_v

Section 12.8.1.3

1. Regular Structure	Yes
2. ≤ 5 Stories above grade	Yes
3. $T \leq 0.5s$	Yes
4. $\rho = 1.0$	Yes
5. Not Site Class E or F	Yes
6. Risk Category I or II	Yes

If all items above are met, S_{DS} may be taken as 1.0, but not less than $0.7 \cdot (\text{Calculated } S_{DS})$

$$T_a = C_t h_n^x \quad \text{Eq. 12.8.7}$$

$$S_{MS} = F_a S_S \quad \text{Eq. 11.4-1}$$

$$S_{M1} = F_v S_1 \quad \text{Eq. 11.4-2}$$

$$S_{DS} = \frac{2}{3} S_{MS} \quad \text{Eq. 11.4-3}$$

$$S_{D1} = \frac{2}{3} S_{M1} \quad \text{Eq. 11.4-4}$$

$$C_s = \frac{S_{DS}}{(R/I_e)} \quad \text{Eq. 12.8-2}$$

$$C_s = \frac{S_{D1}}{T(R/I_e)} \quad \text{Eq. 12.8-3}$$

$$C_s = \frac{S_{D1} T_L}{T^2 (R/I_e)} \quad \text{Eq. 12.8-4}$$

$$C_s \geq 0.044 S_{DS} I_e \quad \text{Eq. 12.8-5}$$

$$C_s \geq 0.01 \quad \text{Eq. 12.8-5}$$

$$C_{VX} = w_x h_x^k / \sum_{i=1}^n w_x h_i^k \quad \text{Eq. 12.8-12}$$

$$F_{px} = \frac{\sum_{i=x}^n F_i}{\sum_{i=x}^n w_i} w_{px} \quad \text{Eq. 12.10-1}$$

$$F_{px} \geq 0.2 S_{DS} I_e w_{px} \quad \text{Eq. 12.10-2}$$

Vertical Distribution ASD $\rho = 1$ k = 1.000

Level	h_x (ft)	W_x (k)	h_x^k (ft)	$W_x h_x^k$	Story Shear ASD			Diaphragm Force (ρ not included)				
					C_{vx} (%)	F_x (k)	SV (k)	$F_{px, calc}$	$F_{px, min}$	$F_{px, max}$	$F_{px, design}$	$\gamma = F_{px} / F_x$
Roof	16.0	35	16.0	560	0.640	4.8	4.8	4.8	4.9	9.8	4.9	1.02
2	9.0	35	9.0	315	0.360	2.7	7.5	3.8	4.9	9.8	4.9	1.81
Σ		70.0		875		7.5						



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 Seismic Criteria _____

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Wind Design - MWFRS

ASCE 7 Chapter 27 - Directional Procedure

Design Method	ASD
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Wind Coefficients

Exposure	B	
V=	98	mph
K_d =	0.85	Table 26.6-1
K_h =	0.68	Table 27.3-1
K_e =	0.99	Table 26.9-1
G=	0.85	26.9.4

Transverse Wind Pressures

L/B = 0.40 h/L = 0.98

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-0.81 / -0.18
Leeward Roof	-0.60

Location and Building Dimensions

Calculate K_{zt} ?	Yes	
K_{zt}	1.00	
Roof Type	Gable	
Roof Slope - Transverse Dir	18	degrees
Roof Slope - Long Dir	0	degrees
Ground to top of roof	30	ft
Bot of roof to top of roof	5	ft
Mean Roof Height, h	27.5	ft
Short Plan Dimension	28	ft
Long Plan Dimension	70	ft
Parapet ?	No	
Ground to top of parapet		ft
Average Parapet Height		ft

Velocity Pressure at Mean Roof Height, q_h =	14.1	psf
--	------	-----

Wall Pressures (Unfactored):

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{hw\ walls}$	P_{walls} (psf)
0-15	0.57	11.77	8.01	6.00	9.6
15-20	0.62	12.81	8.71	6.00	9.6
20-25	0.66	13.63	9.27	6.00	9.6
25-30	0.7	14.46	9.83	6.00	9.6
30-40	0.76	15.70	10.67	6.00	10.0
41-50	0.81	16.73	11.38	6.00	10.4
51-60	0.85	17.56	11.94	6.00	10.8
61-70	0.89	18.38	12.50	6.00	11.1
71-80	0.93	19.21	13.06	6.00	11.4
81-90	0.96	19.83	13.48	6.00	11.7
91-100	0.99	20.45	13.91	6.00	11.9

Roof Pressures (Unfactored)

Windward		Leeward	Horiz Proj (psf)
Max	Min	-7.2	4.80
-2.1	-9.7		

Longitudinal Wind Pressures

L/B = 2.50 h/L = 0.39

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.28
Windward Roof	-0.9 / -0.18
Leeward Roof	-0.50

Wall Pressures (Unfactored):

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{hw\ walls}$	P_{walls} (psf)
0-15	0.57	11.77	8.01	3.30	9.60
15-20	0.62	12.81	8.71	3.30	9.60
20-25	0.66	13.63	9.27	3.30	9.60
25-30	0.7	14.46	9.83	3.30	9.60
30-40	0.76	15.70	10.67	3.30	9.60
41-50	0.81	16.73	11.38	3.30	9.60
51-60	0.85	17.56	11.94	3.30	9.60
61-70	0.89	18.38	12.50	3.30	9.60
71-80	0.93	19.21	13.06	3.30	9.82
81-90	0.96	19.83	13.48	3.30	10.07
91-100	0.99	20.45	13.91	3.30	10.32

Roof Pressures (Unfactored)

Windward		Leeward	Horiz Proj (psf)
Max	Min	-6.0	4.80
-2.2	-10.8		



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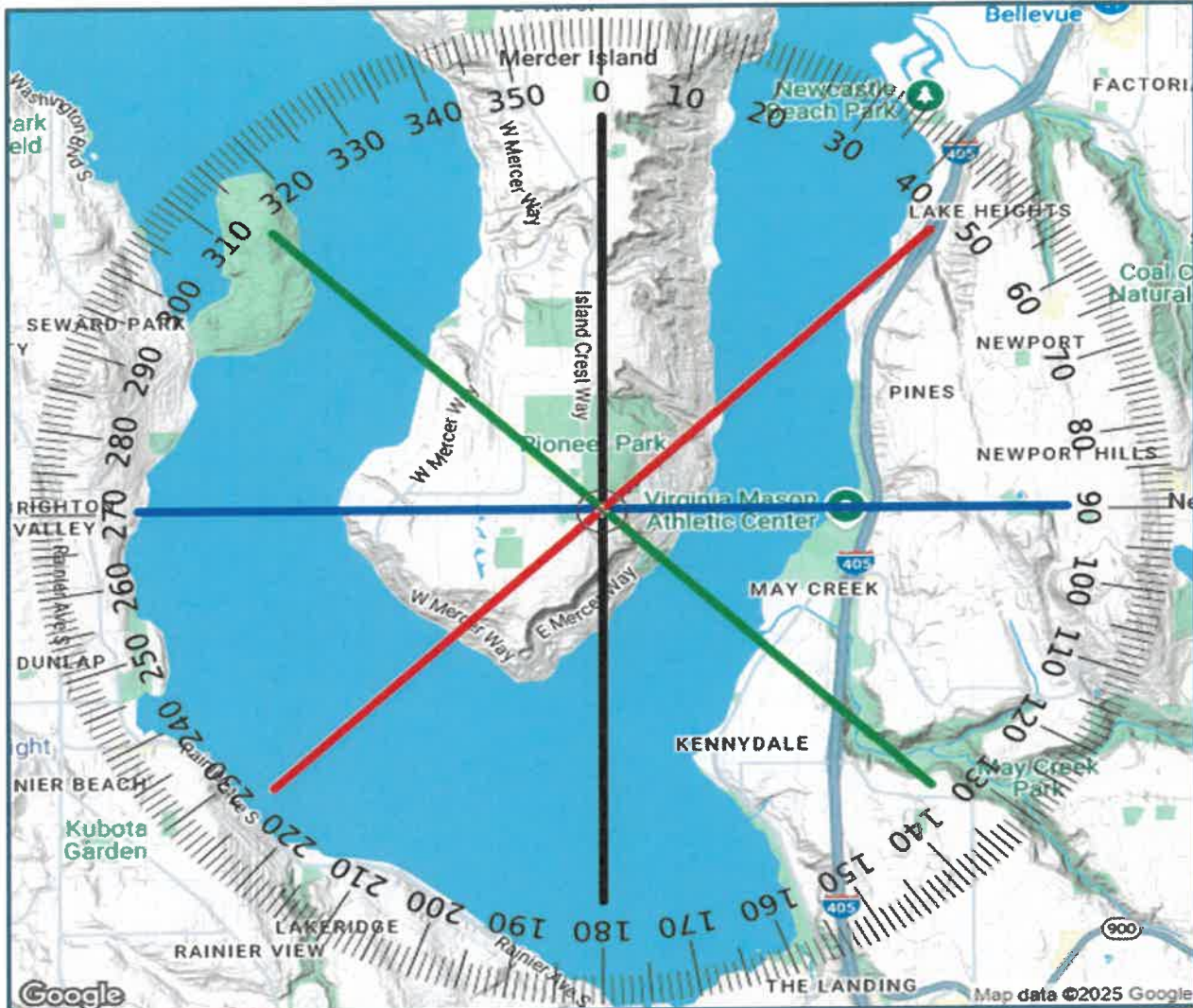
Site Address

Address 7340 island crest way
 City: mercer island State: WA
 Lat Long 47.53733 -122.2200

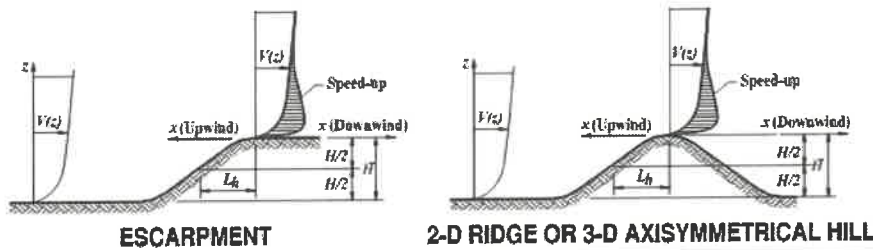
Wind Radius 2.00 Miles
 Angle 0°
 Exposure B

Profile 1: 0° to 180°
 Profile 2: 270° to 90°
 Profile 3: 315° to 135°
 Profile 4: 45° to 225°

SITE MAP



Topography from Figure 26.8-1



$$K_{zt} = (1 + K_1 K_2 K_3)^2$$

$$K_1 = \text{Per Figure 26.8-1}$$

$$K_2 = (1 - |x|/\mu L_h)$$

$$K_3 = e^{-\gamma z/L_h}$$

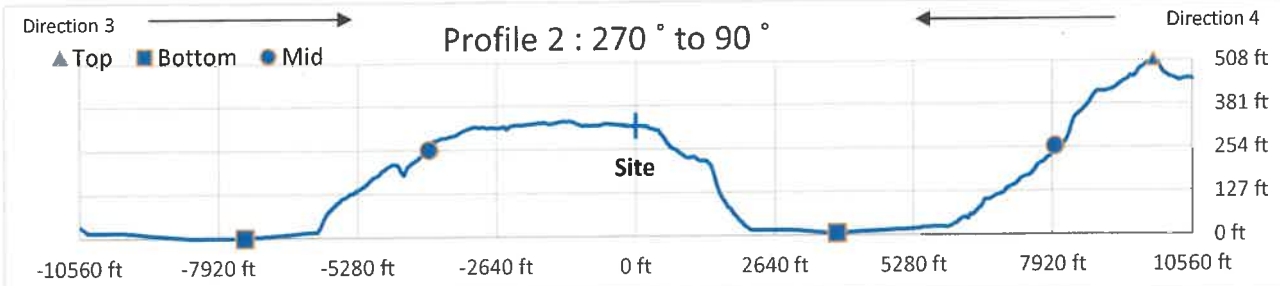
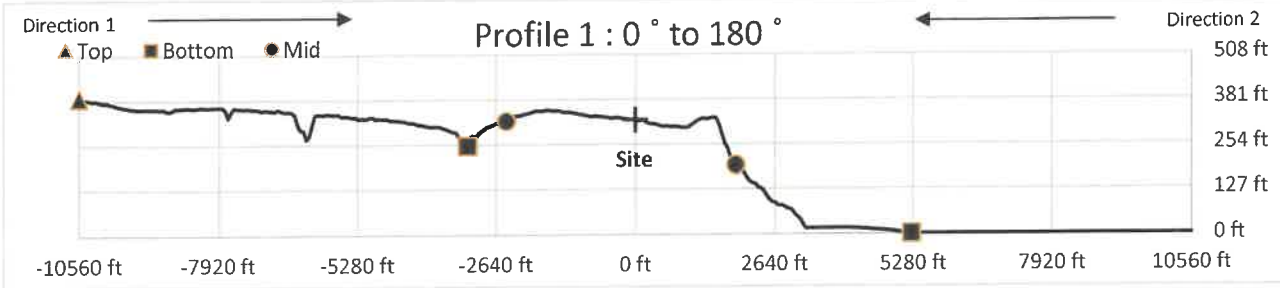
$$K_{zt} = 1, \text{ if } H/L_h \leq 0.2$$

PER FIGURE 26.8-1



Parmenter Residence _____
 Kzt Calculations _____

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Direction 1 - 0° to Site

Direction 2 - Site to 180°

Direction 3 - 270° to Site

Direction 4 - Site to 90°

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	Yes
5. H ≥ 60'	Yes

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-10560
Bott. of Hill Dist.	-3184
L @ H/2	-2441
Site	downwnd
Top of Hill Elev.	388
Bott. of Hill Elev.	250
Site Elev.	322.7
Site Dist.	0
H/2	319

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-10560
Bott. of Hill Dist.	5253
L @ H/2	1910
Site	upwind
Top of Hill Elev.	388
Bott. of Hill Elev.	0
Site Elev.	322.7
Site Dist.	0
H/2	194

Terrain Data

Terrain	Ridge
Top of Hill Dist.	9817
Bott. of Hill Dist.	-7429
L @ H/2	-3927
Site	upwind
Top of Hill Elev.	510
Bott. of Hill Elev.	0
Site Elev.	322.7
Site Dist.	0
H/2	255

Terrain Data

Terrain	Ridge
Top of Hill Dist.	9817
Bott. of Hill Dist.	3821
L @ H/2	7960
Site	downwnd
Top of Hill Elev.	510
Bott. of Hill Elev.	7
Site Elev.	322.7
Site Dist.	0
H/2	259

Kzt Calculations

H=	138
Lh=	8119
x=	10560
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.02
K2=	0.13
k3=	0.99
H/Lh =	0.02
Kzt =	100

Kzt Calculations

H=	388
Lh=	12470
x=	10560
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.04
K2=	0.44
k3=	0.99
H/Lh =	0.03
Kzt =	100

Kzt Calculations

H=	510
Lh=	13744
x=	9817
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.05
K2=	0.52
k3=	0.99
H/Lh =	0.04
Kzt =	100

Kzt Calculations

H=	502
Lh=	1857
x=	9817
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.35
K2=	0.00
k3=	0.96
H/Lh =	0.27
Kzt =	100

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TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | ☎ 253.284.9470

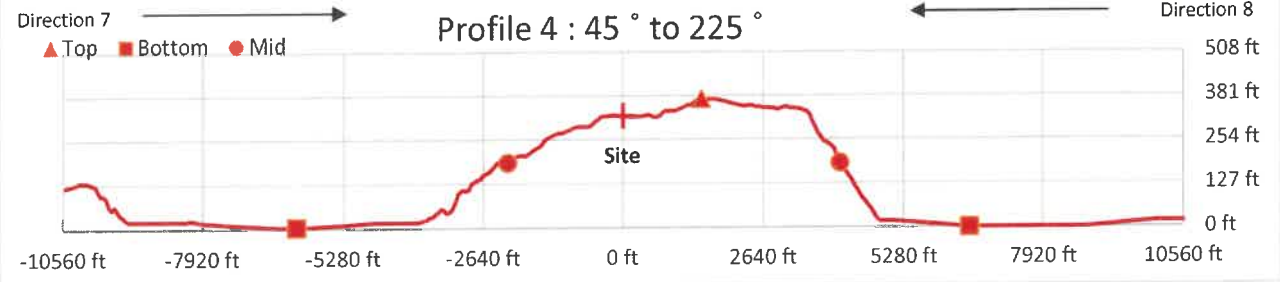
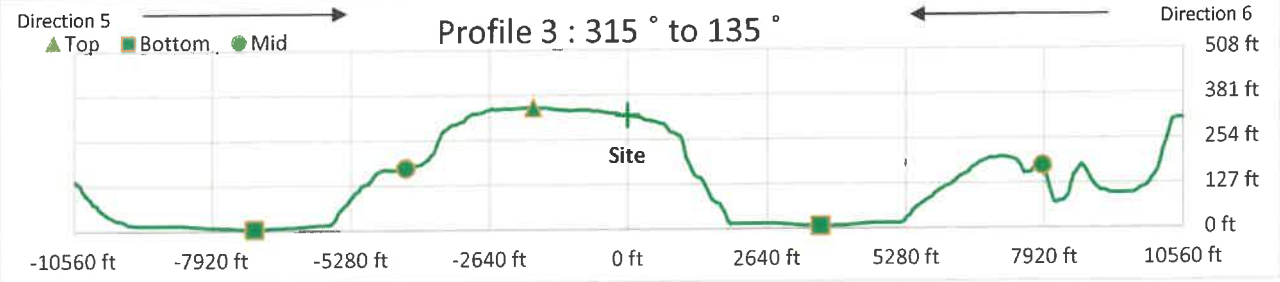
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SWENSON SAY FAGET



Parmenter Residence _____
Kzt Calculations _____

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Direction 5 - 315° to Site

Direction 6 - Site to 135°

Direction 7 - 45° to Site

Direction 8 - Site to 225°

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Site Conditions (26.8.1)

1. Unobstructed	Yes
2. Isolated	Yes
3. Upper Half Hill	Yes
4. H/Lh ≥ 0.2	No
5. H ≥ 60'	Yes

Kzt=1

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-1804
Bott. of Hill Dist.	-7111
L @ H/2	-4245
Site	downwnd
Top of Hill Elev.	346
Bott. of Hill Elev.	5
Site Elev.	322.7
Site Dist.	0
H/2	175

Terrain Data

Terrain	Ridge
Top of Hill Dist.	-1804
Bott. of Hill Dist.	3662
L @ H/2	7907
Site	upwind
Top of Hill Elev.	346
Bott. of Hill Elev.	8
Site Elev.	322.7
Site Dist.	0
H/2	177

Terrain Data

Terrain	Ridge
Top of Hill Dist.	1486
Bott. of Hill Dist.	-6156
L @ H/2	-2176
Site	upwind
Top of Hill Elev.	372
Bott. of Hill Elev.	3
Site Elev.	322.7
Site Dist.	0
H/2	187

Terrain Data

Terrain	Ridge
Top of Hill Dist.	1486
Bott. of Hill Dist.	6527
L @ H/2	4086
Site	downwnd
Top of Hill Elev.	372
Bott. of Hill Elev.	0
Site Elev.	322.7
Site Dist.	0
H/2	186

Kzt Calculations

H=	341
Lh=	2441
x=	1804
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.18
K2=	0.51
k3=	0.97
H/Lh =	0.14
Kzt =	1.00

Kzt Calculations

H=	338
Lh=	9711
x=	1804
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.05
K2=	0.88
k3=	0.99
H/Lh =	0.03
Kzt =	1.00

Kzt Calculations

H=	369
Lh=	3662
x=	1486
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.13
K2=	0.73
k3=	0.98
H/Lh =	0.10
Kzt =	1.00

Kzt Calculations

H=	372
Lh=	2600
x=	1486
z=	27.5
μ=	1.5
γ=	3
K1 value =	1.3
K1=	0.19
K2=	0.62
k3=	0.97
H/Lh =	0.14
Kzt =	1.00

Parmenter Residence _____

Kzt Calculations _____

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ROOF FRAMING

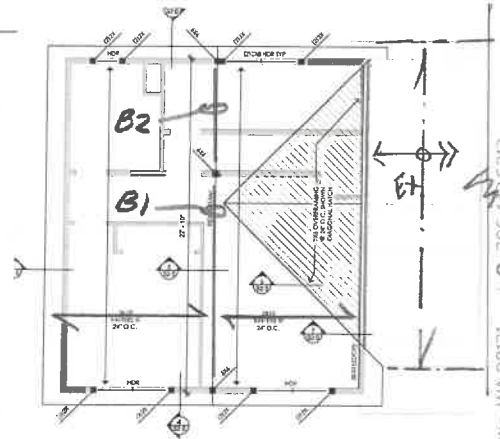
JOISTS L=12.5' 2x10 @ 24
 $f_b = .88 \text{ ksi}$
 $\Delta = .34" = 1/439$

B1 RIDGE
 L=18'
 $w = .04(12.5) = .5 \text{ k/ft}$
 $R = 4.5 \text{ k}$
 $M = 20 \text{ k-ft}$

GL 5 1/2 x 12
 $f_b = 1.84 \text{ ksi}$
 $\Delta = .83" = 2/261$
 3 1/2 x 15
 $f_b = 1.85 \text{ ksi}$
 $\Delta = .67" = 1/325$

B2 L=9'
 $w = .5 \text{ k/ft}$
 $R = 2.2 \text{ k}$
 $M = 5 \text{ k-ft}$

4 x 12
 $f_b = .82 \text{ ksi}$
 $\Delta = .12" = 1/912$

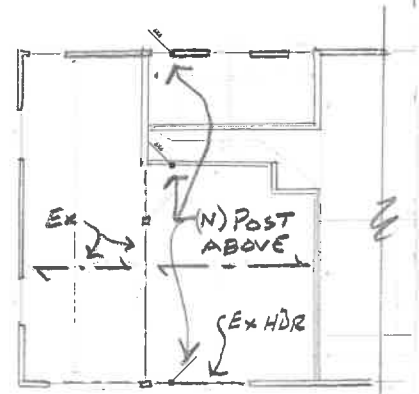


ROOF FRAMING

UPP FLOOR FRAMING

NO CHANGES TO GROUND FLOOR
 CHECK (N) POST ABOVE LOCATIONS
 CENTER POST, P=4.5+2.2k=6.7k
 FTG 2.5' Ø 3 = 1072 psf

Ex HDR, P=4.5k
 $w = 6.3 \text{ k/ft}$ 4x12 DF 9"
 6.75 1.75 3.6k
 $f_b = 1.0 \text{ ksi}$
 $f_v = 136 \text{ psi}$ (OK IF EXISTING)
 $\Delta = .09"$ (ADD IF NOT PRESENT)

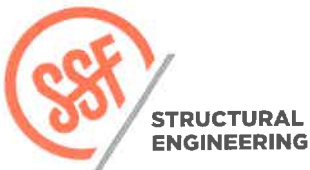


UPP FLR FRAMING

Check Ex JOISTS
 L=14' 2x10 @ 24 $f_b = .92 \text{ ksi}$
 $\Delta = .39" = 1/433$

Ex Bm L=13'-9" (3) 2x10
 $w = .05(12) = .6 \text{ k/ft}$ $f_b = 2.6 \text{ ksi}$
 $R = 4.1 \text{ k}$ $\Delta = 1.1" = 1/50$
 $M = 14 \text{ k-ft}$
 SISTER 3-LVL x 9 1/4 OR 2-LVL x 11 1/4
 BASED ON EI, LVL 2.0 (5.25) = 10.5
 2x3 1.4 (4.5) = 6.75 (39%)

(3) 2x10 $w = .39(.6) = .23 \text{ k/ft}$
 $f_b = 1.0 \text{ ksi}$
 $\Delta = .42" = 1/390$ OK NOTE BEAM IS CONTINUOUS 2-SPAN!



Parmenter
 PROJECT

5/28/25

DATE

DESIGN

DESIGN

SHEET

7

