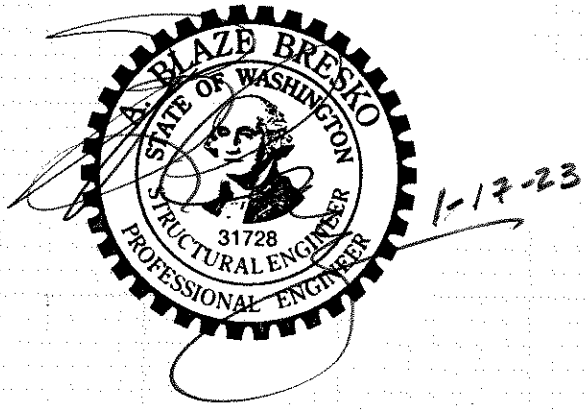
STRUCTURAL CALCULATIONS
FOR THE
PATTISON RESIDENCE

8019 SE 20th St
MERCER IS, WA 98040

ARCHITECT
CHARLES FRITZEMEIER



SWENSON SAY FAGÉT · ssfengineers.com
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

STRUCTURAL ENGINEERING

Pattison Residence
PROJECT

DATE

PROJ #

DESIGN

Cover
SHEET

Criteria Sheet

Codes

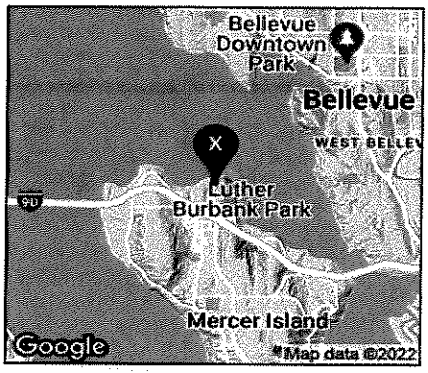
Structural	IBC 2018
Loading	ASCE 7-16
Wood:	NDS 2018
Steel:	AISC 360-16
Concrete:	ACI 318-14
Masonry:	TMS 402/602-16

Project Location

Street & Number	8019 SE 20th st
City:	mercer island State: WA
ZIP:	98040
Latitude:	47.5926 N
Longitude:	-122.2310 W
Ground Elevation	40 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 =	28 kips	Ω_o=	2.5
S_S=	1.38	S_1=	0.481
S_{DS}=	1.00	S_{D1}=	0.58
C_s=	0.154	I_E=	1.0

Story Information

# Stories Above Grade (Including Mezzanine Levels)	3

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 = C

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	2.2 psf
Misc./Mech.	1 psf	Misc./Mech.	1 psf
Ceiling Finish	2.5 psf	Ceiling Finish	2.5
Solar Panels	4 psf		10 psf
	15 psf	Use	10 psf
Use	15 psf		

Live Loads:

Roof	20	psf
Floor	40	psf

Snow Loading Criteria:

Ground Snow, p_g	20 psf	Flat Roof Snow Load, p_f	25.0 psf
Exposure Factor, C_e	1.00	Sloped Roof Snow Load, p_s	25.0 psf
Thermal Factor, C_t	1.00		
Importance Factor, I_s	1.00		
Slope Factor, C_s	0.37		

Soils: Soils Report Provided? Yes

Allowable Bearing	4000 psf	Active	55/35 pcf (Restrained/Unrestrained)
Sliding, μ	0.35	Seismic Surcharge	12H
Passive	350 pcf		

SWENSON SAY FAGET
ssfengineers.com
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

STRUCTURAL ENGINEERING

Pattison Residence

Criteria

DATE 5/27/2022

PROJ. #

DESIGN ENG

SHEET 1

Seismic Design

ASCE 7-16 Seismic Analysis — Equivalent Lateral Force Procedure

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	I, II, or III, or IV per Table 1.5-1
Site Class	D (Default)	Assumed default soil properties, per 11.4.3.
Diaphragm Flexibility	Flexible	

Section 12.8.1.3 Exceptions

Regular Structure	Yes
≤ 5 Stories above grade	Yes
T ≤ 0.5s	Yes
ρ = 1.0	Yes
Not Site Class E or F	Yes
Risk Category I or II	Yes

If all exceptions are met, S_{DS} may be taken as 1, but not less than 0.7*(Calculated S_{DS})

S_S	1.38 g	2% in 50 yr, Latitude & Longitude lookup
S_1	0.481 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	30.0 ft	
Ct	0.02	Table 12.8-2
x	0.75	Table 12.8-2
T_a	0.26 sec	
T	0.26 sec	Eq. 12.8-7
T_0	0.12 sec	
T_S	0.58 sec	
T_L	6.00 sec	
F_a	1.20	Table 11.4-1
F_v	1.82	Table 11.4-2
S_{MS}	1.66 g	Eq. 11.4-1
S_{M1}	0.87 g	Eq. 11.4-2
S_{DS}	1.000 g	Eq. 11.4-3
S_{D1}	0.583 g	Eq. 11.4-4
C_s	***0.154 Controls***	Eq. 12.8-2
	0.350	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	180.0 k	
$V = C_S W$	27.7 k	Eq. 12.8-1, Strength Level Base Shear
$V = C_{Sasd} W$	19.4 k	Eq. 12.8-1 ASD Base Shear

Building Period Per Alternate Analysis

T (sec)	

Per Geotech Report

F_a	
F_v	

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

$$S_{MS} = F_a S_S \quad \text{Eq. 11.4-1}$$
$$S_{M1} = F_v S_1 \quad \text{Eq. 11.4-2}$$
$$S_{DS} = {}^2/_3 S_{MS} \quad \text{Eq. 11.4-3}$$
$$S_{D1} = {}^2/_3 S_{M1} \quad \text{Eq. 11.4-4}$$

$$C_S = \frac{S_{DS}}{(R/I_e)} \quad \text{Eq. 12.8-2}$$
$$C_S = \frac{S_{D1}}{T(R/I_e)} \quad \text{Eq. 12.8-3}$$
$$C_S = \frac{S_{D1} T_L}{T^2(R/I_e)} \quad \text{Eq. 12.8-4}$$
$$C_S \geq 0.044 S_{DS} I_e \quad \text{Eq. 12.8-5}$$
$$C_S \geq 0.01 \quad \text{Eq. 12.8-5}$$

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

$$F_{px} = {}^{\sum_{i=x}^{n} F_i}/_{\sum_{i=x}^{n} w_i} w_{px} \quad \text{Eq. 12.10-1}$$
$$F_{px} \geq 0.2 S_{DS} I_e w_{px} \quad \text{Eq. 12.10-2}$$

Vertical Distribution — ASD — ρ= 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	30.0	40	30.0	1200	0.375	7.3	**7.3**	7.3	5.6	11.2	**7.3**	1.00
3	20.0	60	20.0	1200	0.375	7.3	**14.5**	8.7	8.4	16.8	**8.7**	1.20
2	10.0	80	10.0	800	0.250	4.8	**19.4**	8.6	11.2	22.4	**11.2**	2.31
Σ		180.0		3200		**19.4**						

SSF STRUCTURAL ENGINEERING

SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com
SWENSON SAY FAGET

Wind Design - MWFRS

ASCE 7 Chapter 27 - Directional Procedure

Design Method	ASD

Wind Coefficients

Exposure	C	
V=	98	mph
K_d=	0.85	Table 26.6-1
K_h=	0.98	Table 26.10-1
K_e=	1.00	Table 26.9-1
G=	0.85	26.9.4

Location and Building Dimensions

Calculate Kzt?	Yes	
Kzt	1.00	
Roof Type	Monoslope	
Roof Slope - Transverse Dir	0	degrees
Roof Slope - Long Dir	0	degrees
Ground to top of roof	30	ft
Bot of roof to top of roof	0	ft
Mean Roof Height, h	30	ft
Short Plan Dimension	45	ft
Long Plan Dimension	72	ft
Parapet ?	No	
Ground to top of parapet		ft
Average Parapet Height		ft

Transverse Wind Pressures

L/B = 0.63 h/L = 0.67

Pressure Coefficients from Figure 27.3-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	-1.03 / -0.18
Leeward Roof	-0.57

Velocity Pressure at Mean Roof Height, q_h =	20.5	psf

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lw walls}$	P_{walls} (psf)
0-15	0.85	17.74	12.06	8.71	**12.5**
15-20	0.9	18.78	12.77	8.71	**12.9**
20-25	0.94	19.62	13.34	8.71	**13.2**
25-30	0.98	20.45	13.91	8.71	**13.6**
30-40	1.04	21.70	14.76	8.71	**14.1**
41-50	1.09	22.75	15.47	8.71	**14.5**
51-60	1.13	23.58	16.04	8.71	**14.8**
61-70	1.17	24.42	16.60	8.71	**15.2**
71-80	1.21	25.25	17.17	8.71	**15.5**
81-90	1.24	25.88	17.60	8.71	**15.8**
91-100	1.26	26.29	17.88	8.71	**16.0**

Roof Pressures (Unfactored) ASD

Windward		Leeward	Horiz Proj (psf)
Max	Min		
-3.1	-18.0	-9.9	**4.80**

Longitudinal Wind Pressures

L/B = 1.60 h/L = 0.42

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.38
Windward Roof	-0.9 / -0.18
Leeward Roof	-0.50

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lw walls}$	P_{walls} (psf)
0-15	0.85	17.74	12.06	6.62	**11.21**
15-20	0.9	18.78	12.77	6.62	**11.64**
20-25	0.94	19.62	13.34	6.62	**11.98**
25-30	0.98	20.45	13.91	6.62	**12.32**
30-40	1.04	21.70	14.76	6.62	**12.83**
41-50	1.09	22.75	15.47	6.62	**13.25**
51-60	1.13	23.58	16.04	6.62	**13.59**
61-70	1.17	24.42	16.60	6.62	**13.93**
71-80	1.21	25.25	17.17	6.62	**14.27**
81-90	1.24	25.88	17.60	6.62	**14.53**
91-100	1.26	26.29	17.88	6.62	**14.70**

Roof Pressures (Unfactored) ASD

Windward		Leeward	Horiz Proj (psf)
Max	Min		
-3.1	-15.7	-8.7	**4.80**

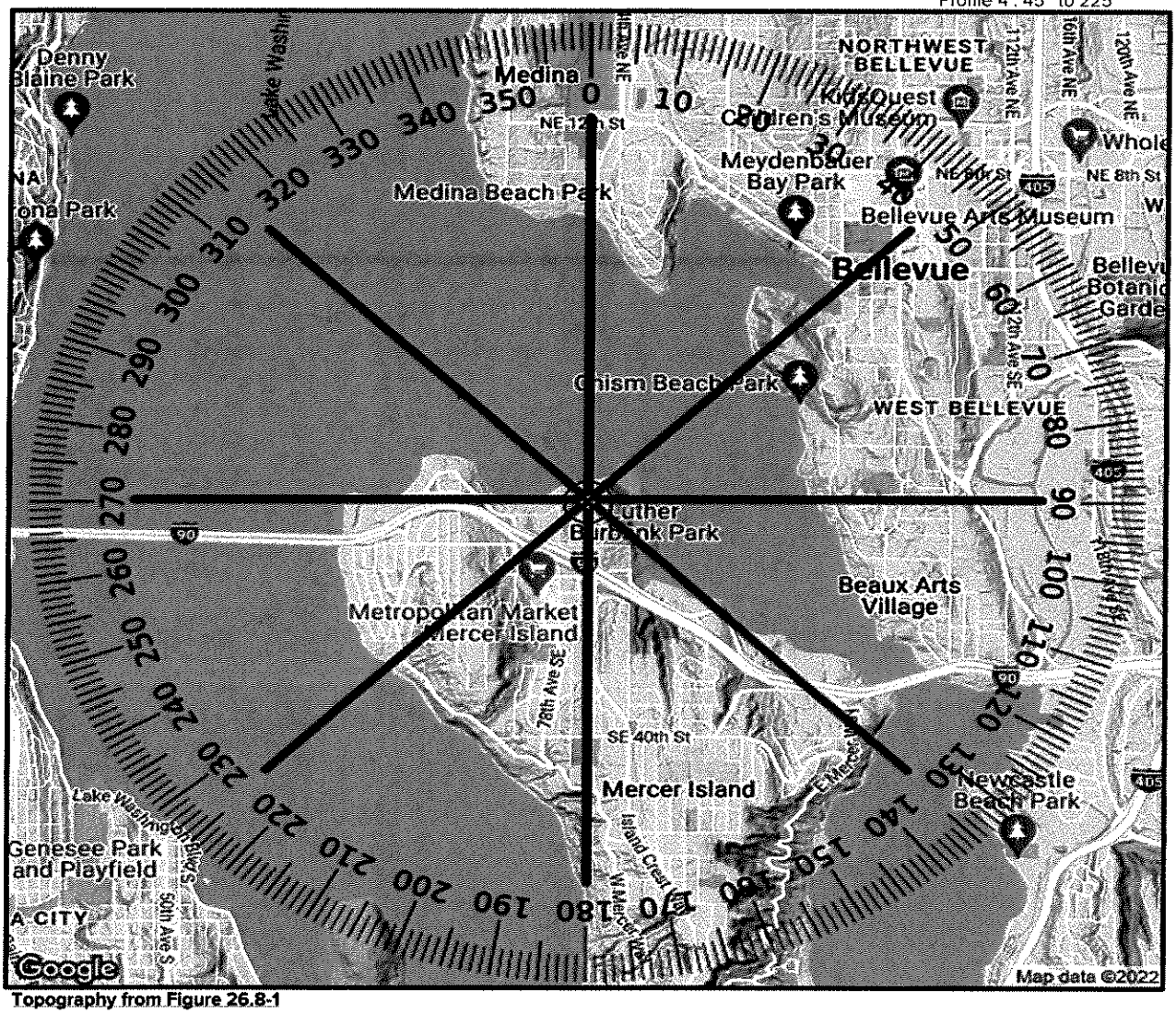
SWENSON SAY FAGET
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

Site Address

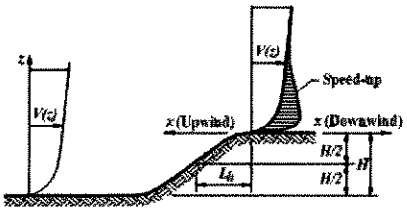
Address	8019 SE 20th st			Wind Radius	2.00 Miles
City:	mercer islanc	State:	WA	Angle	0 °
Lat Long	47.59258	-122.2310		Exposure	C

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

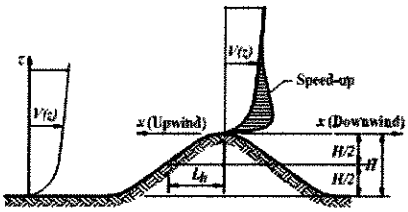
SITE MAP



Topography from Figure 26.8-1



ESCARPMENT



2-D RIDGE OR 3-D AXISYMMETRICAL HILL

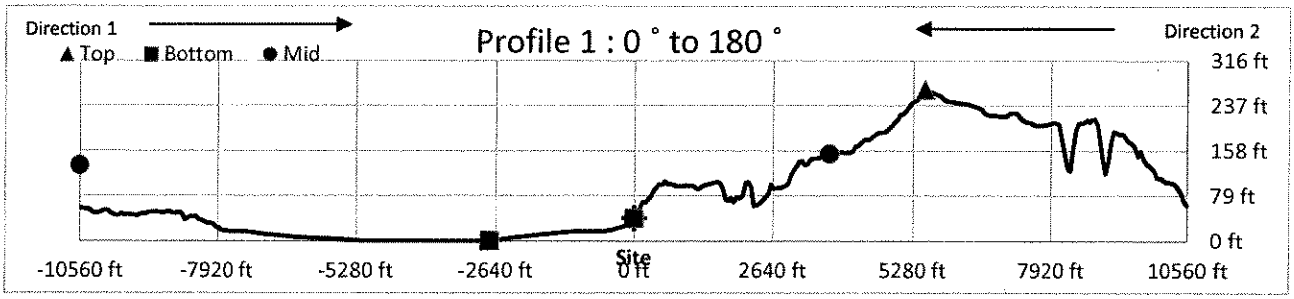
$K_{zt} = (1 + K_1 K_2 K_3)^2$
K_1 = Per Figure
$K_2 = (1 - |x|/\mu L_h)$
$K_3 = e^{-\gamma z / L_h}$
$K_{zt} = 1$, If H/Lh ≤ 0.2

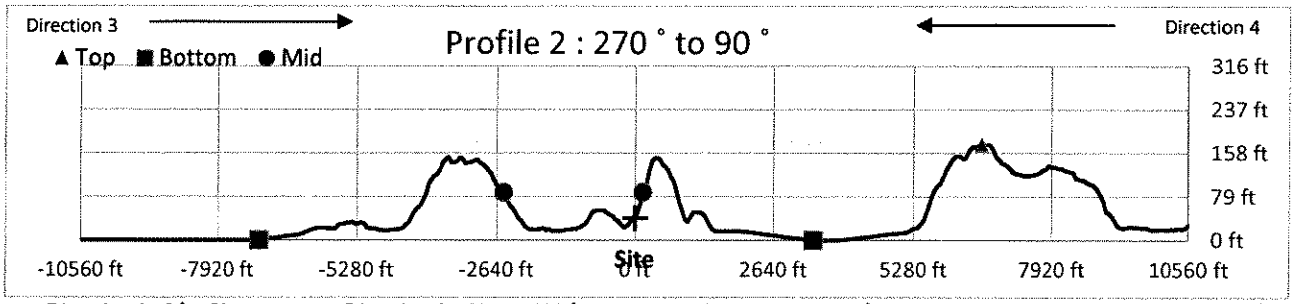
PER FIGURE 26.8-1

SWENSON SAY FAGET
ssfengineers.com
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

STRUCTURAL ENGINEERING

Pattison Residence		DATE	5/27/2022
Kzt Calculations		PROJ. #	
		DESIGN	ENG
		SHEET	4





Direction 1 - 0 ° to Site

Site Conditions (26.8.1)

1. Unobstructed	Yes	
2. Isolated	Yes	
3. Upper Half Hill	No	Kzt=1
4. H/Lh ≥ 0.2	No	Kzt=1
5. H≥ 15'	Yes	

Terrain Data

Terrain	Ridge
Top of Hill Dist.	5519
Bott. of Hill Dist.	-2759
L @ H/2	-10560
Site	upwind
Top of Hill Elev.	265
Bott. of Hill Elev.	0
Site Elev.	39.6
Site Dist.	0
H/2	132

Kzt Calculations

H=	265
Lh=	16079
x=	5519
z=	30
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.02
K2=	0.77
k3=	0.99
H/Lh =	0.02
Kzt =	1.00

Direction 2 - Site to 180 °

Site Conditions (26.8.1)

1. Unobstructed	Yes	
2. Isolated	Yes	
3. Upper Half Hill	No	Kzt=1
4. H/Lh ≥ 0.2	No	Kzt=1
5. H≥ 15'	Yes	

Terrain Data

Terrain	Ridge
Top of Hill Dist.	5519
Bott. of Hill Dist.	0
L @ H/2	3715
Site	downwnd
Top of Hill Elev.	265
Bott. of Hill Elev.	40
Site Elev.	39.6
Site Dist.	0
H/2	152

Kzt Calculations

H=	225
Lh=	1804
x=	5519
z=	30
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.18
K2=	0.00
k3=	0.95
H/Lh =	0.12
Kzt =	1.00

Direction 3 - 270 ° to Site

Site Conditions (26.8.1)

1. Unobstructed	Yes	
2. Isolated	Yes	
3. Upper Half Hill	No	Kzt=1
4. H/Lh ≥ 0.2	No	Kzt=1
5. H≥ 15'	Yes	

Terrain Data

Terrain	Ridge
Top of Hill Dist.	6580
Bott. of Hill Dist.	-7111
L @ H/2	-2494
Site	upwind
Top of Hill Elev.	174
Bott. of Hill Elev.	0
Site Elev.	39.6
Site Dist.	0
H/2	87

Kzt Calculations

H=	174
Lh=	9074
x=	6580
z=	30
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.03
K2=	0.52
k3=	0.99
H/Lh =	0.02
Kzt =	1.00

Direction 4 - Site to 90 °

Site Conditions (26.8.1)

1. Unobstructed	Yes	
2. Isolated	Yes	
3. Upper Half Hill	No	Kzt=1
4. H/Lh ≥ 0.2	No	Kzt=1
5. H≥ 15'	Yes	

Terrain Data

Terrain	Ridge
Top of Hill Dist.	6580
Bott. of Hill Dist.	3396
L @ H/2	159
Site	downwnd
Top of Hill Elev.	174
Bott. of Hill Elev.	0
Site Elev.	39.6
Site Dist.	0
H/2	87

Kzt Calculations

H=	174
Lh=	6421
x=	6580
z=	30
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.04
K2=	0.32
k3=	0.99
H/Lh =	0.03
Kzt =	1.00

SWENSON SAY FAGÉT
ssfengineers.com
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470

SSF SSF STRUCTURAL ENGINEERING

Pattison Residence

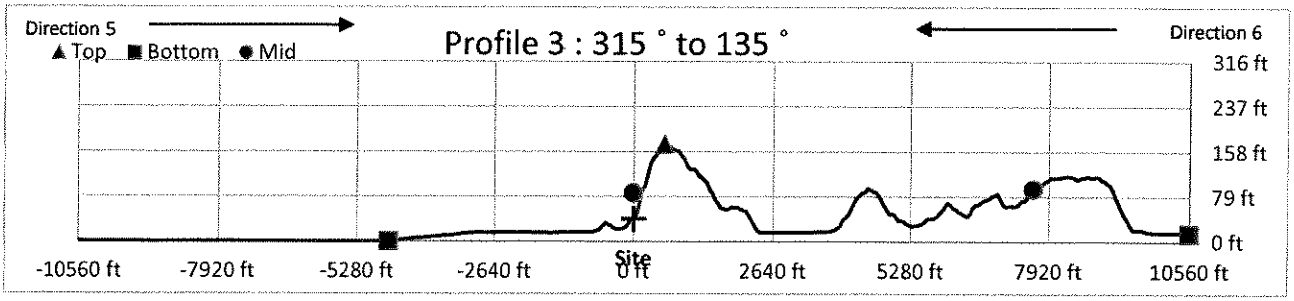
Kzt Calculations

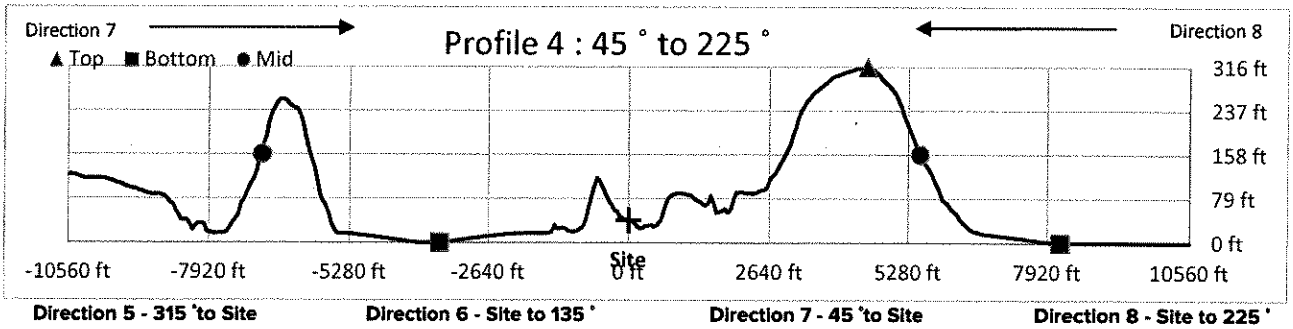
DATE 5/27/2022

PROJ. #

DESIGN ENG

SHEET 5





Direction 5 - 315 °to Site

Site Conditions (26.8.1)

1. Unubstructed	Yes	
2. Isolated	Yes	
3. Upper Half Hill	No	Kzt=1
4. H/Lh ≥ 0.2	Yes	
5. H≥ 15'	Yes	

Terrain Data

Terrain	Ridge
Top of Hill Dist.	584
Bott. of Hill Dist.	-4670
L @ H/2	0
Site	upwind
Top of Hill Elev.	170
Bott. of Hill Elev.	0
Site Elev.	39.6
Site Dist.	0
H/2	85

Kzt Calculations

H=	170
Lh=	584
x=	584
z=	30
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.42
K2=	0.33
k3=	0.86
H/Lh =	0.29
Kzt =	1.00

Direction 6 - Site to 135 °

Site Conditions (26.8.1)

1. Unubstructed	Yes	
2. Isolated		
3. Upper Half Hill	No	Kzt=1
4. H/Lh ≥ 0.2	No	Kzt=1
5. H≥ 15'	Yes	

Terrain Data

Terrain	Ridge
Top of Hill Dist.	584
Bott. of Hill Dist.	10560
L @ H/2	7641
Site	downwnd
Top of Hill Elev.	170
Bott. of Hill Elev.	14
Site Elev.	39.6
Site Dist.	0
H/2	92

Kzt Calculations

H=	156
Lh=	7057
x=	584
z=	30
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.03
K2=	0.94
k3=	0.99
H/Lh =	0.02
Kzt =	1.00

Direction 7 - 45 °to Site

Site Conditions (26.8.1)

1. Unubstructed	Yes	
2. Isolated	Yes	
3. Upper Half Hill	No	Kzt=1
4. H/Lh ≥ 0.2	No	Kzt=1
5. H≥ 15'	Yes	

Terrain Data

Terrain	Ridge
Top of Hill Dist.	4511
Bott. of Hill Dist.	-3555
L @ H/2	-6898
Site	upwind
Top of Hill Elev.	316
Bott. of Hill Elev.	0
Site Elev.	39.6
Site Dist.	0
H/2	158

Kzt Calculations

H=	316
Lh=	11409
x=	4511
z=	30
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.04
K2=	0.74
k3=	0.99
H/Lh =	0.03
Kzt =	1.00

Direction 8 - Site to 225 °

Site Conditions (26.8.1)

1. Unubstructed	Yes	
2. Isolated	Yes	
3. Upper Half Hill	No	Kzt=1
4. H/Lh ≥ 0.2	Yes	
5. H≥ 15'	Yes	

Terrain Data

Terrain	Ridge
Top of Hill Dist.	4511
Bott. of Hill Dist.	8172
L @ H/2	5519
Site	downwnd
Top of Hill Elev.	316
Bott. of Hill Elev.	0
Site Elev.	39.6
Site Dist.	0
H/2	158

Kzt Calculations

H=	316
Lh=	1008
x=	4511
z=	30
μ=	1.5
γ=	3
K1 value =	1.45
K1=	0.45
K2=	0.00
k3=	0.91
H/Lh =	0.31
Kzt =	1.00

SWENSON SAY FAGET
ssfengineers.com
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | 253.284.9470

STRUCTURAL ENGINEERING

Pattison Residence

Kzt Calculations

DATE 5/27/2022

PROJ. #

DESIGN ENG

SHEET 6

ROOF FRAMING

J1 L = 26'

11 7/8 TJI/560 @ 16" o/c

w_a = 47 #/'

Δ = .86" = L/362

J2 L = 23'

11 7/8 TJI/560 @ 24

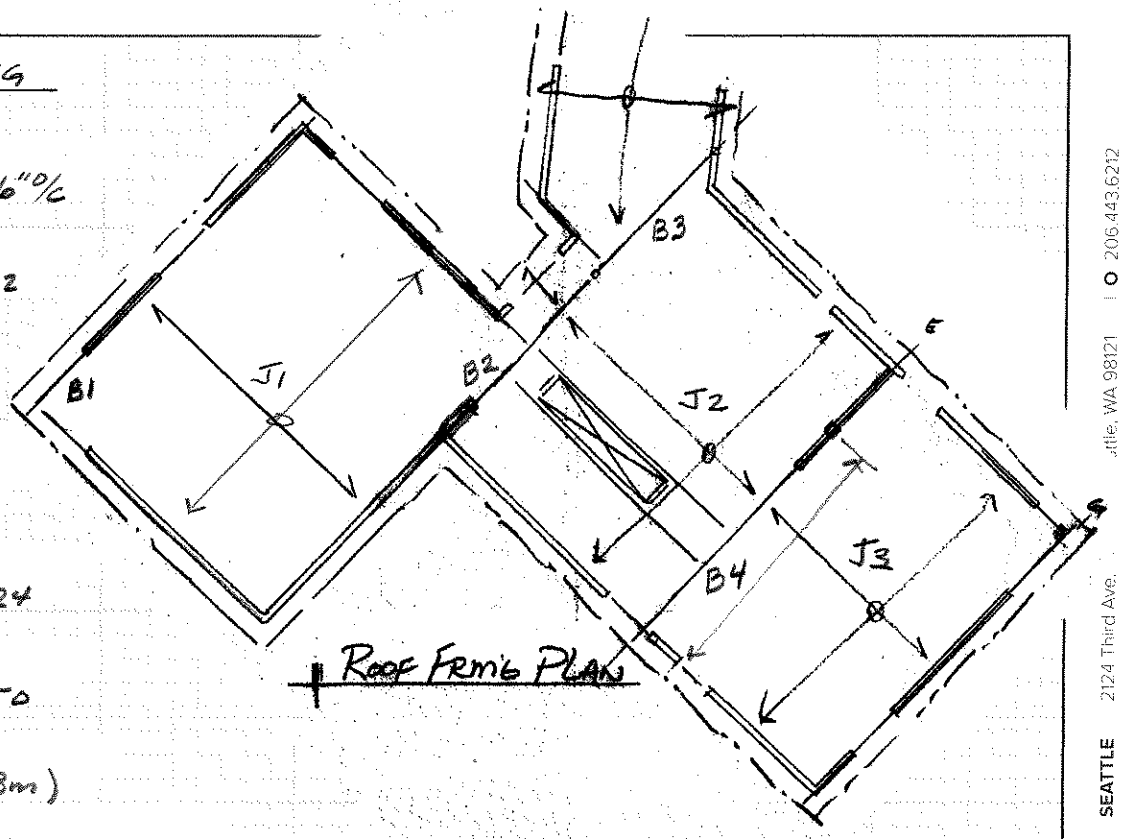
Δ = .79" = L/349

J3 L = 20'

11 7/8 TJI/360 @ 24

w_a = 112 #/'

Δ = .69" = L/350



ROOF FRM'G PLAN

B1 (CANTILEVER Bm)

w = .04(13) = .52 k/'

M- = 9.4 k'

6' min 6'

MIN 3 1/2 x 11 7/8 RIM

f_b = 1.37 ksi

Δ = .27" = 24/831

B2 w_1 = .04(43/2) = .86 k/'

w_2 = .04(13) = .52 k/'

M = 17.5 k'

w_1 w_2

5.5 k 4.5' 8' 4.3 k

5 1/4 x 11 7/8

f_b = 1.7 ksi

Δ = .41" = L/426

B3 w_1 = .04(23/2) + .04(14/2)(1/2) = .66 k/'

w_2 = .04(23/2) = .46 k/'

M = 13.8 k'

w_1 w_2

4.1 k 14' 3.7 k

5 1/4 x 11 7/8

f_b = 1.34 ksi

Δ = .3" = L/560

L = (18.5' - 11.5') 2-SPAN

B4 w = .04(43/2) = .86 k/'

M+ = 24 k'

M- = 28 k'

18.5 11.5

6.4 16.9 2.5

5 1/4 x 11 7/8

f_b = 2.74 ksi

f_v = 208 ksi

Δ = .77" = L/287

Check B4 For L = 22'-6"

w = .84 k/'

R = 9.7 k

M = 54.4 k'

W10x26

f_b = 23.4 ksi

Δ = 1.19" = L/228

W10x30

Δ = 1" = L/270

SEATTLE 2124 Third Ave. | 206.443.6212
TACOMA 934 Broadway, Su... | 253.284.9470
ssfengineers.com
SWENSON SAY FAGET

STRUCTURAL ENGINEERING

Pattison — PROJECT

11-1-22 — DATE

PROJ #

DESIGN

7 — SHEET

UPPER FLR FRMG

JOISTS (50psf)

J1 L = 26'

11 7/8 TJI/560 @ 12

L_a = 26'-1"

J2 L = 23'

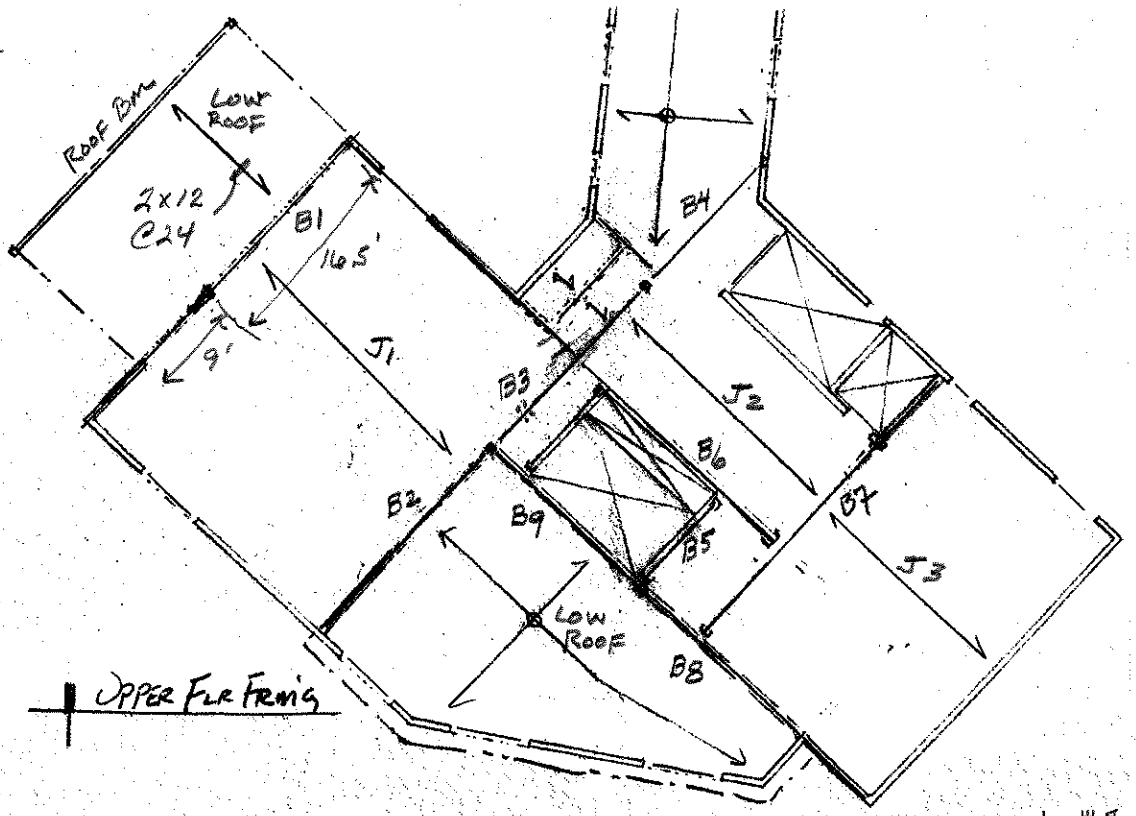
11 7/8 TJI/560 @ 16

L_a = 23'-8"

J3 L = 20'

11 7/8 TJI/360 @ 16

L_a = 20'-11"



UPPER FLR FRMG

ROOF BM (OFF MASTER)

L = 25'

w = .04(7) = .28 k/'

R = 3.5 k

m = 21.9 k'

GL 5 1/2 x 15

F_b = 1.27 ksi

Δ = .88" = L/340

BEAMS (when combined w/ S+L use .75(S+L))

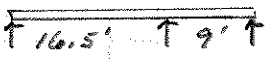
B1 L = 16.5

w = .03(20) + .04(13) = 1.12 k/'

use Cont 2-span

M_+ = 25 k'

M_- = 28.7 k'



5 1/4 x 11 7/8

F_b = 2.79 ksi

f_b = 237 psi

Δ = .64" = L/307

B2 L = 12.5'

w = (.04 + .03)(26/2) = .91 k/'

R = 5.7 k

m = 17.8 k'

5 1/4 x 11 7/8

F_b = 1.73 ksi

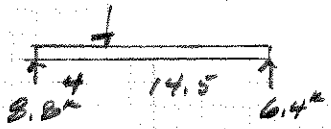
Δ = .31" = L/484

B3 w_{AVG} = .04(15) = .6 k/'

P = 5.5 k (.75) = 4.1 k

m = 34.5 k'

w_{eq} = .80 k/'



7 x 11 7/8

F_b = 2.5 ksi

f_b = 147 psi

Δ = .92" = L/241

W10 x 26 f_b = 14.7 ksi

Δ = .51" = L/422

B4 L = 14'

w_{AVG} = .05(14/2) = .35 k/'

R = 2.5 k

m = 8.6 k'

3 1/2 x 11 7/8

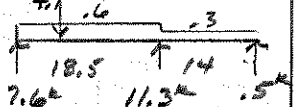
F_b = 1.25 ksi

Δ = .28 = L/587

Check loading if combine B3 + B4 2-span

M_+ = 23.8 k'

M_- = 22.6 k'



5 1/4 x 11 7/8

F_b = 2.3 ksi

Δ + = .8" = L/279

SWENSON SAY FAGÉT

ssfengineers.com

STRUCTURAL ENGINEERING

Pattison
PROJECT

11-1-22
DATE

BLG
DESIGN

8
SHEET

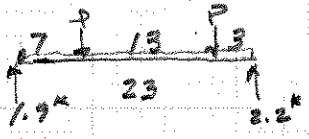
UPP Flr Framing (Cont)

Beams (Cont)

B5 $L = 10'$
$w = .05(7/2) = .18^k/_{l'}$
$R = .9^k$
$M = 2.2^{k'}$

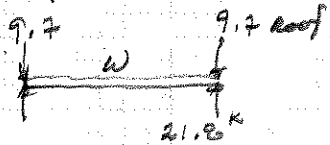
$1\ 3/4 \times 11\ 7/8$
$f_b = .66$ ksi
$\Delta = .11"$

B6
$w = .1$ misc
$P = .9^k$
$M = 11.3^{k'}$
$w_{sg} = .17^k/_{l'}$



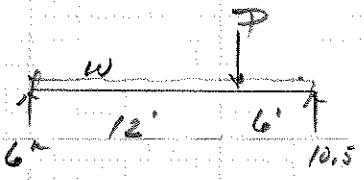
$5\ 1/2 \times 11\ 7/8$ PSL
$f_b = 1.6$ ksi
$\Delta = 1" = L/276$
use 5 1/4

B7 $L = 22'-6"$
$w = .05(\frac{43}{2}) = 1.08^k/_{l'}$
$R = 12.1^k$
$M = 68^{k'}$



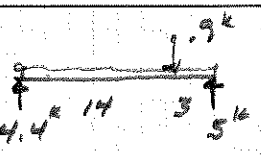
W10x30
$f_b = 25.2$ ksi
$\Delta = 1.24"$
W10x54
$\Delta = .71" = L/383$

B8 $w = .034(6') = .22^k/_{l'}$
$P = 17^k$ (B7)
$M = 59^{k'}$



W10x26
$f_b = 25.4$ ksi
$\Delta = .67" = L/321$

B9 $w = .04(10) + .1$
$= .5^k/_{l'}$
$M = 19.4^{k'}$



$5\ 1/4 \times 11\ 7/8$
$f_b = 1.89$ ksi
$\Delta = .63 = L/322$

SWENSON SAY FAGÉT
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

SSF STRUCTURAL ENGINEERING

PROJECT Patterson

DATE 11-1-22

DESIGN

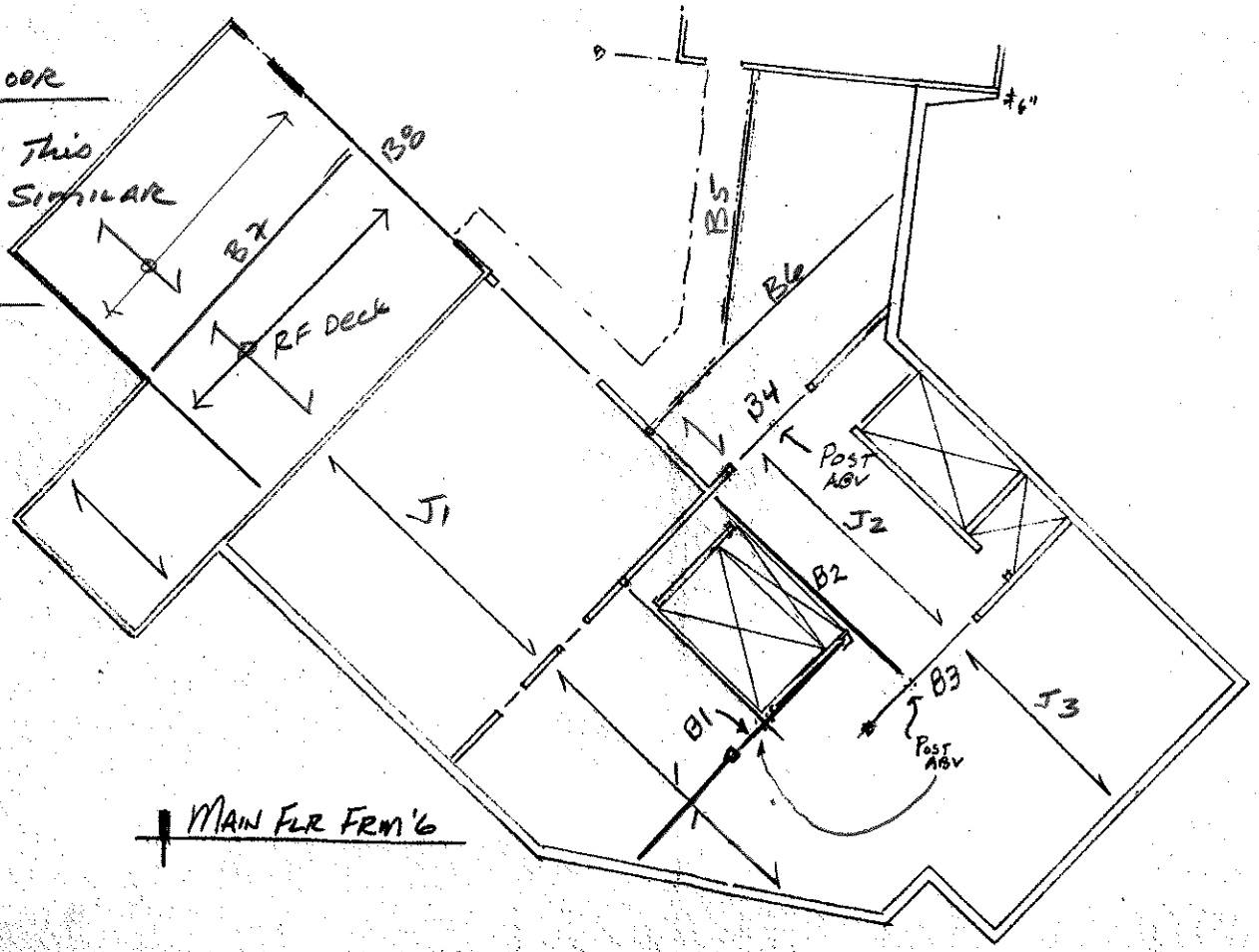
SHEET 9

MAIN FLOOR

JOISTS THIS LEVEL SIMILAR TO THE UPPER FLR

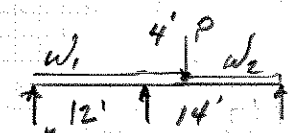
RF DECK JSTS
L = 16'
w = 70 psf
1 3/4 x 9 1/4 @ 16 LVL's

f_b = 1.5
Δ = .64"
= L/300



BEAMS

B1 2-SPAN
$w_{1\,AVG}$ = .6 k/'
w_2 = .4 k/'
P = 4.4
5.9
10.3 k
M^+ = 26.7 k'
M^- = 25.7 k'



W10 x 26
f_b = 11.6 ksi
Δ = .2" = L/855

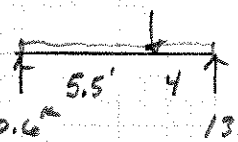
B2 w_{AVG} = .1 k/'
P = 4.1 k
M = 23 k'

W10 x 26
f_b = 9.9 ksi
Δ = .44" = L/604

B3 w = .04(13) = .52 k/'
w_2 = .04($\frac{4.3}{2}$) = .86 k/'
P = 17.2 k
M = 67 k'

W10 x 26
f_b = 29 ksi
Δ = .41 = L/377

B4 w = .04($\frac{26}{2}$) = .52 k/'
P = 4.3 + 3.7 (RF) + 11.3 (U.F.) = 19.3 k
M = 50.4 k'



W10 x 26
f_b = 21.7 ksi
Δ = .16" = L/710

SWENSON SAY FAGÉT

STRUCTURAL ENGINEERING

PROJECT: Swenson
DATE: 11-1-22
DESIGN:
SHEET: 10

MAIN FLR FRAMING (Cont'd)

B5 $L = 24'$

$W = (.04(2) + .03)\frac{14}{2} + .23 = 1^{k}/_{'}$

$R = 12^{k}$

$M = 72^{k'}$

W10x45

$f_b = 17.6$ ksi

$\Delta = 1" > {}^{L}/_{280}$

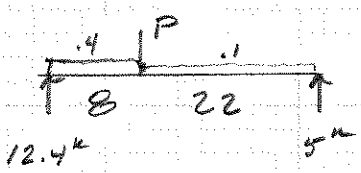
W10x68

$\Delta = .65 = {}^{L}/_{440}$

B6 $P = 12^{k}$

$W = .4^{k}/_{'}$

$M = 86^{k'}$



W10x68

$f_b = 13.7$ ksi

$\Delta = .88" = {}^{L}/_{410}$

W12x87

$\Delta = .47"$

B7 $W = .07(^{29}/_{2}) = 1^{k}/_{'}$

$L = 25.5$

$R = 12.7^{k}$

$M = 81^{k'}$

W10x68

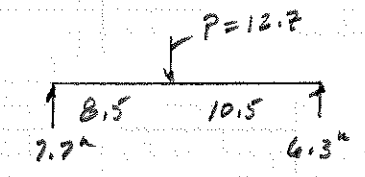
$f_b = 12.9$ ksi

$\Delta = .83 = {}^{L}/_{368}$

OR W12x50

B8 $P = 12.7 + R_{FDL} = 14^{k}$

$M = 66^{k'}$



W12x22

$f_b = 31$ ksi

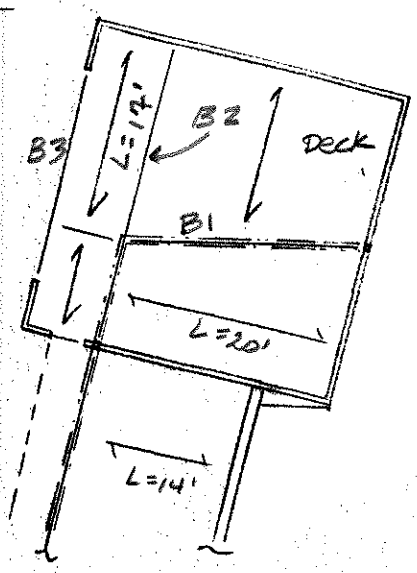
$\Delta = .75" = {}^{L}/_{300}$

W14x26

$\Delta = .48"$

SWENSON SAY FAGET
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

MAIN FLR FRMG AT EAST GARAGE



FLR JOISTS

L=20' 11 7/8 TJI/360 @16
La = 20'-11"

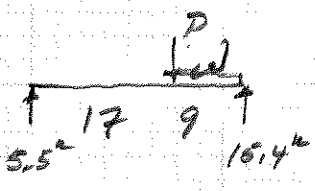
L=17' (Deck LL=60)
11 7/8 TJI/360 @16
Δ = .45" = L/454

OR 1 3/4 x 9 1/4 LVL @ 12" o/c
Δ = .56 = L/358

B1 L=20'
$w_{wt} = .07(\frac{17}{2}) + .3 = .9^{k}/_{'}$
R = 9k
M = 45 k'

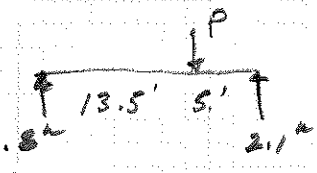
PSL 5 1/4 x 16 or W10x62 W12x53
f_b = 2.4 ksi Δ = .28 = L/844 W14x43
Δ = .82 = L/292 W18x35 W16x36
GL 5 1/2 x 18 f_b = 9.4 ksi
Δ = .22"

B2 w = .14(10) 2 + .3
= 1.1 k/'
P = 9 + 2 = 11k
M = 93.9 k'



W10x68
f_b = 14.9 ksi
Δ = .79 = L/393
or W16x57
Δ = .41 = L/760
OR W18x50

B3 P = .075(13)(5) = 2.9k
M = 10.6 k'



3 1/2 x 11 7/8
f_b = 1.5 ksi
Δ = .45 = L/493

SWENSON SAY FAGÉT
SEATTLE 2124 Third
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | 253.284.9470
ssfengineers.com

STRUCTURAL ENGINEERING

Parkhurst
PROJECT

11-1-22
DATE

DESIGN

12
SHEET

RETAINING WALLS

SOIL CRITERIA BY: PANGEO

BASEMENT WALLS

$\ell_a = 45 pcf$

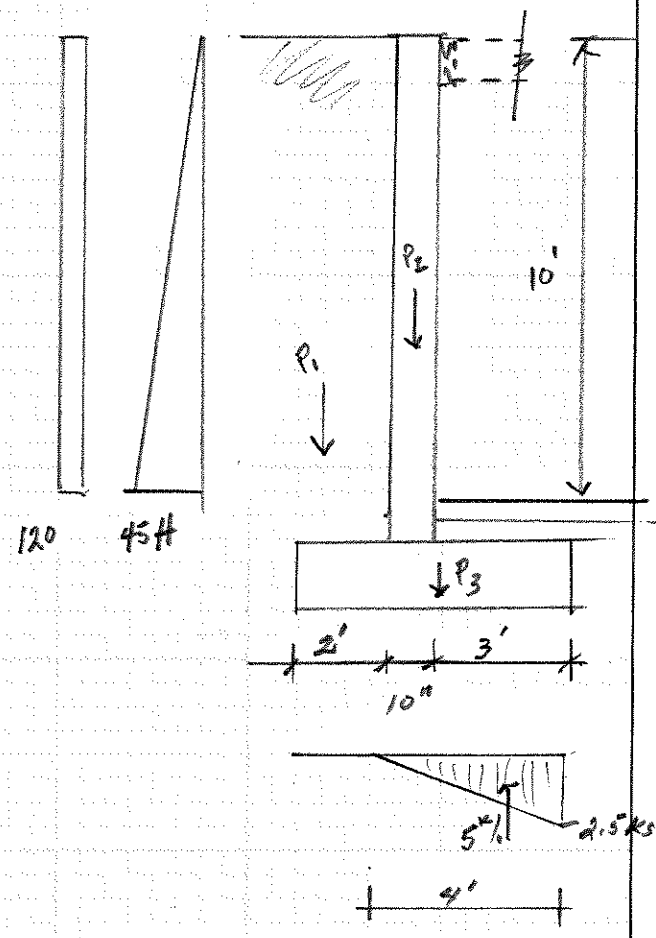
$\ell_{surcharge} = 12H$

$\ell_{passive} = 350 pcf$

$f = .35$

$g = 4 ksf$

TYPICAL WALL AT BASEMENT IS BRACED BY SLAB ON GRADE AND IS FULL HT, H=10' MAX



$M_{STATIC} = .045(10)^3/6 = 7.5^{k'}/_{'}$

$M_{SLIS} = .12(10)^2/2 = 6.0^{k'}/_{'}$

$13.5^{k'}/_{'}$

$M_u = 7.5(1.6) + 6 = 18^{k'}/_{'}$

$P_1 = .125(10.5)(2) = 2.6^{k}/_{'}$

$P_2 = .125(10.5) = 1.3^{k}/_{'}$

$P_3 = .15(1.17)(5.8) = 1.1^{k}/_{'}$

$5^{k}/_{'}$

$M_R = 2.6(4.83) = 12.6$

$+ 1.3(3.42) = 4.4$

$+ 1.1(2.92) = 3.2$

$20.2^{k'}$ $FS = \frac{20.2}{13.5} = 1.5$

$x = \frac{20.2 - 13.5}{5.0} = 1.34$

$g_{max} = \frac{2(5)}{1.34(5)} = 2488 psf$

WALL STEEL (10") $d = 7.5"$, $M_u = 18$

$A_s = .58 in^2/ft$ #5's @ 6
#6's @ 9
#7's @ 12

FOOTING MOMENT

$M_{SOIL} = 5(2.67) = 13^{k}/_{'}$

$M_u = 21^{k}/_{'}$

$d = 14 - 3.5 = 10.5"$

$A_s = .46 in^2/ft$ (USE SAME WALL STEEL)

TOP STEEL

$A_{s\,min} = .0018(12)(14) = .30 in^2/ft$

#5's @ 12

SWENSON SAY FAGÉT

SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212

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

ssfengineers.com

SSF STRUCTURAL ENGINEERING

PATTISON
PROJECT

11-3-22
DATE

PROJ #
DESIGN

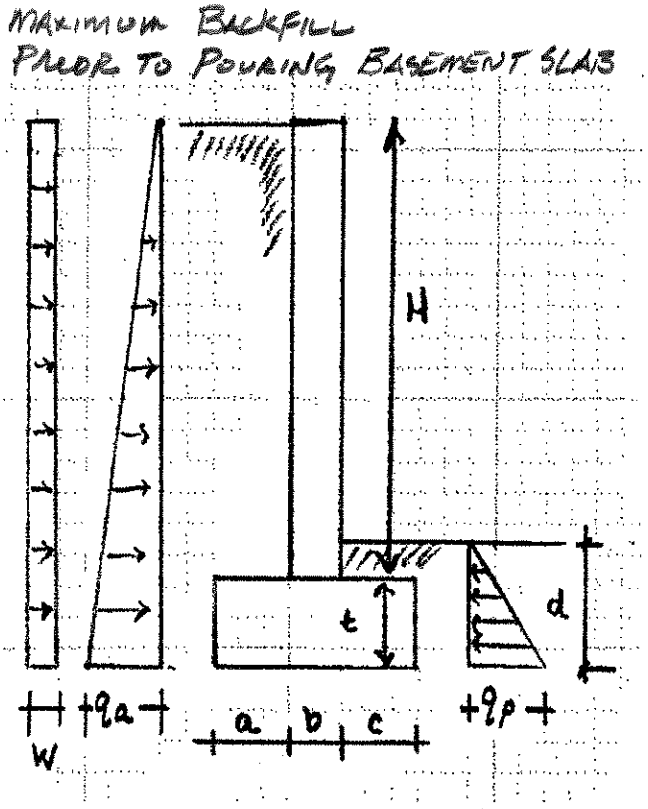
13
SHEET

Retaining Wall Analysis

Project	Pattison Residence		
Wall Height (ft)	H to T.O.F	feet	8
allow bearing pressure		psf	4000
allow passive pressure	Qp	pcf	350
allow friction coef	f		0.35
earth pressure	Qa	pcf	35
surcharge pressure	w	psf	0
wall thickness	b	inches	10
heel length	a	inches	24
toe length	c	inches	36
footing length		feet	5.83333
footing depth	t	inches	14
depth of soil in front of ftg	d	inches	14
length to CL of soil			4.83333
length to CL of wall			3.41667
length to CL of toe			1.5
passive pressure force			0.09263
friction resisting force			1.42917
footing weight			1.02083
wall weight			1.0625
soil weight at heel	0.125		2
soil weight at toe	0.125		0
total dead load			4.08333
Wall moment based on H			2.98667
overturning moment			4.49315
sliding force			1.47049
resisting moment			16.2743
allowable sliding resistence			1.5218
Wall ultimate moment	1.6L + 1.0E		4.77867
x			2.88518
L/3			1.94444
e=L/2-x if 3x<L			0.03149
max soil pressure-based on x			0.94352
min soil pressure-e			0.67733
max soil pressure-e			0.72267

3.622 >1.5

1.0349 >1.0 ← GOVERNS IN TEMP CASE

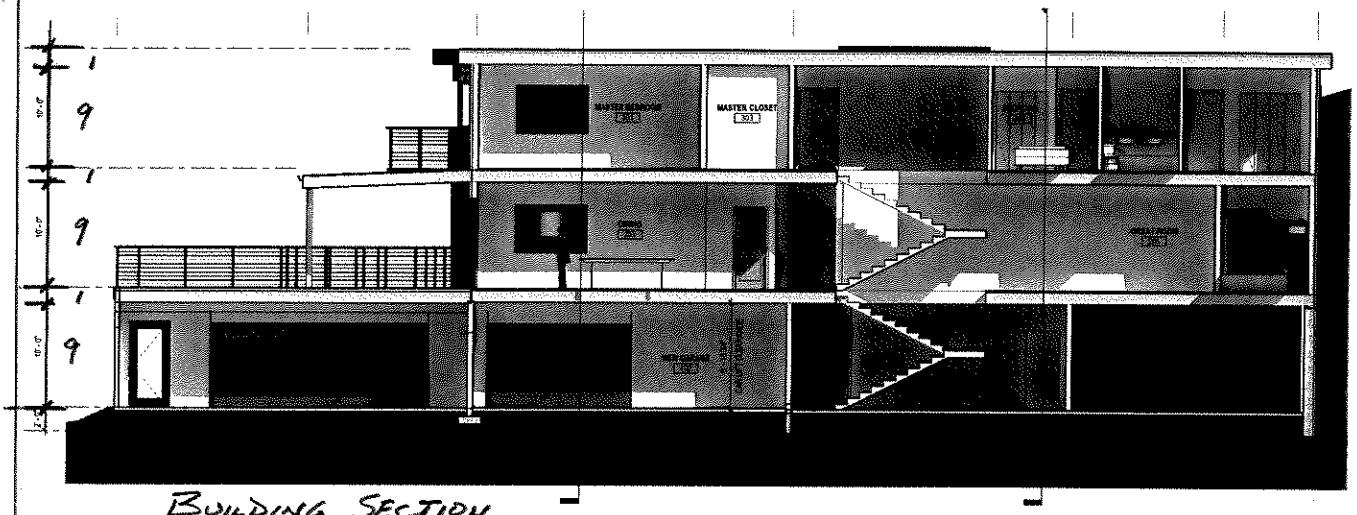


PATTISON

11-2-22

14

LATERAL DESIGN



BUILDING SECTION

G SECTION

WIND LOADING

$w_{ROOF} = .014(1 + 9/2) = .08^{k}/_{'}$

$w_{UPP} = .013(10) = .13^{k}/_{'}$

$w_{MAIN} = .012(10) = .12^{k}/_{'}$

$(.07^{k}/_{'}$ WHEN 1-STORY)

ROOF LEVEL

E-W DIRECTION

.08

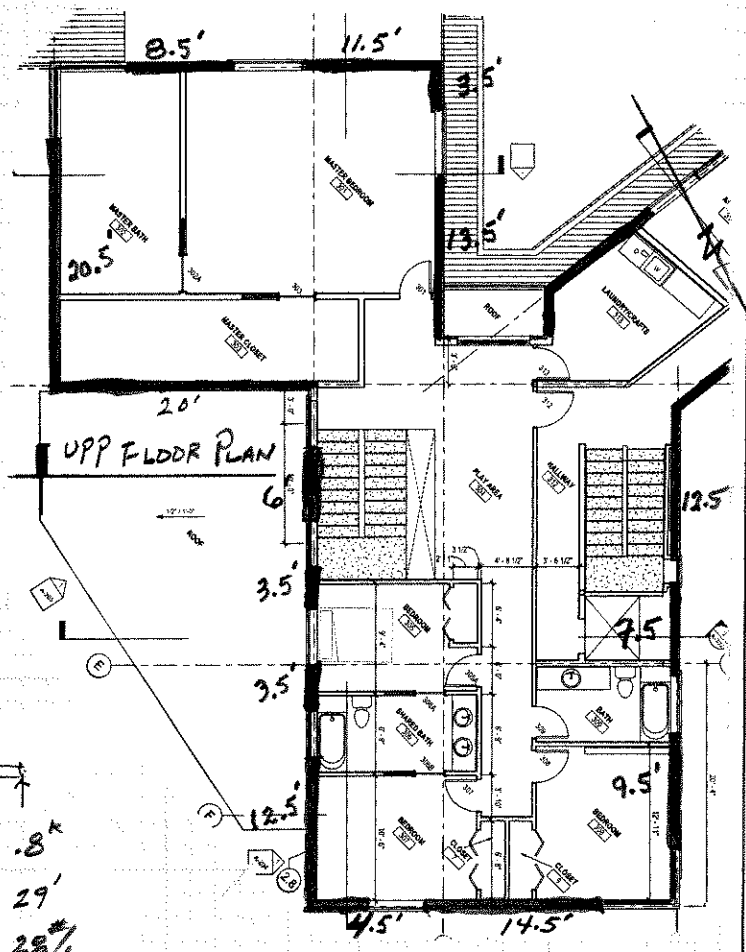
27' | 44 |

V	1.1^{k}	2.8	1.8
L_W	20'	20'	19'
v	55$^{\#}/_{'}$	140$^{\#}/_{'}$	95$^{\#}/_{'}$
SW	W6	W6	W6

N-S DIRECTION

20 | 10 | 20'

V	.8^{k}	2.4^{k}	.8^{k}
L_W	20'	42'	29'
v	40$^{\#}/_{'}$	57$^{\#}/_{'}$	28$^{\#}/_{'}$
	W6	W6	W6



SWENSON SAY FAGÉT
SEATTLE
TACOMA
2124 Third Ave, Suite 100, Seattle, WA 98121 | O 206.443.6212
934 Broadway, Suite 100, Tacoma, WA 98402 | O 253.284.9470
ssfengineers.com

SSF STRUCTURAL ENGINEERING

PROJECT: Pattison

DATE: 11-2-22

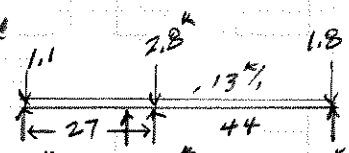
DESIGN:

SHEET: 15

LATERAL DESIGN (CONT)

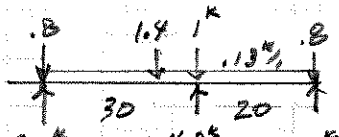
UPP FLOOR LOADING

E-W DIRECTION

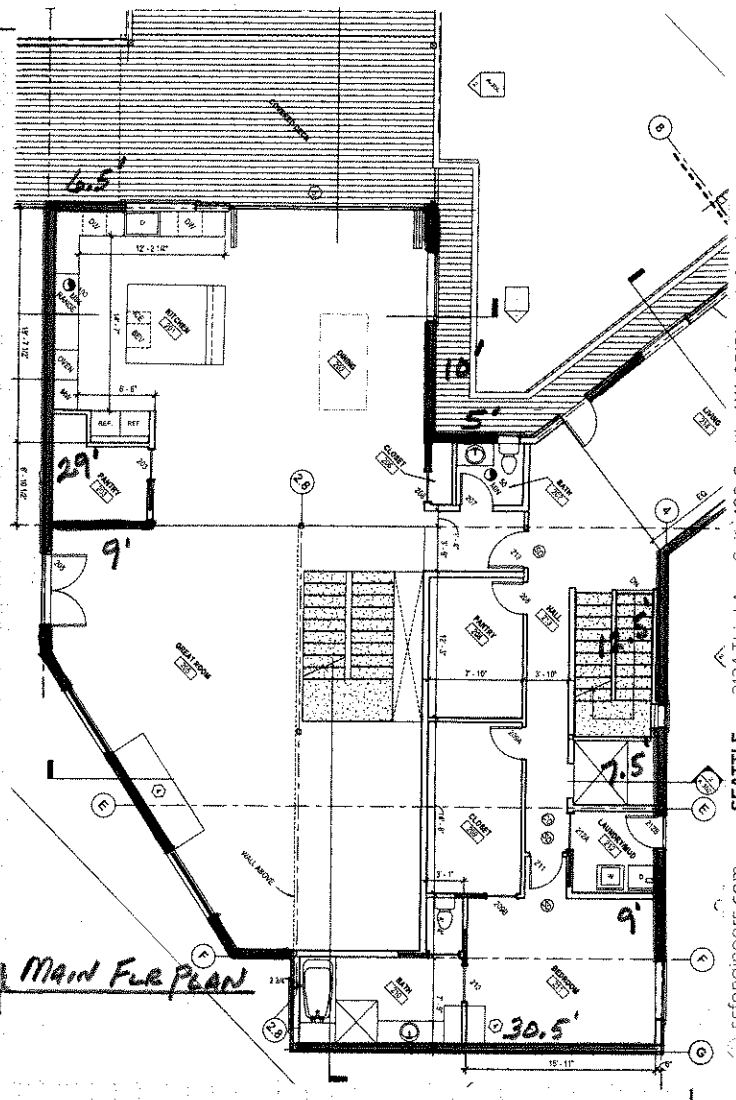


V	2.8K	7.5K	4.6K
L_w	6.5'	14'	30.5'
Σ	431#/'	536#/'	151#/'
SW	W3	W2	W6
H.D.	3.9K	4.8K	—
	HDU5	HDU5	

N-S DIRECTION



V	3.2K	4.3K	2.1K
L_w	29'	10'	29'
Σ	110#/'	430#/'	73#/'
SW	W6	W3	W6
HD	—	3.9K	—
		HDU5	



SWENSON SAY FAGÉT
SEATTLE 2124 Third Ave, Suite 100, Seattle, WA 98121 O 206.443.6212
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 O 253.284.9470
ssfengineers.com

SSF STRUCTURAL ENGINEERING

PROJECT: Pattison

DATE: 11-2-22

PROJ. DESIGN:

SHEET: 16

LATERAL DESIGN (CONT)

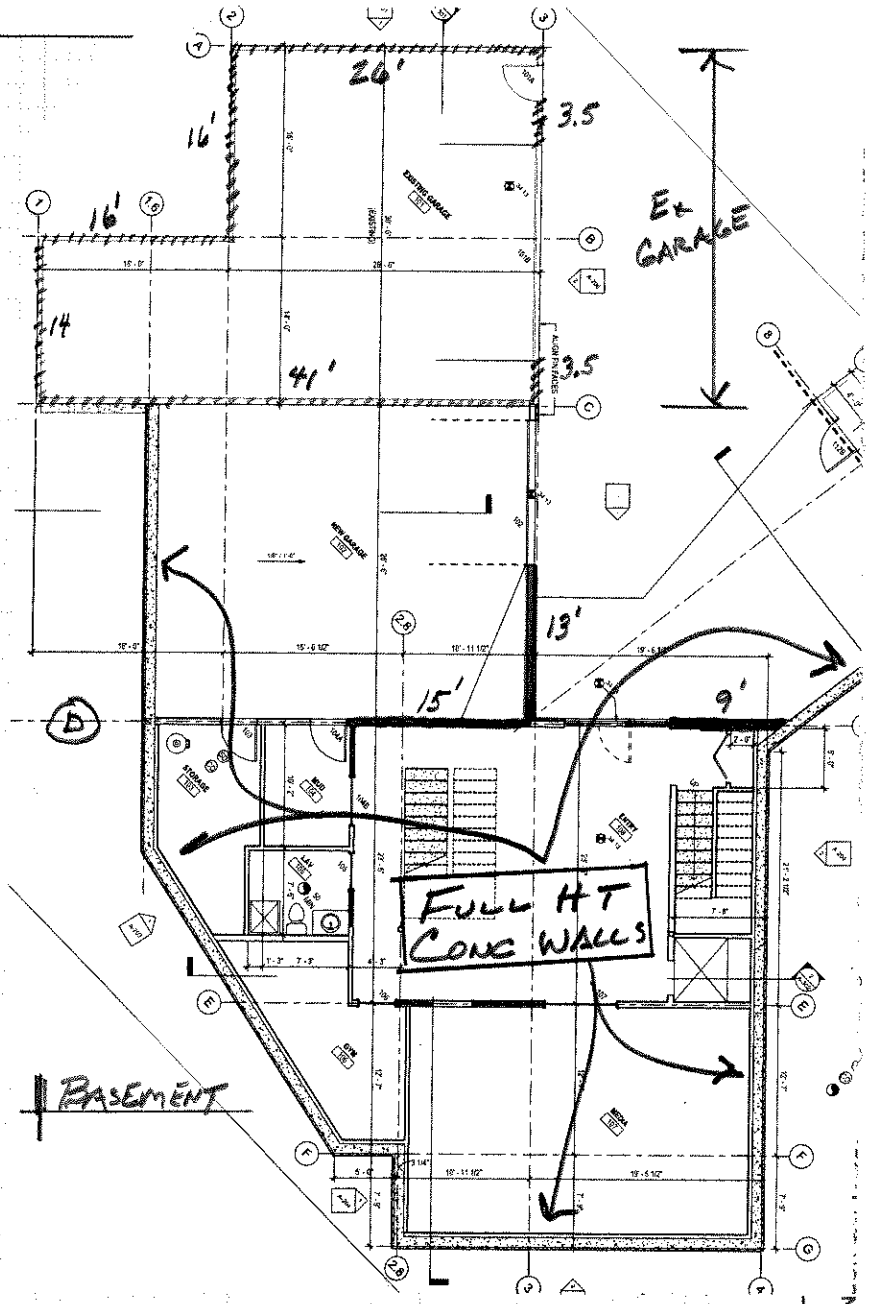
AT MAIN FLOOR MOST PERIMETER LATERAL LOADS TRANSFER DIRECTLY TO FULL HT CONC. WALLS

CHECK THE BASEMENT WOOD FRAME WALLS AT OTHER CONDITIONS ALONG GRID (D) (E-W) AND GRID (3) (N-S)

GRID D, L = 24'
V = 7.5'
v = 313#/'
W4 MIN

GRID (3) L = 13' (IGNORE EX WALLS)
V = 4.3K
v = 331#
W4 MIN

NO LATERAL CHANGES TO EX GARAGE, AND EX WALLS ARE SHEATHED W/ PLYWOOD NO UPGRADES REQ'D.



SWEN TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 O 253.284.9470

SSF STRUCTURAL ENGINEERING

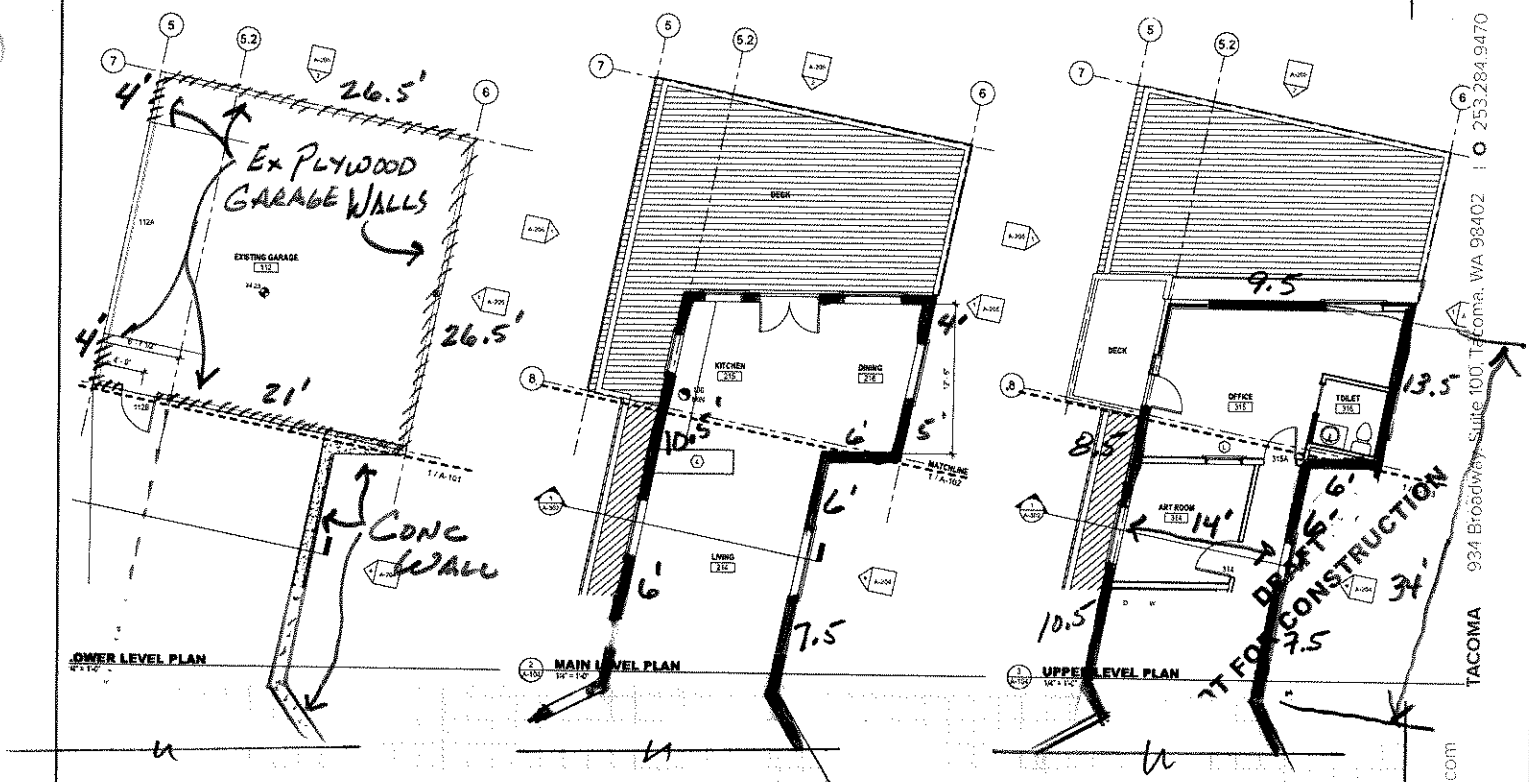
Pattison
PROJECT

11-2-22
DATE

PROJ. DESIGN

17
SHEET

LATERAL @ NW GARAGE



IN N-S DIRECTION, DESIGN IS TRIVIAL SINCE THIS WING IS INTER-CONNECTED W/ MAIN HOUSE AND WE HAVE MANY WALLS ALONG WEST & EAST ELEVATIONS

CHECK THE TRANSFER OF SEISMIC LOADS DOWN TO THE GARAGE LEVEL

$V_{ROOF} = .02(750\#).154/1.4 = 1.6^k$

$V_{UPP} = 1.6^k$

$V_{MAIN} = .02(1000).154/1.4 = 2.2^k$

LET ALL LOADS BE RESISTED BY THE EAST ELEVATION

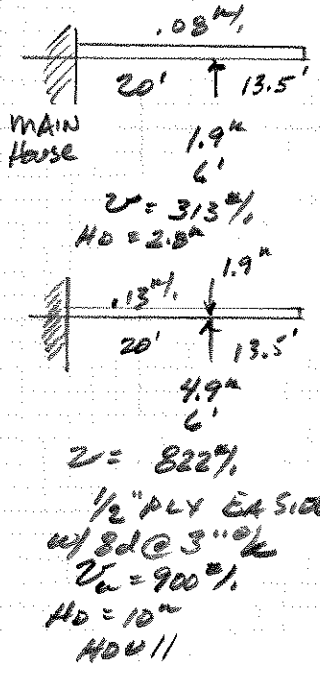
$v_{BOT} = \frac{5.4^k}{26.5'} = 204\#/'$ Ex WALL ONLY

(NOTE: FULL HT CONC WALL ALSO RESISTS PART OF THE LOAD)

NO UPGRADES REQ'D

EAST-WEST ELEVATION

IGNORE THE NORTH WALL & CANTILEVER DIAPH OFF 6' WALL



SWENSON SAY FAGET
TACOMA 934 Broadway, Suite 100, Tacoma, WA 98402 | 253.284.9470
ssfengineers.com

SSF STRUCTURAL ENGINEERING

Pattison
PROJECT

11-2-22
DATE

PR
DESIGN

18
SHEET