

Harriott Valentine Engineers Inc.

STRUCTURAL CALCULATIONS

Project:

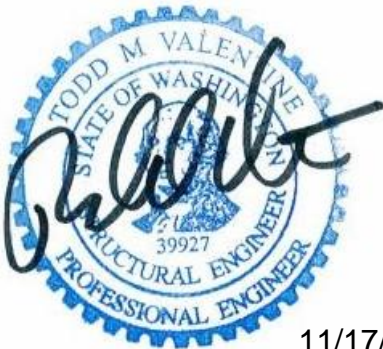
Buchanan Residence
5601 90th Ave SE
Mercer Island, WA 98040

Architect:

Brandt Design Group
66 Bell Street, Unit 1
Seattle, WA 98121

Structural Engineer:

Harriott Valentine Engineers, Inc.
1932 First Avenue, Suite 720
Seattle, WA 98101
tel. 206-624-4760



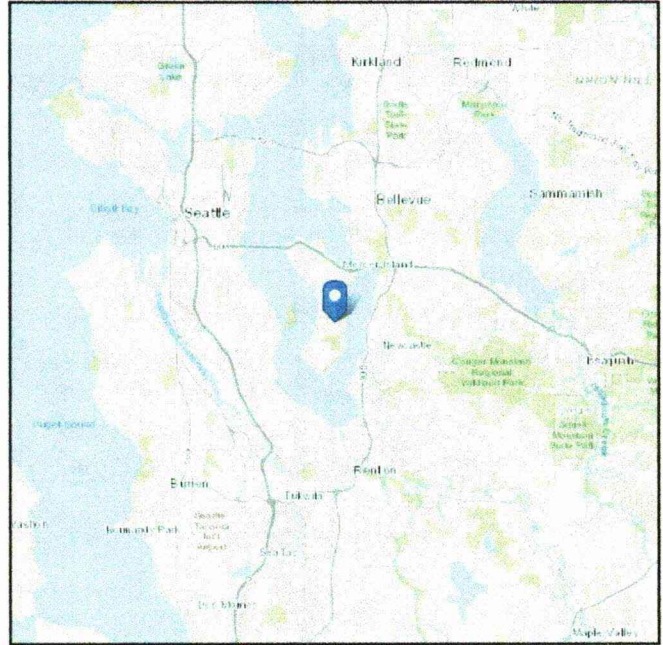
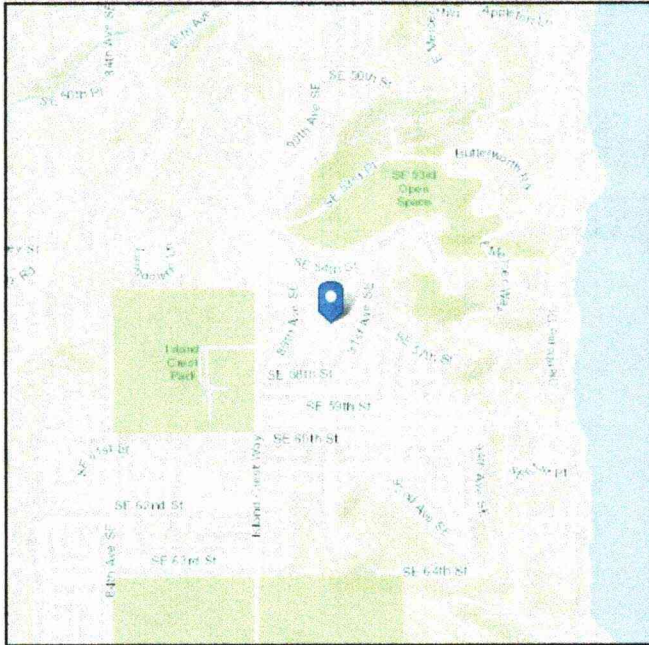
11/17/2023

ASCE 7 Hazards Report

Address:
5601 90th Ave SE
Mercer Island, Washington
98040

Standard: ASCE/SEI 7-10
Risk Category: II
Soil Class: D - Stiff Soil

Latitude: 47.552023
Longitude: -122.218962
Elevation: 353.5732122100117 ft
(NAVD 88)



Wind

Results:

Wind Speed	110 Vmph
10-year MRI	72 Vmph
25-year MRI	79 Vmph
50-year MRI	85 Vmph
100-year MRI	91 Vmph

Data Source: ASCE/SEI 7-10, Fig. 26.5-1A and Figs. CC-1–CC-4, and Section 26.5.2,
Date Accessed: incorporating errata of March 12, 2014
FRI NOV 17 2023

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 7-10 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 7-10 Section 26.2.

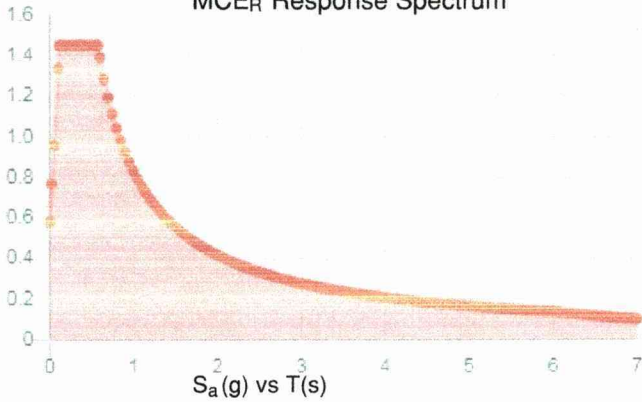
Site Soil Class:

Results:

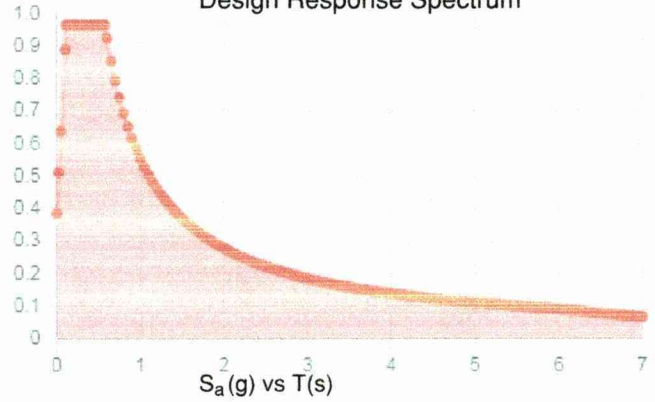
S_S :	1.448	S_{D1} :	0.555
S_1 :	0.555	T_L :	6
F_a :	1	PGA :	0.601
F_v :	1.5	PGA _M :	0.601
S_{MS} :	1.448	F_{PGA} :	1
S_{M1} :	0.833	I_e :	1
S_{DS} :	0.965		

Seismic Design Category: D

MCE_R Response Spectrum



Design Response Spectrum



Data Accessed:

Fri Nov 17 2023

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

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SEISMIC DESIGN

ASCE 7-16
Equivalent Lateral Force Procedure

Occupancy Category	II	
Seismic Design Category	D	Table 11.6-1
Importance Factor	1.00	Table 1.5-2
Site Class	D	Table 20.3-1
S _s	144.80 %g	(from USGS Seismic Hazard Curves, 2008 data)
S ₁	55.50 %g	(from USGS Seismic Hazard Curves, 2008 data)
F _a	1.00	Table 11.4-1
F _v	1.50	Table 11.4-2
C _t	0.02	Table 12.8-2
x	0.75	Table 12.8-2
h _n	8.00 feet	(height to highest level)

S _{MS} = F _a *S _s	1.4480	Eq. 11.4-1
S _{M1} = F _v *S ₁	0.8325	Eq. 11.4-2
S _{DS} = (2/3)*S _{MS}	0.9653 g	Eq. 11.4-3
S _{D1} = (2/3)*S _{M1}	0.5550 g	Eq. 11.4-4
Period T _a = C _t *h _n ^x	0.0951 s	Eq. 12.8-7
T _o	0.1150 s	"=.02*SD1/SDS"
T _s	0.5749 s	"=SD1/SDS"

R	6.5	Table 12.2-1
Ω _o	2.5	Table 12.2-1
C _d	4	Table 12.2-1
Section 9.5.5 ok?	Yes	Table 12.6-1

Equivalent Lateral Force Procedure (section 12.8)

C _s	0.1485	Eq. 12.8-2
W, weight	68,664 lb	per table below
V	10,197 lb	Eq. 12.8-1

Vertical Force Distribution (section 12.8.3)

k = 1.00

Level	Hx (ft)	Floor Area (ft ²)	Seismic Dead Ld (psf)	Floor Wt. (k)	Wall Length (ft)	Wall Wt. (k)	Total Wt. (k)	WxHx (k-ft)	Cvx (%)	(LRFD) Q _E (k)	(ASD) 0.7Q _E (k)
Roof (S2.3)	8.00	3340	18	60.1	267	8.5	68.7	549.3	100.0	10.20	7.14
							68.66	549.31	100.00	10.20	7.14

WIND DESIGN

ASCE 7-16

Simplified Envelope Method (Chapter 28)

$$p_s = \lambda K_{zt} I p_{s30}$$

$$\lambda = \text{adjustment factor} = 1.00$$

$$I = \text{importance factor} = 1.00$$

$$K_{zt} = \text{topographic factor} = 1.30$$

Part of Figure 28.6-1 - Adjustment Factor for Building Height and Exposure, λ

Mean Roof Height (ft)	Exposure		
	B	C	D
15	1.00	1.21	1.47
16	1.00	1.23	1.49
17	1.00	1.24	1.50
18	1.00	1.26	1.52
19	1.00	1.27	1.53
20	1.00	1.29	1.55
21	1.00	1.30	1.56
22	1.00	1.31	1.57
23	1.00	1.33	1.59
24	1.00	1.34	1.60
25	1.00	1.35	1.61
26	1.00	1.36	1.62
27	1.00	1.37	1.63
28	1.00	1.38	1.64
29	1.00	1.39	1.65
30	1.00	1.40	1.66

Zone
Computation

a = 10% of least horizontal dimension or 0.4 x h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 feet.

$$w = 25.00 \text{ ft} \times 0.1 = 2.50 \text{ ft}$$

$$h = 10.00 \text{ ft} \times 0.4 = 4.00 \text{ ft}$$

$$w = 25.00 \text{ ft} \times 0.04 = 1.00 \text{ ft}$$

$$a = 3.00 \text{ ft}$$

$$2a = 6.00 \text{ ft}$$

Zone B - end zone of roof

Zone A - end zone of wall

Zone D - interior zone of roof

Zone C - interior zone of wall

Part of Figure 28.6-1 - Method 2

Design Wind Pressure, p_{s30}

Basic Speed	Roof Angle	Roof Pitch	Horizontal Pressures (psf)			
			A	B	C	D
97	0 to 5	flat	14.9	-7.7	9.9	-4.6
	10	2	16.8	-7.0	11.2	-4.1
	15	3	18.8	-6.2	12.5	-3.6
	20	4	20.7	-5.4	13.8	-3.0
	25	6	18.8	3.0	13.6	3.1
	30 to 45	7 to 12	16.8	11.5	13.4	9.2

Design Wind Pressure, ps

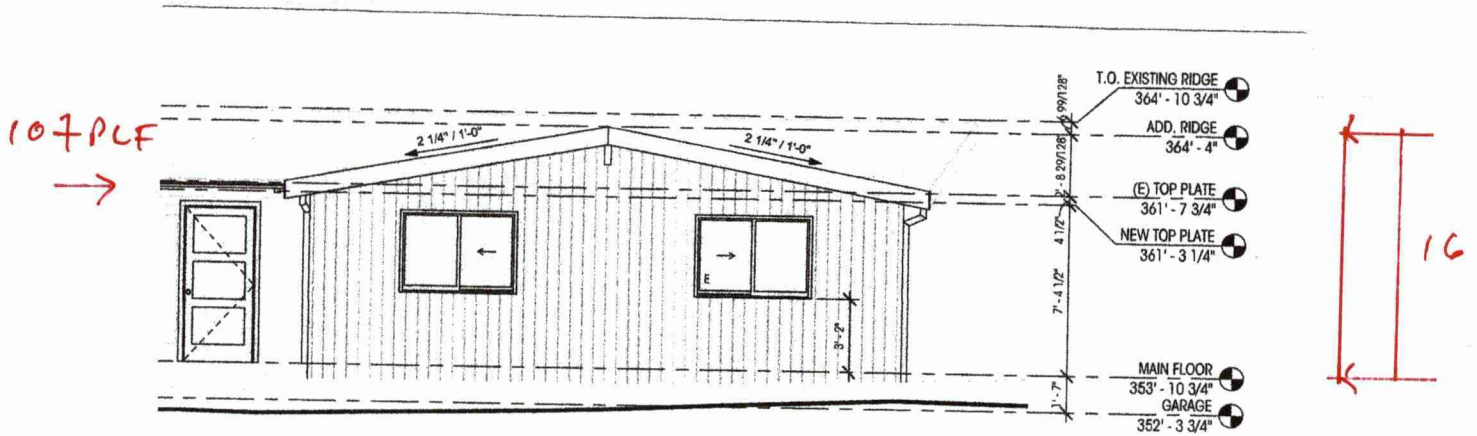
Basic Speed	Roof Angle	Roof Pitch	Horizontal Pressures (psf)			
			A	B	C	D
97	0 to 5	flat	19.4	-10.0	12.9	-6.0
	10	2	21.9	-9.1	14.5	-5.3
	15	3	24.4	-8.1	16.3	-4.6
	20	4	26.9	-7.1	17.9	-3.9
	25	6	24.4	3.9	17.6	4.1
	30 to 45	7 to 12	21.8	14.9	17.4	12.0

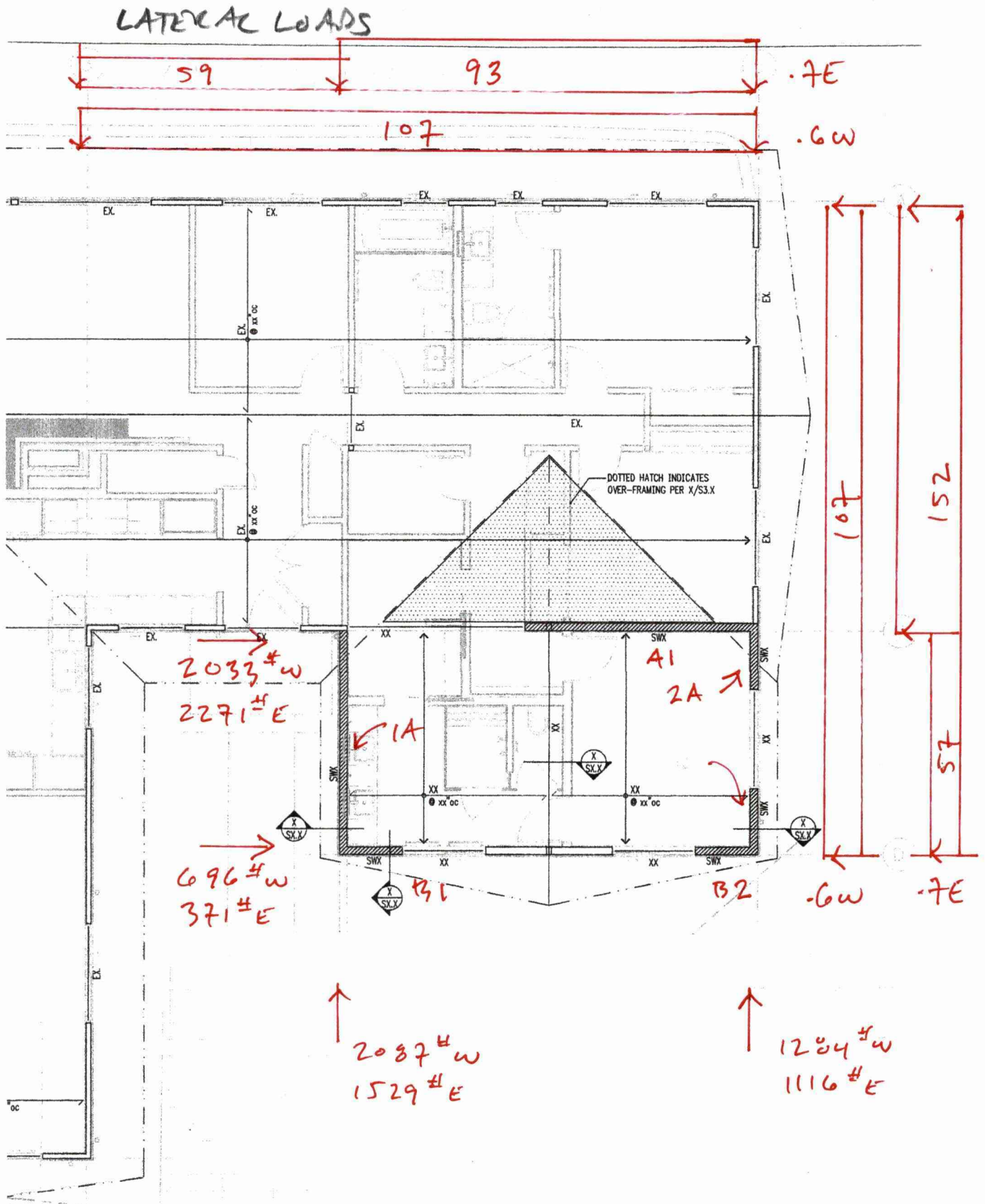
WIND LOADS

$$A = 14.9 \times 0.6 = 8.94 \text{ PSF}$$

USE 16 PSF MIN

$$AP = 8.94 \times 1.3 = 11.6 \text{ PSF}$$





SHEAR WALLS

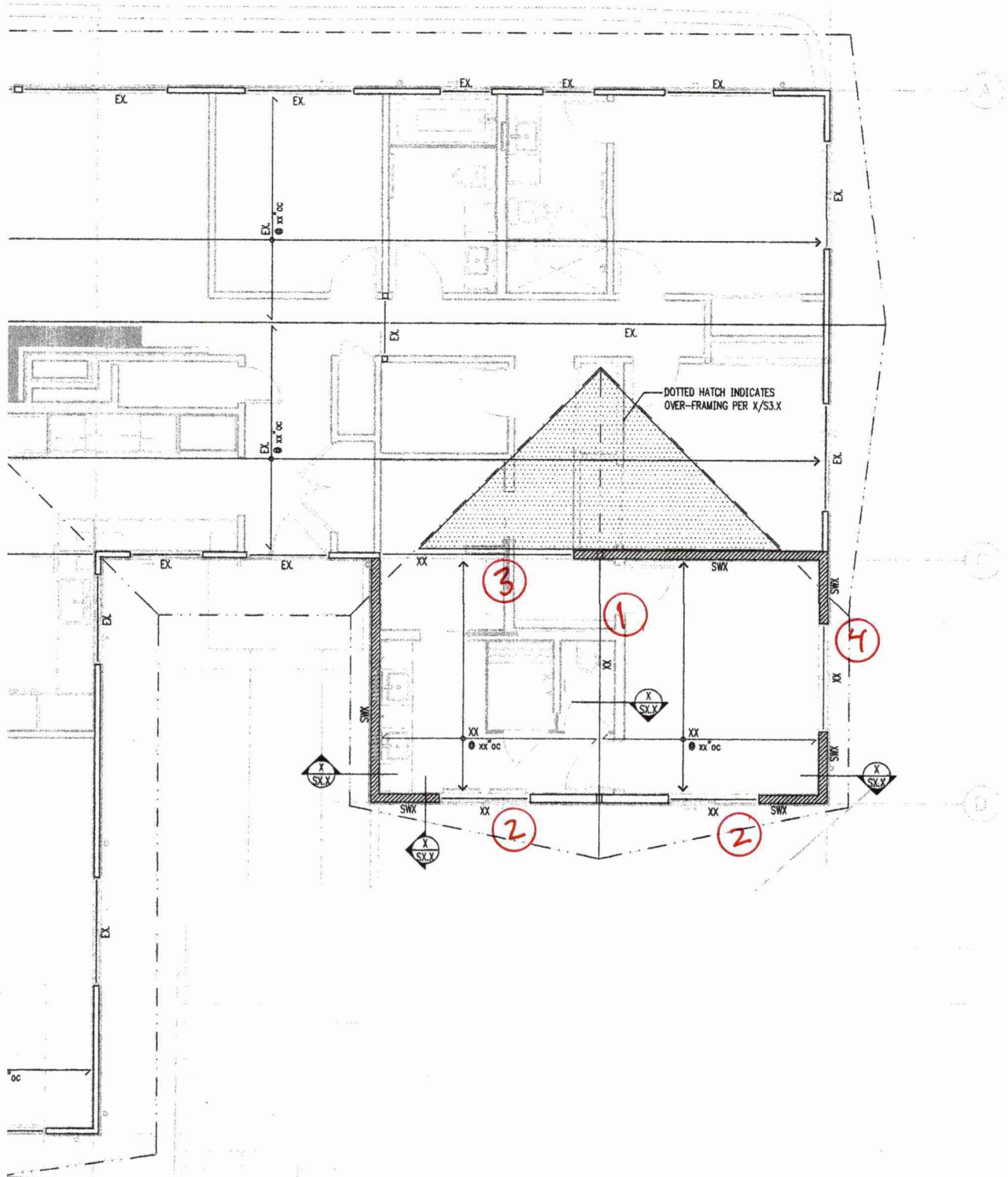
SEISMIC

WALL	L	H	V	W	SW	OT	MO
A1	13'-6"	8'	2271	168	SW1	1346 [#]	MOU2
B1	3'-9"	8'	186	50	SW1	403 [#]	MOU2
B2	3'-9"	8'	186	50	SW1	403 [#]	MOU2
1A	13'-6"	8'	1529	113	SW1	906 [#]	MOU2
2A	4'	8'	558	140	SW1	1116 [#]	MOU2
2B	4'	8'	558	140	SW1	1116 [#]	MOU2

WIND

A1	13'-6"	8'	2033	151	SW1	1205 [#]	MOU2
B1	3'-9"	8'	348	93	SW1	742 [#]	MOU2
B2	3'-9"	8'	348	93	SW1	742 [#]	MOU2
1A	13'-6"	8'	2087	155	SW1	1237 [#]	MOU2
2A	4'	8'	642	161	SW1	1284 [#]	MOU2
2B	4'	8'	642	161	SW1	1284 [#]	MOU2

ROOF FRAMING



BUCHANAN
11/9/23

ROOF FRAMING

① $l = 13'$
 $w = \frac{24'}{2} (15+25)$
 $= 480 \text{ PLF}$
 $M = 10.1 \text{ K}\cdot\text{FT}$
 $V = 3.12 \text{ K}$

PSL $3\frac{1}{2} \times 11\frac{1}{4}$
 $M_R = 17.9 \text{ K}\cdot\text{FT}$
 $V_R = 7.6 \text{ K}$
 $\Delta = .37'' = \frac{l}{420} \text{ OK}$
 $\pm = 415$

② NON-BEARING - USE (2) 2×8

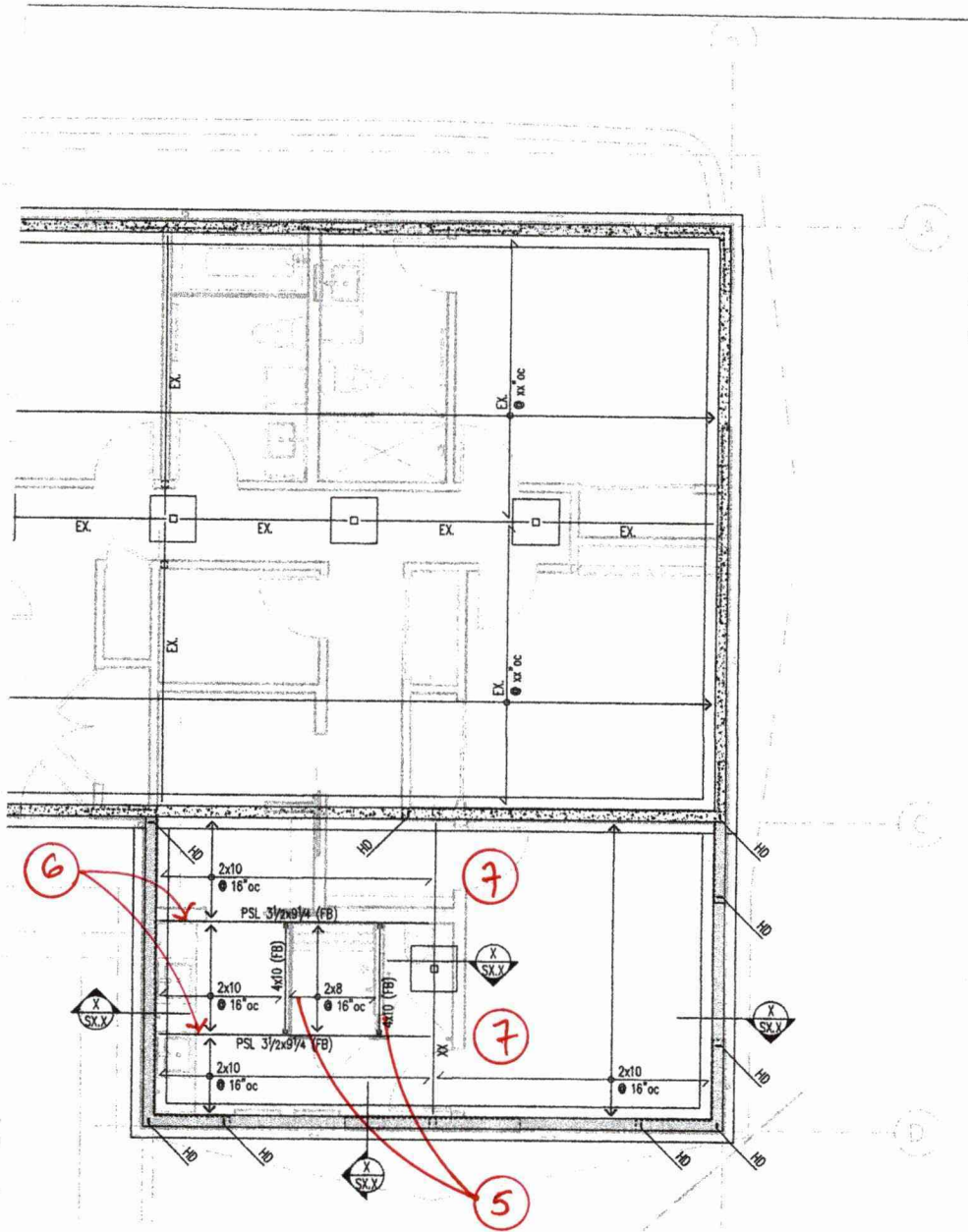
③ $l = 10\text{'}-3''$
 $w = \frac{25'}{2} (15+25)$
 $= 500 \text{ PLF}$
 $M = 6.6 \text{ K}\cdot\text{FT}$
 $V = 1.3 \text{ K}$

PSL $3\frac{1}{2} \times 9\frac{1}{4}$
 $M_R = 12.4 \text{ K}\cdot\text{FT}$
 $V_R = 6.2 \text{ K}$
 $\Delta = .27'' = \frac{l}{457} \text{ OK}$
 $\pm = 231$

④ $l = 6'$
 $w = \frac{12'}{2} (15+25)$
 $= 240 \text{ PLF}$
 $M = 1080 \text{ K}\cdot\text{FT}$
 $V = 720 \text{ K}$

~~(2) 2×8~~ 4×6
 $M_R = \frac{2.23 \text{ K}\cdot\text{FT}}{1.87}$
 $V_R = \frac{2.18 \text{ K}}{2.2}$
 $\Delta = .06'' \text{ OK } .11'' = \frac{l}{1049}$

MAIN FLOOR FRAMING



BUCHANAN
11/9/23

FLOOR FRAMING

JOISTS

$$L = 12'$$

$$W = 74 \text{ PLF}$$

$$M = 1.3 \text{ K}\cdot\text{F}$$

$$V = 444 \text{ \#}$$

$$L = 4'$$

$$W = 74 \text{ PLF}$$

$$M = 148 \text{ \#}\cdot\text{F}$$

$$V = 148 \text{ \#}$$

2x10

$$M_R = 1.67 \text{ K}\cdot\text{F}$$

$$V_R = 1.34 \text{ \#}$$

$$d = .27" = \text{OK}$$

2x8 OK

Flexure Elements

⑤

$$L = 5'$$

$$w = \frac{10'}{2} (15 + 40)$$

$$= 275 \text{ PLF}$$

$$M = 859 \text{ \#}\cdot\text{ft}$$

$$V = 688 \text{ \#}$$

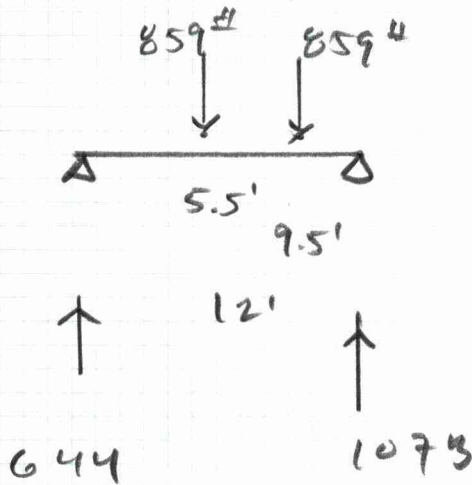
4x10

$$M_{UL} = 4.24 \text{ K}\cdot\text{ft}$$

$$V_{UL} = 3.24 \text{ K}$$

$$\Delta = \text{OK}$$

⑥



PSC 3 2 x 9 1/2

$$M_{UL} = 12.4 \text{ K}\cdot\text{ft}$$

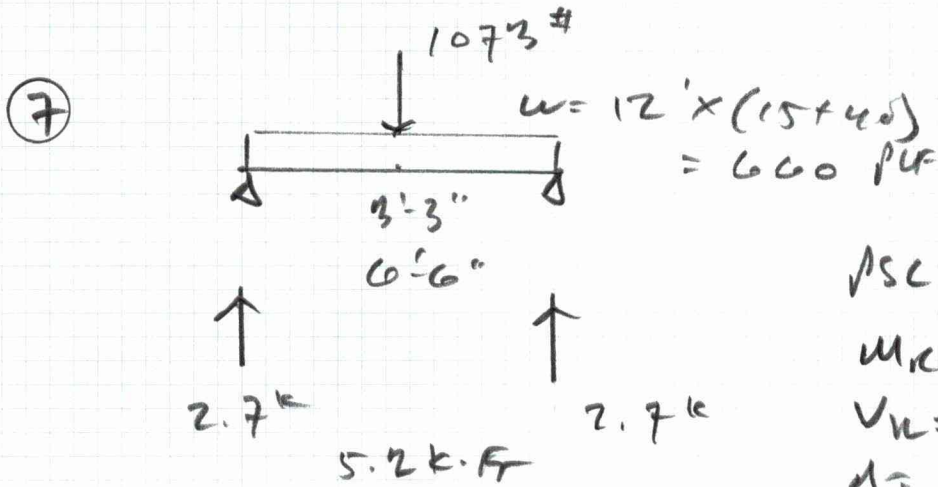
$$V_{UL} = 6.2 \text{ K}$$

$$\Delta = \text{OK}$$

$$M = 644 \times 5.5'$$

$$= 3.5 \text{ K}\cdot\text{ft}$$

FLOOR FRAMING



ISC # 2 x 9 1/4
 $M_R = 12.4 \text{ k}\cdot\text{ft}$
 $V_R = 6.2 \text{ k}$
 $\Delta = 0.12$