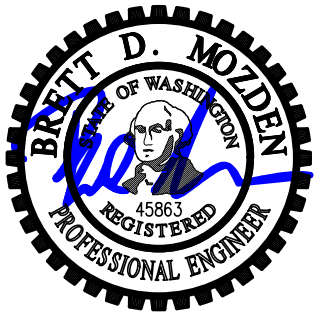
Structural Calculations For:

Garrett Residence

9007 SE 44th ST

Mercer Island, WA 98040



Prepared for: Atelier Drome Architecture

Job #: 02233-2024-38

Date: April 21, 2025

STRUCTURAL ENGINEERING

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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	9007 SE 44th St		
City:	Mercer Island	State:	WA
ZIP:	98040		
Latitude:	47.5668	N	
Longitude:	-122.2186	W	
Ground Elevation	372	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 =	6 kips	Ω_o=	2.5
S_S=	1.423	S_1=	0.494
S_{DS}=	1.00	S_{D1}=	0.59
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}=	1.90
Exposure =	B		

Dead Loads:

Roof			Floor		
Roofing	1	psf	Finish Floor	2	psf
1/2" Sheathing	1.8	psf	3/4" Sheathing	2.7	psf
Roof Framing	2.5	psf	Joists @ 16" oc	2.2	psf
Misc./Mech.	1.5	psf	Misc./Mech.	2	psf
Ceiling Finish	2.8	psf	Ceiling Finish	2.8	
Solar Panels	5	psf		11.7	psf
	15	psf	Use	12	psf
Use	12	psf	Add'l Seismic Weight	10	psf
Add'l Seismic Weight	5	psf	Seismic Weight	22	psf
Seismic Weight	17	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

Soils Report Provided?	Yes
Site Specific Ground Motion Hazard Analysis Provided?	Yes

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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	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

1. Regular Structure	Yes
2. ≤ 5 Stories above grade	Yes
3. T ≤ 0.5s	Yes
4. ρ = 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*(Calculated S_{DS})

S_S	1.423 g	2% in 50 yr, Latitude & Longitude lookup
S_1	0.494 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	14.8 ft	
Ct	0.02	Table 12.8-2
x	0.75	Table 12.8-2
T_a	0.15 sec	
T	0.15 sec	Eq. 12.8-7
T_0	0.12 sec	
T_S	0.59 sec	
T_L	6.00 sec	
F_a	1.20	Table 11.4-1
F_v	1.81	Table 11.4-2
S_{MS}	1.71 g	Eq. 11.4-1
S_{M1}	0.89 g	Eq. 11.4-2
S_{DS}	1.000 g	Eq. 11.4-3
S_{D1}	0.595 g	Eq. 11.4-4
C_s	***0.154 Controls***	Eq. 12.8-2
	0.608	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	36.4 k	
V = C_SW	5.6 k	Eq. 12.8-1, Strength Level Base Shear
V = C_{Sasd}W	3.9 k	Eq. 12.8-1 ASD Base Shear

Building Period Per Alternate Analysis

T (sec)	

Per Geotech Report

F_a	
F_v	

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

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

$$C_S = \frac{S_{DS}}{(R/I_e)} \quad \text{Eq. 12.8-2}$$
$$C_S = \frac{S_{D1}}{T(R/I_e)} \quad \text{Eq. 12.8-3}$$
$$C_S = \frac{S_{D1} T_L}{T^2(R/I_e)} \quad \text{Eq. 12.8-4}$$
$$C_S \geq 0.044 S_{DS} I_e \quad \text{Eq. 12.8-5}$$
$$C_S \geq 0.01 \quad \text{Eq. 12.8-5}$$
$$C_S \geq 0.5 \frac{S_1}{(R/I_e)} \quad \text{Eq. 12.8-6}$$

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

$$F_{px} = {}^{\sum_{i=x}^{n} F_i}/_{\sum_{i=x}^{n} w_i}\, w_{px} \quad \text{Eq. 12.10-1}$$
$$F_{px} \geq 0.2 S_{DS} I_e w_{px} \quad \text{Eq. 12.10-2}$$
$$F_{px} \leq 0.4 S_{DS} I_e w_{px} \quad \text{Eq. 12.10-3}$$

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 C_{vx} (%)	Story Shear ASD F_x (k)	Story Shear ASD SV (k)	Diaphragm Force (ρ not included) $F_{px,calc}$	$F_{px,min}$	$F_{px,max}$	$F_{px,design}$	γ=F_{px}/F_x
Roof	14.8	12	14.8	177	0.446	1.7	**1.7**	1.7	1.7	3.4	**1.7**	1.00
1	9.0	24	9.0	220	0.554	2.2	**3.9**	2.6	3.4	6.8	**3.4**	1.57
Σ		36.4		397		**3.9**						

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Wind Design - MWFRS

ASCE 7 Chapter 27 - Directional Procedure

Design Method	ASD

Wind Coefficients

Exposure	B	
V=	98	mph
K_d=	0.85	Table 26.6-1
K_h=	0.59	Table 27.3-1
K_e=	0.99	Table 26.9-1
G=	0.85	26.9.4

Transverse Wind Pressures

L/B = 0.95 h/L = 0.42

Pressure Coefficients from Figure 27.4-1:

Bldg Face	C_p
Windward Wall	0.8
Leeward Wall	-0.50
Windward Roof	0 / 0.4
Leeward Roof	-0.60

Location and Building Dimensions

Calculate Kzt?	No	
Kzt	1.90	
Roof Type	Gable	
Roof Slope - Transverse Dir	45	degrees
Roof Slope - Long Dir	45	degrees
Ground to top of roof	18.5	ft
Bot of roof to top of roof	5	ft
Mean Roof Height, h	16	ft
Short Plan Dimension	38	ft
Long Plan Dimension	40	ft
Parapet ?	No	
Ground to top of parapet		ft
Average Parapet Height		ft

Velocity Pressure at Mean Roof Height, q_h =	22.9	psf

Wall Pressures (Unfactored): ASD

Ht	K_z	q_z	$P_{ww\ walls}$	$P_{lwwalls}$	**P_{walls} (psf)**
0-15	0.57	22.33	15.18	9.75	**15.0**
15-20	0.62	24.29	16.52	9.75	**15.8**
20-25	0.66	25.86	17.58	9.75	**16.4**
25-30	0.7	27.42	18.65	9.75	**17.0**
30-40	0.76	29.77	20.25	9.75	**18.0**
41-50	0.81	31.73	21.58	9.75	**18.8**
51-60	0.85	33.30	22.64	9.75	**19.4**
61-70	0.89	34.87	23.71	9.75	**20.1**
71-80	0.93	36.43	24.77	9.75	**20.7**
81-90	0.96	37.61	25.57	9.75	**21.2**
91-100	0.99	38.78	26.37	9.75	**21.7**

Roof Pressures (Unfactored) ASD

Windward		Leeward	**Horiz Proj (psf)**
Max	Min		
7.8	0.0	-11.7	**11.70**

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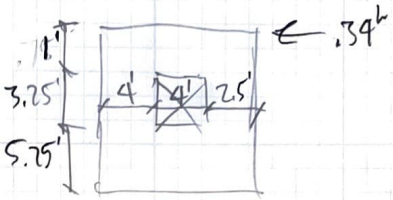
GARRETT - LATERAL DESIGN

LATERAL REVISIONS ARE MINIMAL. NEW MUDROOM REPLACING EXSTG MUDROOM. DESIGN EA. WALL OF MUDROOM TO SUPPORT ITSELF ON SOUTH WALL, NO CHANGES TO EAST WALLS, WEST WALL TO SUPPORT ITSELF AND NORTH WALL OF MUDROOM TO SUPPORT KITCHEN/MUD ROOM. MUDROOM $V_{eq} = .2^k$ MUDROOM/KITCHEN $V_{eq} = .58^k$

SOUTH WALL DESIGN: $V_{eq} = .2^k/2 = .1^k$

$V_w = .34^k$

FTAO:



SEE P. 5 – W6 WALLS W/ CS16 AND NO UPLIFT

WEST WALL DESIGN: $V_{eq} = .1^k$

$V_w = .7^k$

$L = 6'$

$v = 117^{psi}$ SW = W6 NO OT.

NORTH WALL DESIGN: $V_{eq} = .58^k/2 = .29^k$

$V_w = .93^k$

$L = 3'$ $L_{REDUCED} = 2.4'$

$v = 388^{psi}$ SW = W4 HD = 2.3k - DL = HDU2

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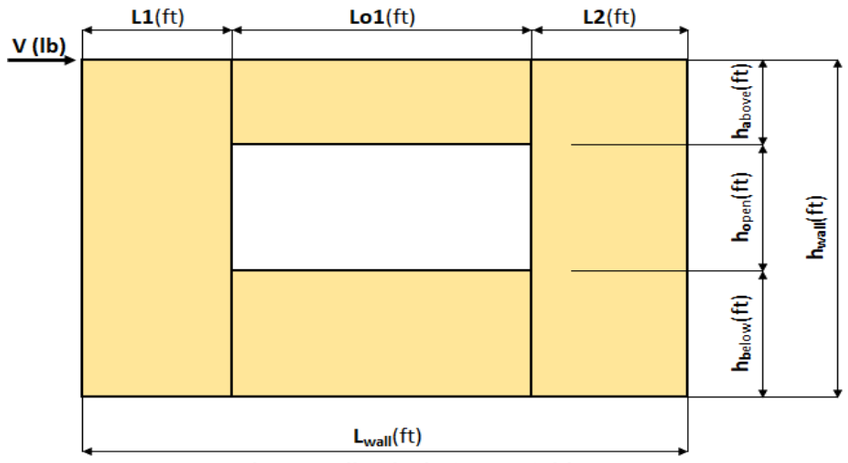
This version of the Force Transfer Around Openings calculator has expired.
Please go to **www.apawood.org** to download the latest version.

Project Information

Code:	
Designer:	BDM
Client:	A+D
Project:	Garrett
Wall Line:	

Date: 4/11/2025



Shear Wall Calculation Variables

V	340 lbf		Opening 1
L1	4.00 ft	h_a	1.00 ft
L2	2.50 ft	h_o	3.25 ft
h_{wall}	9.50 ft	h_b	5.25 ft
L_{wall}	10.50 ft	Lo1	4.00 ft

Adj. Factor Method = 1.25-0.125h/bs

Wall Pier Aspect Ratio		Adj. Factor
P1=h_o/L1=	0.81	N/A
P2=h_o/L2=	1.30	N/A

1. Hold-down forces: H = Vh_{wall}/L_{wall} 308 lbf

2. Unit shear above + below opening

First opening: va1 = vb1 = H/(h_a+h_b) = 49 plf

3. Total boundary force above + below openings

First opening: O1 = va1 x (Lo1) = 197 lbf

4. Corner forces

F1 = O1(L1)/(L1+L2) = 121 lbf
F2 = O1(L2)/(L1+L2) = 76 lbf

5. Tributary length of openings

T1 = (L1*Lo1)/(L1+L2) = 2.46 ft
T2 = (L2*Lo1)/(L1+L2) = 1.54 ft

6. Unit shear beside opening

v1 = (V/L)(L1+T1)/L1 = 52 plf
v2 = (V/L)(T2+L2)/L2 = 52 plf
Check v1*L1+v2*L2=V? 340 lbf **OK**

7. Resistance to corner forces

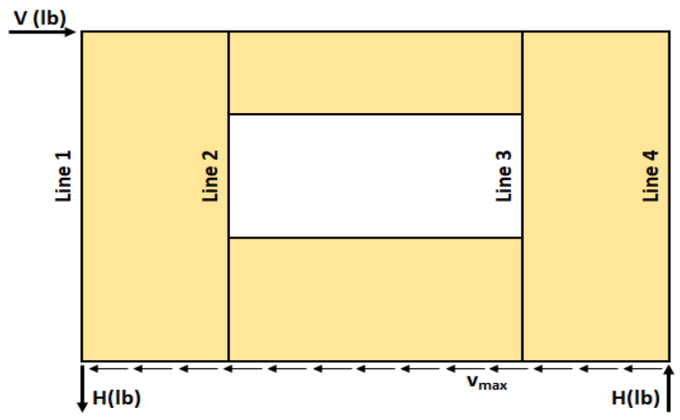
R1 = v1*L1 = 209 lbf
R2 = v2*L2 = 131 lbf

8. Difference corner force + resistance

R1-F1 = 88 lbf
R2-F2 = 55 lbf

9. Unit shear in corner zones

vc1 = (R1-F1)/L1 = 22 plf
vc2 = (R2-F2)/L2 = 22 plf



Check Summary of Shear Values for One Opening

Line 1: vc1(h_a+h_b)+v1(h_o)=H?		138	170	308 lbf
Line 2: va1(h_a+h_b)-vc1(h_a+h_b)-v1(h_o)=0?	308	138	170	0
Line 3: va1(h_a+h_b)-vc2(h_a+h_b)-v1(h_o)=0?	308	138	170	0
Line 4: vc2(h_a+h_b)+v2(h_o)=H?		138	170	308 lbf

Design Summary*

Req. Sheathing Capacity	52 plf	**4-Term Deflection**		**3-Term Deflection**	
Req. Strap Force	121 lbf	**4-Term Story Drift %**		**3-Term Story Drift %**	
Req. HD Force (H)	308 lbf				
Req. Shear Wall Anchorage Force (v_{max})	32 plf				

***The Design Summary assumes that the shear wall is designed as blocked.**

GRAVITY DESIGN

New Bm Between Kitchen and Mudroom

L = 10.5'
w = 400#
R = 2.1k
M = 5.51k-ft

f_b = 1.3ksi
f_v = 83psi
Δ_{TL} = .28" = L/452
4x10

alt: Fb = 1.28 ksi
Fv = 67 psi
defl = 0.35" = L/356
6x10

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STRUCTURAL ENGINEERING

PROJECT: GARRETT
DATE: 4/11/25
PROJ. #: 0223-2024-38
DESIGN: BDM
SHEET: 6