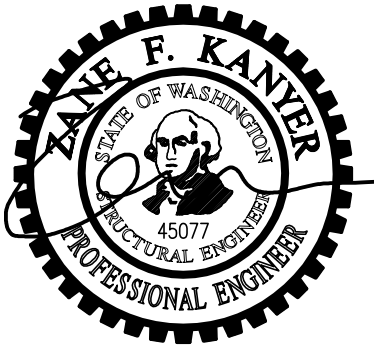
Supplemental Structural Calculations For:

Prior Residence

Mercer Island, WA



Prepared for: Richartz Studios
8212 SE 64th St
Mercer Island, WA 98040

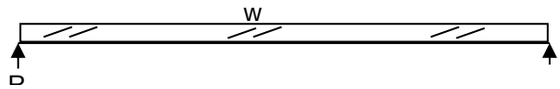
Job #: 00052-2021-05

Date: 5/25/2022

SSF STRUCTURAL ENGINEERING

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

Beam		B1		LVL	3 1/2 x 7 1/4	
w=	100	plf		R=	650	lbs
L=	13	ft		M=	2,113	ft-lbs
b=	3.50	in		Fb=	827	psi
d=	7.25	in		Fv=	35	psi
E=	1900	ksi		Δ=	0.30	in
Cv=	1.00	≤1.0		l /	513	



STRUCTURAL ENGINEERING

2124 Third Avenue . Suite 100 . Seattle . WA 98121
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Project: Prior

Post Permit Updates

Exteneded office joists

Date: 05/25/22

Project #:

Design: AGL

Sheet:

Force Transfer Around Openings Calculator

ONE OPENING

The force transfer around openings (FTAO) method of shear wall analysis is an approach that aims to reinforce the wall such that it performs as if there was no opening. This approach lends certain advantages over segmented shear walls: more versatility, because it allows for narrower wall segments while still meeting the height-to-width ratios and, often, fewer required hold-downs.

Project Information

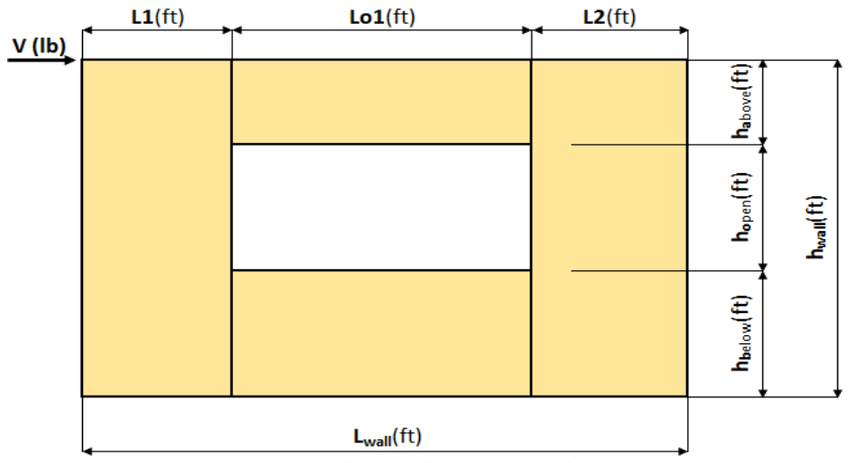
Code: **Date:**

Designer:

Client:

Project: Prior Bedroom Wall

Wall Line:



Shear Wall Calculation Variables

V	1400 lbf		Opening 1
L1	2.00 ft	h_a	2.00 ft
L2	2.00 ft	h_o	3.50 ft
h_{wall}	7.50 ft	h_b	2.00 ft
L_{wall}	6.50 ft	Lo1	2.50 ft

Adj. Factor Method =	2bs/h
Wall Pier Aspect Ratio	Adj. Factor
P1=h_o/L1= 1.75	N/A
P2=h_o/L2= 1.75	N/A

1. Hold-down forces: H = Vh_{wall}/L_{wall} 1615 lbf

2. Unit shear above + below opening

First opening: va1 = vb1 = H/(h_a+h_b) = 404 plf

3. Total boundary force above + below openings

First opening: O1 = va1 x (Lo1) = 1010 lbf

4. Corner forces

F1 = O1(L1)/(L1+L2) = 505 lbf

F2 = O1(L2)/(L1+L2) = 505 lbf

5. Tributary length of openings

T1 = (L1*Lo1)/(L1+L2) = 1.25 ft

T2 = (L2*Lo1)/(L1+L2) = 1.25 ft

6. Unit shear beside opening

v1 = (V/L)(L1+T1)/L1 = 350 plf

v2 = (V/L)(T2+L2)/L2 = 350 plf

Check v1*L1+v2*L2=V? 1400 lbf **OK**

7. Resistance to corner forces

R1 = v1*L1 = 700 lbf

R2 = v2*L2 = 700 lbf

8. Difference corner force + resistance

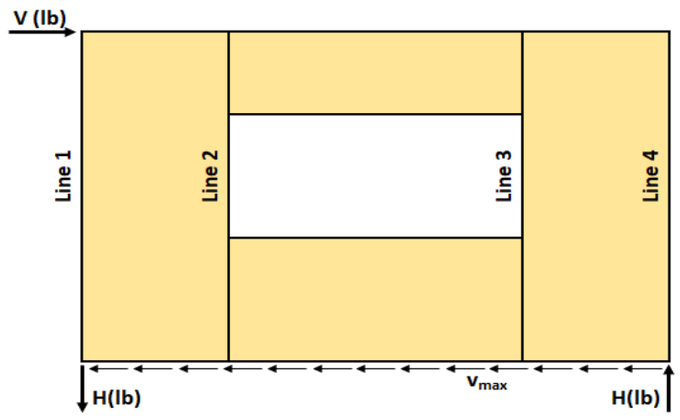
R1-F1 = 195 lbf

R2-F2 = 195 lbf

9. Unit shear in corner zones

vc1 = (R1-F1)/L1 = 98 plf

vc2 = (R2-F2)/L2 = 98 plf



Check Summary of Shear Values for One Opening

Line 1: vc1(h_a+h_b)+v1(h_o)=H?		390	1225	1615 lbf
Line 2: va1(h_a+h_b)-vc1(h_a+h_b)-v1(h_o)=0?	1615	390	1225	0
Line 3: va1(h_a+h_b)-vc2(h_a+h_b)-v1(h_o)=0?	1615	390	1225	0
Line 4: vc2(h_a+h_b)+v2(h_o)=H?		390	1225	1615 lbf

Design Summary*

Req. Sheathing Capacity	404 plf	**4-Term Deflection**	0.611 in.	**3-Term Deflection**	0.659 in.
Req. Strap Force	505 lbf	**4-Term Story Drift %**	0.027 %	**3-Term Story Drift %**	0.029 %
Req. HD Force (H)	1615 lbf				
Req. Shear Wall Anchorage Force (v_{max})	215 plf				

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

Project Information

Code: **Date:**

Designer:

Client:

Project: Prior Bedroom Wall

Wall Line:

Shear Wall Deflection Calculation Variables

Unfactored Shear Load $V_{unfactored}$: 1400 (lbf)

Sheathing Type: 15/32 OSB
Grade: APA Rated Sheathing

G_t Override:
G_a Override:

Wood End Post Values:
Species: Hem Fir
E: 1.30E+06 (psi)

	Qty	Stud Size	
Dimensions:	2	2x4	
A:	10.5		($in.^2$)
A Override:			($in.^2$)

Nail Type: 8d common (penny weight)

	Pier 1	Pier 2	
Nail Spacing:	3	3	(in.)
HD Capacity:	1760	1760	(lbf)
HD Deflection:	0.125	0.125	(in.)

Four-Term Equation Deflection Check

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a\frac{h}{b} \qquad \text{(Equation 23-2)}$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
$v_{unfactored}$:	350	350	350	350	(plf)
E:	1.30E+06	1.30E+06	1.30E+06	1.30E+06	(psi)
h:	7.50	5.50	5.50	7.50	(ft)
A:	10.5	10.5	10.5	10.5	($in.^2$)
G_t:	83,500	83,500	83,500	83,500	(lbf/in.)
Nail Spacing:	3	3	3	3	(in.)
V_n:	88	88	88	88	(plf)
e_n:	0.0033	0.0033	0.0033	0.0033	(in.)
b:	2.00	2.00	2.00	2.00	(ft)
HD Capacity:	1760	1760	1760	1760	(lbf)
HD Defl:	0.125	0.125	0.125	0.125	(in.)

Sheathing Type: 15/32 OSB APA Rated Sheathing

Nail Type: 8d common

Check Total Deflection of Wall System

Pier 1 (left)				Pier 1 (right)			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.043	0.031	0.019	0.699	0.017	0.023	0.014	0.376
		Sum	0.793			Sum	0.430
Pier 2 (left)				**Pier 2 (right)**			
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-1	Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 4 HD-2
0.017	0.023	0.014	0.376	0.043	0.031	0.019	0.699
		Sum	0.430			Sum	0.793

Total Defl.	
0.611	(in.)
0.0272	%drift

Project Information

Code: **Date:**

Designer:

Client:

Project: Prior Bedroom Wall

Wall Line:

Shear Wall Deflection Calculation Variables

Unfactored Shear Load $V_{unfactored}$: 1400 (lbf)

Wood End Post Values:

Sheathing Type: 15/32 OSB
Grade: APA Rated Sheathing

Species: Hem Fir
E: 1.30E+06 (psi)

Nail Type: 8d common (penny weight)

G_t Override:
G_a Override:

	Qty	Stud Size
Dimensions:	2	2x4
A:	10.5	(in.^{2})
A Override:		(in.^{2})

	Pier 1	Pier 2	
Nail Spacing:	3	3	(in.)
HD Capacity:	1760	1760	(lbf)
HD Deflection:	0.125	0.125	(in.)

Three-Term Equation Deflection Check

$$\delta_{sw} = \frac{8vh^3}{EAb} + \frac{vh}{1000G_a} + \frac{h\Delta_a}{b} \qquad (4.3\text{-}1)$$

	Pier 1-L	Pier 1-R	Pier 2-L	Pier 2-R	
$v_{unfactored}$:	350	350	350	350	(plf)
E:	1.30E+06	1.30E+06	1.30E+06	1.30E+06	(psi)
h:	7.50	5.50	5.50	7.50	(ft)
A:	10.5	10.5	10.5	10.5	(in.^{2})
G_a:	25.0	25.0	25.0	25.0	(kips/in.)
b:	2.00	2.00	2.00	2.00	(ft)
HD Capacity:	1760	1760	1760	1760	(lbf)
HD Defl:	0.125	0.125	0.125	0.125	(in.)

Sheathing Type: 15/32 OSB APA Rated Sheathing

Nail Type: 8d common

Check Total Deflection of Wall System

Pier 1 (left)			Pier 1 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.043	0.105	0.699	0.017	0.077	0.376
	Sum	0.847		Sum	0.470
Pier 2 (left)			Pier 2 (right)		
Term 1 Bending	Term 2 Shear	Term 3 Fastener	Term 1 Bending	Term 2 Shear	Term 3 Fastener
0.017	0.077	0.376	0.043	0.105	0.699
	Sum	0.470		Sum	0.847

Total Defl.	
0.659	(in.)
0.0293	%drift

Comment: The 3-term equation is calibrated to be approximately equal to 4-term equation at 1.4*ASD capacity.