

# Structural Calculations Cover Sheet

Project Number: 2022.059  
Project Name: Wai

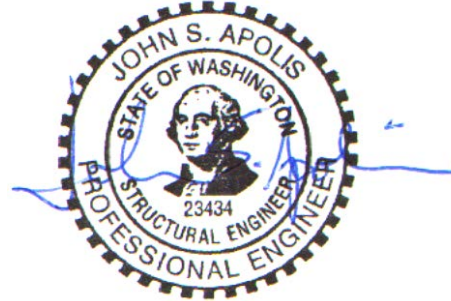
Date: July 14, 2023  
Architect: Shawn Sullivan

**Structural Design For:** Structural design for an addition and remodel

**Construction Type:** Conventional wood platform framing with conventional concrete foundations

## CODES

2018 International Building Code (IBC)  
2018 NDS  
ASCE 7-16



## LOADS

Dead Loads As required  
Floor Load 40 psf  
Roof Load 25 psf  
Wind 110 mph, Exposure C, Per ASCE 7-16 Section 28,  $K_{zt} = 1.0$   
Seismic Per ASCE 7-16 Section 12  
Peak Ground Accelerations (PGA) based on USGS Hazards Program 2003, by Lat/Lon.  
PGA 1 sec  $\approx .502$     PGA .2 sec = 1.453    %V = .149 \* DL

## Material Design Values

Soils (assumed) Minimum 1,500 psf allowed bearing (subject to field verification)  
Concrete  $f'_c=2,500$  psi; 5-1/2 sack mix, or alternate mix pre-approved by bldg. dept.  
Reinforcing Grade 60;  $F_y=60,000$  psi minimum  
Sawn Lumber Joists, Rafters: Hem-Fir #2 and better  
Beams, Posts: DF-L #2  
Studs & Plates: Hem-Fir Standard  
Glu-Lam Beams 24F-V4 for simple span beams, 24F-V8 for cantilevered beams  
Parallam Beams 2.2E PSL,  $F_b=2,900$  psi,  $F_v=290$  psi,  $E=2.2 \times 10^6$  psi (minimum)  
Microllam Beams 1.9E LVL,  $F_b=2,600$  psi,  $F_v=285$  psi,  $E=1.9 \times 10^6$  psi (minimum)  
Timberstrand Bms 1.7E LSL,  $F_b=2,600$  psi,  $F_v=400$  psi,  $E=1.7 \times 10^6$  psi (minimum)  
Anchor Bolts F1554 Anchor Bolts, A307 other bolts

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CSES, Inc.

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Architect:

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**BEAM DESIGN (Uniform Load+Concentrated Load)**

2018 International Building Code (IBC)

2018 NDS

Beam Description: SOUTH DECK BEAM

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	18.5 ft	Tributary Width:	3 ft	P Location:	18.5 ft
Add'l uniform DL:		DL unit load:	12 psf	Concentrated DL:	
Add'l uniform LL:		LL unit load:	60 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	333 lbs	DL Reaction 2:	333 lbs	Note: Design automatically uses ASD load combinations
LL Reaction 1:	1665 lbs	LL Reaction 2:	1665 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	1998 lbs	Total Reaction 2:	1998 lbs	

**Material Properties:**

E	1.8 msi	E'	1.8 msi
Fb	2400 psi	Fb'	2400 psi
Fv	265 psi	Fv'	265 psi
Fc perp	650 psi	Fc perp'	650 psi
Emin	0.95 msi	Emin'	0.95 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/		240	
For LL only: Allowed deflection criteria, span/		360	
Max. allowed total defl:	0.93 in	Max LL defl:	0.62 in
Total defl. * I:	316.26 in <sup>4</sup>	Required I:	341.91 in <sup>4</sup>
LL defl. * I:	263.55 in <sup>4</sup>	Required I:	427.38 in <sup>4</sup>
Actual deflections:	TOTAL: 0.63 in		0.52 in

**Force analysis:**

Max. moment:	9241 ft-lb	Max Shear:	1998 lbs
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**Selected Member: (1) GLB 3.5 x 12**

<b>Member properties:</b>	<b>Provided:</b>	<b>Required:</b>
Moment of inertia:	504. in <sup>4</sup>	427.38 in <sup>4</sup>
Section Modulus:	84. in <sup>3</sup>	46.2 in <sup>3</sup>
Section Area:	42. in <sup>2</sup>	11.31 in <sup>2</sup>
Bearing Area:		3.07 in <sup>2</sup>
Minimum bearing dimensions:	3.5 in x	0.88 in

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**BEAM DESIGN (Uniform Load+Concentrated Load)**

2018 International Building Code (IBC)

2018 NDS

Beam Description: *BEAM SUPPORTING ENTRY*

Fully Supported:	1	Snow Load:	1	Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	9.5 ft	Tributary Width:	3 ft	P Location:	9.5 ft
Add'l uniform DL:		DL unit load:	25 psf	Concentrated DL:	
Add'l uniform LL:		LL unit load:	60 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:	25 psf	Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	356 lbs	DL Reaction 2:	356 lbs	Note: Design automatically uses ASD load combinations
LL Reaction 1:	855 lbs	LL Reaction 2:	855 lbs	
SL Reaction 1:	356 lbs	SL Reaction 2:	356 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	1265 lbs	Total Reaction 2:	1265 lbs	

**Material Properties:**

E	1.6 msi	E'	1.6 msi
Fb	900 psi	Fb'	1242 psi
Fv	180 psi	Fv'	207 psi
Fc perp	625 psi	Fc perp'	625 psi
Emin	0.58 msi	Emin'	0.58 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/		240	
For LL only: Allowed deflection criteria, span/		360	
Max. allowed total defl:	0.48 in	Max LL defl:	0.32 in
Total defl. * I:	37.8 in^4	Required I:	79.58 in^4
LL defl. * I:	29.21 in^4	Required I:	92.23 in^4
Actual deflections:	TOTAL: 0.16 in		0.13 in

**Force analysis:**

Max. moment:	3004 ft-lb	Max Shear:	1265 lbs
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**Selected Member: (1) DF #2 3.5 x 9.25**

*(MIN. REQUIRED, UPGRADE MAY BE PROVIDED)*

<b>Member properties:</b>	<b>Provided:</b>	<b>Required:</b>
Moment of inertia:	230.84 in^4	92.23 in^4
Section Modulus:	49.91 in^3	29.02 in^3
Section Area:	32.38 in^2	9.16 in^2
Bearing Area:		2.02 in^2
Minimum bearing dimensions:	3.5 in x	0.58 in

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Architect:

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**BEAM DESIGN (Uniform Load+Concentrated Load)**

2018 International Building Code (IBC)

2018 NDS

Beam Description: *CENTRAL BEAM LINE LONGEST SPAN*

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:	1	Wet Use:	

**Geometry and Loads:**

Span:	9 ft	Tributary Width:	4.5 ft	P Location:	9 ft
Add'l uniform DL:		DL unit load:	12 psf	Concentrated DL:	
Add'l uniform LL:		LL unit load:	60 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	243 lbs	DL Reaction 2:	243 lbs	Note: Design automatically uses ASD load combinations
LL Reaction 1:	1215 lbs	LL Reaction 2:	1215 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	1458 lbs	Total Reaction 2:	1458 lbs	

**Material Properties:**

E	1.6 msi	E'	1.52 msi
Fb	900 psi	Fb'	864 psi
Fv	180 psi	Fv'	144 psi
Fc perp	625 psi	Fc perp'	625 psi
Emin	0.58 msi	Emin'	0.551 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/		240	
For LL only: Allowed deflection criteria, span/		360	
Max. allowed total defl:	0.45 in	Max LL defl:	0.3 in
Total defl. * I:	31.47 in^4	Required I:	69.93 in^4
LL defl. * I:	26.22 in^4	Required I:	87.41 in^4
Actual deflections:	TOTAL: 0.14 in		0.11 in

**Force analysis:**

Max. moment:	3281 ft-lb	Max Shear:	1458 lbs
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**Selected Member: (1) DF #2 3.5 x 9.25**

<b>Member properties:</b>	<b>Provided:</b>	<b>Required:</b>
Moment of inertia:	230.84 in^4	87.41 in^4
Section Modulus:	49.91 in^3	45.56 in^3
Section Area:	32.38 in^2	15.19 in^2
Bearing Area:		2.33 in^2
Minimum bearing dimensions:	3.5 in x	0.67 in

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**BEAM DESIGN (Uniform Load+Concentrated Load)**

2018 International Building Code (IBC)

2018 NDS

Beam Description: *NEW HEADER*

Fully Supported:	1	Snow Load:		Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	7.5 ft	Tributary Width:	7 ft	P Location:	7.5 ft
Add'l uniform DL:	30 lbs/ft	DL unit load:	15 psf	Concentrated DL:	
Add'l uniform LL:	150 lbs/ft	LL unit load:	40 psf	Concentrated LL:	
Add'l uniform SL:		SL unit load:		Concentrated SL:	
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	506 lbs	DL Reaction 2:	506 lbs	Note: Design automatically uses ASD load combinations
LL Reaction 1:	1613 lbs	LL Reaction 2:	1613 lbs	
SL Reaction 1:	0 lbs	SL Reaction 2:	0 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	2119 lbs	Total Reaction 2:	2119 lbs	

**Material Properties:**

E	1.8 msi	E'	1.8 msi
Fb	2400 psi	Fb'	2400 psi
Fv	265 psi	Fv'	265 psi
Fc perp	650 psi	Fc perp'	650 psi
Emin	0.95 msi	Emin'	0.95 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/	240		
For LL only: Allowed deflection criteria, span/	480		
Max. allowed total defl:	0.38 in	Max LL defl:	0.19 in
Total defl. * I:	22.35 in^4	Required I:	59.59 in^4
LL defl. * I:	17.01 in^4	Required I:	90.7 in^4
Actual deflections: TOTAL:	0.18 in		0.14 in

**Force analysis:**

Max. moment:	3973 ft-lb	Max Shear:	2119 lbs
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**Selected Member: (1) GLB 3.5 x 7.5**

<b>Member properties:</b>	<b>Provided:</b>	<b>Required:</b>
Moment of inertia:	123.05 in^4	90.7 in^4
Section Modulus:	32.81 in^3	19.86 in^3
Section Area:	26.25 in^2	11.99 in^2
Bearing Area:		3.26 in^2
Minimum bearing dimensions:	3.5 in x	0.93 in

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 Date: 3-Feb-23  
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**BEAM DESIGN (Uniform Load+Concentrated Load)**

2018 International Building Code (IBC) 2018 NDS

**Beam Description:** NEW GARAGE DOOR HEADER

Fully Supported:	1	Snow Load:	1	Wind Load:	
Repetitive Member:		P.T. Lumber:		Wet Use:	

**Geometry and Loads:**

Span:	19.5 ft	Tributary Width:	2 ft	P Location:	10 ft
Add'l uniform DL:		DL unit load:	30 psf	Concentrated DL:	2340 lbs
Add'l uniform LL:		LL unit load:	40 psf	Concentrated LL:	3120 lbs
Add'l uniform SL:		SL unit load:	25 psf	Concentrated SL:	1950 lbs
Add'l uniform WL:		WL unit load:		Concentrated WL:	

DL Reaction 1:	1785 lbs	DL Reaction 2:	1725 lbs	Note: Design automatically uses ASD load combinations
LL Reaction 1:	2380 lbs	LL Reaction 2:	2300 lbs	
SL Reaction 1:	1488 lbs	SL Reaction 2:	1438 lbs	
WL Reaction 1:	0 lbs	WL Reaction 2:	0 lbs	
Total Reaction 1:	4686 lbs	Total Reaction 2:	4528 lbs	

**Material Properties:**

E	1.8 msi	E'	1.8 msi
Fb	2400 psi	Fb'	2700 psi
Fv	265 psi	Fv'	305 psi
Fc perp	650 psi	Fc perp'	650 psi
Emin	0.95 msi	Emin'	0.95 msi

**Deflection analysis:**

For total load: Allowed deflection criteria, span/	240		
For LL only: Allowed deflection criteria, span/	360		
Max. allowed total defl:	0.98 in	Max LL defl:	0.65 in
Total defl. * I:	1441.33 in <sup>4</sup>	Required I:	1478.28 in <sup>4</sup>
LL defl. * I:	986.17 in <sup>4</sup>	Required I:	1517.18 in <sup>4</sup>
Actual deflections: TOTAL:	0.93 in		0.64 in

**Force analysis:**

Max. moment:	37406 ft-lb	Max Shear:	4686 lbs
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**Selected Member:** (1) GLB 5.5 x 15

<b>Member properties:</b>	<b>Provided:</b>	<b>Required:</b>
Moment of inertia:	1546.88 in <sup>4</sup>	1517.18 in <sup>4</sup>
Section Modulus:	206.25 in <sup>3</sup>	166.25 in <sup>3</sup>
Section Area:	82.5 in <sup>2</sup>	23.06 in <sup>2</sup>
Bearing Area:		7.21 in <sup>2</sup>
Minimum bearing dimensions:	5.5 in x	1.31 in

STEEL ALTERNATIVE:  $I_{min} = 96 in^4 < 98 in^4$  W8x28  
 $M_{cap} = 44 k-ft > 37 k-ft$  OK

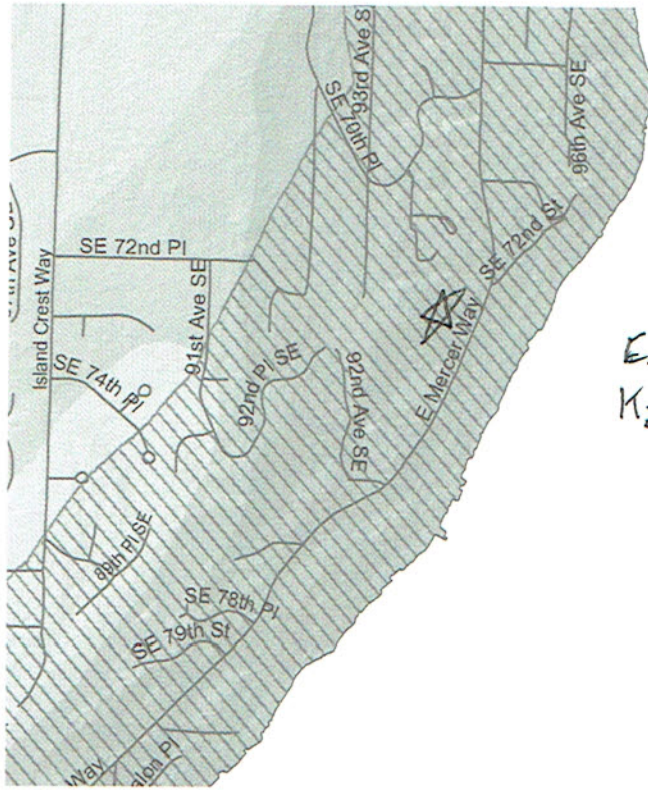
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Latitude, Longitude: 47.53745139999999, -122.2131888



<b>Date</b>	5/19/2022, 11:39:20 AM
<b>Design Code Reference Document</b>	ASCE7-16
<b>Risk Category</b>	II
<b>Site Class</b>	D - Default (See Section 11.4.3)

Type	Value	Description
$S_S$	1.453	$MCE_R$ ground motion. (for 0.2 second period)
$S_1$	0.502	$MCE_R$ ground motion. (for 1.0s period)
$S_{MS}$	1.743	Site-modified spectral acceleration value
$S_{M1}$	null -See Section 11.4.8	Site-modified spectral acceleration value
$S_{DS}$	1.162	Numeric seismic design value at 0.2 second SA
$S_{D1}$	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA



Exp. C  
 $K_{zt} = 1.0$



**Lateral Loads Design per ASCE 7-16, Wind: Section 28 Seismic: Section 12**

**(Simplified Envelope Procedure Part 2)**

2018 International Building Code (IBC)

**WIND LOADS** 110 mph Basic Wind Speed 2015 NDS  
 $P_s = \lambda * K_{zt} * P_s(30) * 0.6$  Exposure **C** Roof Slope: **4.00** : 12 = 18.4  
 Least Horizontal Dimension, feet: **50** Mean Roof Ht, feet: **23** (degrees)  
 $\lambda = 1.33$   $a = 5.0$  ft,  $2a = 10.0$  ft  
 $I_w = 1.00$   $K_{zT} = 1.00$

<u>Tabulated Ps(30):</u> (Refer to ASCE 7-16, Figure 28.6-1)	<u>Zone</u>	<u>Tabulated Wind Pressure</u>	<u>Calc'd Design Pressure</u> (*lambda*KzT*0.6)	<u>Min Design Pressure</u>	(Per section 28.6.4 minimum wind pressure is 16 PSF for zones A,C, and 8 PSF for zones B, D)
(horizontal)	A	25.8	psf 20.5	20.5	
"	B	-7.3	psf -5.8	6.4	
"	C	17.2	psf 13.7	13.7	
"	D	-4.1	psf -3.3	6.4	
(vertical)	E	-23.1	psf -18.4		
"	F	-15.7	psf -12.5		
"	G	-16.0	psf -12.7		
"	H	-12.0	psf -9.5		
(uplift on overhangs)	E(oh)	-32.3	psf -25.7		
"	G(oh)	-25.3	psf -20.1		

**(Equivalent Lateral Force Procedure, Section 12.8)**

**SEISMIC LOADS**  $I_e = 1.0$   $R = 6.5$  ASCE 7-16, Table 12.2.1  
 Seismic Parameters Group I Site Class: **D**  
 per ASCE 7-16)  $PGA (.2 \text{ sec}) = 1.453$   $F_a = 1.00$  ASCE 7-16 Table 11.4-1  
 $PGA (1 \text{ sec}) = 0.502$   $F_v = 1.50$  ASCE 7-16 Table 11.4-2

**Seismic Design Categories per ASCE 7-16 Tables 11.6-1, 11.6-2**

Based on  $S_d$ s: **D** Based on  $S_{d1}$ : **D**

PGA's based on peak ground accelerations per latest USGS Hazards Program (based on lat/lon).

$S_s = 1.4530$   $S_{ms} = F_a * S_s = 1.45$  Equation 11.4-1  
 $S_1 = 0.5020$   $S_{m1} = F_v * S_1 = 0.75$  Equation 11.4-2

Equations 11.4-3, 11.4-4  $S_d = 2/3 * S_{ms} = 0.97$   $S_{d1} = 2/3 * S_{m1} = 0.50$   
 Equation 12.14-11  $C_s \text{ (or \%V)} = (S_d / (R/I)) = 0.149$  **Building period < 0.5 s per IBC eq 12.8-7**

**Base Shear = %V \* W \* 0.7 = 4.38 psf**, uniformly distributed over floor area  
 (0.7 reduction factor per ASCE 7-16, Section 2.4.1, Eq 5 (seismic vertical distribution per IBC eqs 12.8-11 & 12)

	<u>Roof or Floor DL (psf)</u>	<u>Wall DL (psf)</u>	<u>Story Height Above Base (ft)</u>	<u>Lateral Load (psf)</u>
Base = top of foundation				
Top Framing	12	6	17	2.57
Main Floor	12	12	9	1.81
				0.00
<b>Total Seismic DL:</b>	<b>42</b>		Sum	<b>4.38</b>

SHEAR WALL DESIGN - EAST WALL - LOWER FLOOR - L = 5' + 21.5'

$$P_w = 10' \times 15.5' \times 20.5 \text{ pcf} + 8' \times 16.5' \times 13.7 \text{ pcf} = \underline{4,986\#}$$

$$P_e = 10' \times 50' \times (2.57 + 1.81) \text{ pcf} = 3,942\#$$

$$V = \frac{4,986\#}{230 \text{ pcf}} = 21.6' \text{ MIN.} \quad 26.5' \text{ PROVIDED} \quad \underline{\text{SWI OK}}$$

$$\text{UPLIFT} = 8' \times \frac{4,986\#}{26.5'} = 1,505\# < 4,065\# \quad \underline{\text{HOU5}}$$

**CONSULTING STRUCTURAL ENGINEERING SERVICES**

Residential and Commercial Structural Design

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Phone: (206)527-1288 Email: john@cses-engineering.com

Project No. 2022059 Date 7/14/2023

Project Name WAI

Comments \_\_\_\_\_

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