Structural Calculations Cover Sheet

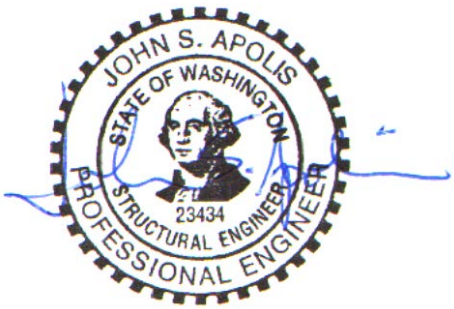
Project Number: 2022.059
Project Name: Wai

Date: October 2, 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, Kzt = 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 = .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; Fy=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, Fb=2,900 psi, Fv=290 psi, E=2.2*10^6 psi (minimum)	
Microllam Beams	1.9E LVL, Fb=2,600 psi, Fv=285 psi, E=1.9*10^6 psi (minimum)	
Timberstrand Bms	1.7E LSL, Fb=2,600 psi, Fv=400 psi, E=1.7*10^6 psi (minimum)	
Anchor Bolts	F1554 Anchor Bolts, A307 other bolts	

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Structural Engineering Consulting and Design

John S. Apolis, P.E.	**CSES, Inc.**	Job number:	**2022.059**
Project:	**Wai**	Date:	7-Jul-23
Architect:		Page number:	U1

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
LL Reaction 1:	1665 lbs	LL Reaction 2:	1665 lbs	ASD load combinations
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^4	Required I:	341.91 in^4
LL defl. * I:	263.55 in^4	Required I:	427.38 in^4
Actual deflections:	TOTAL: 0.63 in		0.52 in

Force analysis:

Max. moment:	9241 ft-lb	Max Shear:	1998 lbs

Selected Member: (1) GLB 3.5 x 12

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

John S. Apolis, P.E.	**CSES, Inc.**	Job number:	**2022.059**
Project:	**Wai**	Date:	7-Jul-23
Architect:		Page number:	U2

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
LL Reaction 1:	855 lbs	LL Reaction 2:	855 lbs	ASD load combinations
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

Selected Member:	(1) DF #2	3.5	x	9.25

(MIN. REQUIRED, UPGRADE MAY BE PROVIDED)

Member properties:	**Provided:**		**Required:**
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

John S. Apolis, P.E. **CSES, Inc.** Job number: **2022.059**

Project: **Wai** Date: 10-Jul-23

Architect: Page number: M 1

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
LL Reaction 1:	1215 lbs	LL Reaction 2:	1215 lbs	ASD load combinations
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

Selected Member:	(1) DF #2	**3.5**	**x**	**9.25**

Member properties:	**Provided:**		**Required:**
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

John S. Apolis, P.E.	**CSES, Inc.**	Job number:	**2022.059**
Project:	**Wai**	Date:	14-Jul-23
Architect:		Page number:	U3

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
LL Reaction 1:	1613 lbs	LL Reaction 2:	1613 lbs	ASD load combinations
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

Selected Member:	(1) GLB	**3.5**	**x**	**7.5**

Member properties:	**Provided:**		**Required:**
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

John S. Apolis, P.E. **CSES, Inc.** Job number: **2022.059**

Project: **Wai** Date: 3-Feb-23

Architect: Page number: G1

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
LL Reaction 1:	2380 lbs	LL Reaction 2:	2300 lbs	ASD load combinations
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^4	Required I:	1478.28 in^4
LL defl. * I:	986.17 in^4	Required I:	1517.18 in^4
Actual deflections:	TOTAL: 0.93 in		0.64 in

Force analysis:

Max. moment:	37406 ft-lb	Max Shear:	4686 lbs

Selected Member:	(1) GLB	**5.5**	**x**	**15**

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

STEEL ALTERNATIVE: $I_{MIN} = 96\ in^4 < 98\ in^4$ W8x28

$M_{CAP} = 44^{k\text{-}ft} > 37^{k\text{-}ft}$ OK

FOOTING DESIGN:

U1 $\frac{1998^{\#} \times 2}{1500 psf} = 384 in^2 < 24 in \times 24 in = 576 in^2$ ✓OK

PIPE PILE CAPACITY $= 3 \times [6000^{\#} \times 5/(5^2+12^2)^{1/2}] = 17,651^{\#}$

$1998^{\#} \times 2 = 3996^{\#} < 17,651^{\#}$ ✓OK

USE 24"x24"x12" DEEP FOOTINGS W/(3) #4 EACH WAY, SUPPORTED BY PIPE PILES PER DETAIL P1.

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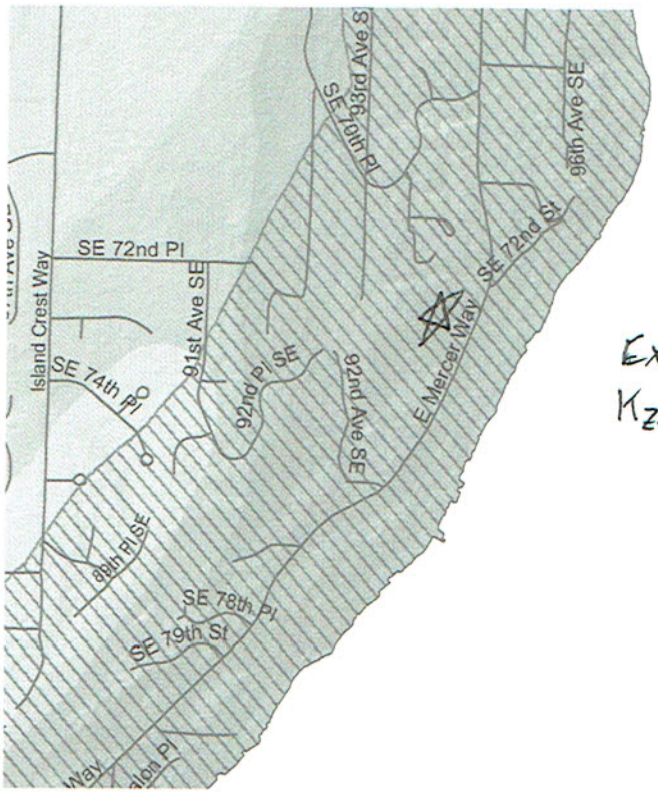
Project No. 2022-059 Date 10/2/23
Project Name CAMPBELL
Comments
Revision Page F1

7235 E Mercer Way, Mercer Island, WA 98040, USA

Latitude, Longitude: 47.53745139999999, -122.2131888

Date	5/19/2022, 11:39:20 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	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


SE 72nd Pl
Island Crest Way
SE 74th Pl
91st Ave SE
92nd Pl SE
92nd Ave SE
E Mercer Way
SE 72nd St
96th Ave SE
SE 78th Pl
SE 79th St

Exp. C
$K_{zt} = 1.0$

John S. Apolis, P.E.	**CSES, Inc.**	Job number:	**2022.059**	
Project:	**Wai**	Date:	19-May-22	
Designer:	**Shawn Sullivan**	Page number:	**L 1**	

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

Ps = lambda * Kzt * Ps(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

Iw = 1.00 KzT = **1.00**

Tabulated Ps(30): (Refer to ASCE 7-16, Figure 28.6-1)	Zone	**Tabulated Wind Pressure**		**Calc'd Design Pressure** (*lambda*KzT*0.6)	**Min Design Pressure**
(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**	

(Per section 28.6.4 minimum wind pressure is 16 PSF for zones A,C, and 8 PSF for zones B, D)

(Equivalent Lateral Force Procedure, Section 12.8)

SEISMIC LOADS Ie 1.0 R = 6.5 ASCE 7-16, Table 12.2.1

Seismic Parameters per ASCE 7-16) Group I Site Class: **D**

PGA (.2 sec) 1.453 Fa = 1.00 ASCE 7-16 Table 11.4-1

PGA (1 sec) 0.502 Fv = 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 Sds: **D** Based on Sd1: **D**

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

Ss = 1.4530 Sms = Fa * Ss = 1.45 Equation 11.4-1

S1 = 0.5020 Sm1 = Fv * S1 = 0.75 Equation 11.4-2

Equations 11.4-3, 11.4-4 Sds = 2/3 * Sms = 0.97 Sd1 = 2/3 * Sm1 = 0.50

Equation 12.14-11 Cs (or %V) = (Sds / (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)

Base = top of foundation	**Roof or Floor DL (psf)**	**Wall DL (psf) dist. over floor area**	**Story Height Above Base (ft)**		**Lateral Load (psf)**
Top Framing	**12**	**6**	**17**		**2.57**
Main Floor	**12**	**12**	**9**		**1.81**
					0.00
Total Seismic DL:	**42**			Sum	**4.38**

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

$P_W = 10' \times 15.5' \times 20.5\,psf + 8' \times 16.5' \times 13.7\,psf = 4{,}986\#$

$P_E = 18' \times 50' \times (2.57 + 1.81)\,psf = 3{,}942\#$

$V = \frac{4{,}986\#}{230\,plf} = 21.6'$ MIN. 26.5' PROVIDED SW1 OK

UPLIFT $= 8' \times \frac{4{,}986\#}{26.5'} = 1{,}505\# < 4{,}065\#$ HDU5

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Project No. 2022.059 Date 7/14/2023
Project Name W/A1
Comments
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