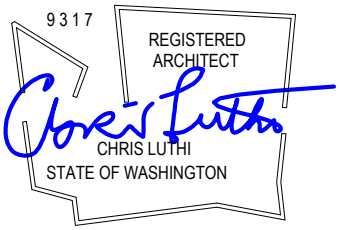
Ahrenholz Addition

Engineering Calculations
9204 SE 60th St. Mercer Island WA



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12.05.22

WoodWorks® SOFTWARE FOR WOOD DESIGN	COMPANY	PROJECT
	Nov. 10, 2022 13:48	Beam1.wwb

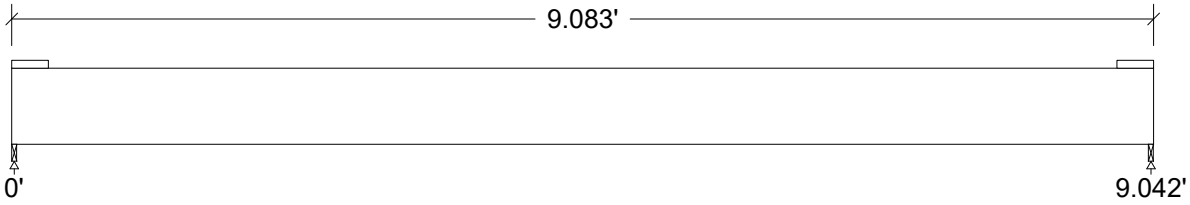
Design Check Calculation Sheet

WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
1	Dead	Full UDL				75.0		plf
2	Roof live	Full UDL				125.0		plf
Self-weight	Dead	Full UDL				6.0		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:			
Dead	368		368
Roof Live	568		568
Factored:			
Total	936		936
Bearing:			
Capacity			
Beam	1094		1094
Support	1211		1211
Des ratio			
Beam	0.86		0.86
Support	0.77		0.77
Load comb	#2		#2
Length	0.50*		0.50*
Min req'd	0.50*		0.50*
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.11		1.11
Fcp sup	625		625

*Minimum bearing length setting used: 1/2" for end supports

Lumber-soft, D.Fir-L, No.2, 4x8 (3-1/2"x7-1/4")

Supports: All - Timber-soft Beam, D.Fir-L No.2

Total length: 9.06'; Clear span: 9.0'; Volume = 1.6 cu.ft.

Lateral support: top = at supports, bottom = at supports;

This section PASSES the design code check.

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 47	Fv' = 180	psi	fv/Fv' = 0.26
Bending(+)	fb = 824	Fb' = 1156	psi	fb/Fb' = 0.71
Live Defl'n	0.11 = < L/999	0.30 = L/360	in	0.35
Total Defl'n	0.21 = L/520	0.45 = L/240	in	0.46

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	180	1.00	1.00	1.00	-	-	-	-	1.00	1.00	2
Fb'+	900	1.00	1.00	1.00	0.988	1.300	-	1.00	1.00	1.00	2
Fcp'	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-
E'	1.6 million	1.00	1.00	1.00	-	-	-	-	1.00	1.00	2
Emin'	0.58 million	1.00	1.00	1.00	-	-	-	-	1.00	1.00	2

CRITICAL LOAD COMBINATIONS:

```
 Shear     : LC #2  = D + Lr
 Bending(+): LC #2  = D + Lr
 Deflection: LC #2  = D + Lr  (live)
             LC #2  = D + Lr  (total)
 Bearing   : Support 1 - LC #2 = D + Lr
             Support 2 - LC #2 = D + Lr
 D=dead Lr=roof live
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```

CALCULATIONS:

```
 V max = 931, V design = 803 lbs; M(+) = 2105 lbs-ft
   EIy = 177.83 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 1.5 dead + "live"
 Lateral stability(+):  Lu = 9.06'  Le = 16.63'  RB = 10.9
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.

WoodWorks® SOFTWARE FOR WOOD DESIGN	COMPANY	PROJECT
	Nov. 10, 2022 13:51	Beam2.wwb

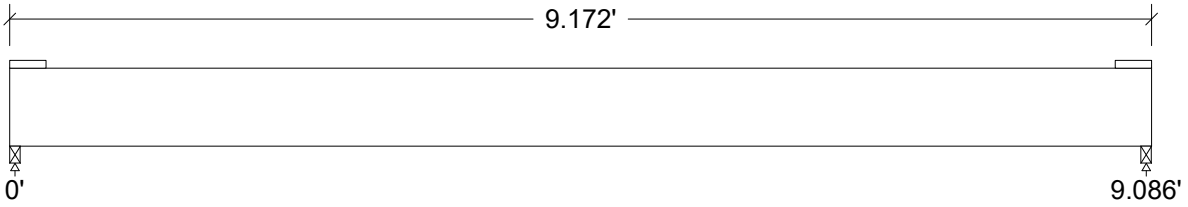
Design Check Calculation Sheet

WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
1	Dead	Full UDL				75.0		plf
2	Roof live	Full UDL				125.0		plf
3	Live	Full UDL				300.0		plf
4	Dead	Full UDL				113.0		plf
Self-weight	Dead	Full UDL				6.0		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:			
Dead	890		890
Live	1376		1376
Roof Live	573		573
Factored:			
Total	2352		2352
Bearing:			
Capacity			
Beam	2352		2352
Support	2503		2503
Des ratio			
Beam	1.00		1.00
Support	0.94		0.94
Load comb	#3		#3
Length	1.03		1.03
Min req'd	1.03		1.03
Cb	1.00		1.00
Cb min	1.00		1.00
Cb support	1.11		1.11
Fcp sup	625		625

Glulam-Balanced, West Species, 24F-1.8E WS, 3-1/2"x7-1/2"

Supports: All - Timber-soft Beam, D.Fir-L No.2

Total length: 9.19'; Clear span: 9'; Volume = 1.7 cu.ft.; 5 laminations, 3-1/2" maximum width,

Lateral support: top = at supports, bottom = at supports;

This section PASSES the design code check.

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 114	Fv' = 265	psi	fv/Fv' = 0.43
Bending(+)	fb = 1935	Fb' = 2353	psi	fb/Fb' = 0.82
Live Defl'n	0.22 = L/493	0.30 = L/360	in	0.73
Total Defl'n	0.42 = L/258	0.45 = L/240	in	0.93

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CV	Cfu	Cr	Cfrt	Notes	Cvr	LC#
Fv'	265	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	3
Fb'+	2400	1.00	1.00	1.00	0.981	1.000	-	-	1.00	1.00	-	3
Fcp'	650	-	1.00	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 million	1.00	1.00	1.00	-	-	-	-	1.00	-	-	3
Eminy'	0.85 million	1.00	1.00	1.00	-	-	-	-	1.00	-	-	3

CRITICAL LOAD COMBINATIONS:

```
 Shear     : LC #3  = D + 0.75(L + Lr)
 Bending(+): LC #3  = D + 0.75(L + Lr)
 Deflection: LC #3  = D + 0.75(L + Lr)  (live)
             LC #3  = D + 0.75(L + Lr)  (total)
 Bearing   : Support 1 - LC #3 = D + 0.75(L + Lr)
             Support 2 - LC #3 = D + 0.75(L + Lr)
 D=dead L=live Lr=roof live
 All LC's are listed in the Analysis output
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```

CALCULATIONS:

```
 V max = 2330, V design = 1987 lbs; M(+) = 5292 lbs-ft
   EIy = 221.48 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 1.5 dead + "live"
 Lateral stability(+):  Lu = 9.06'  Le = 16.69'  RB = 11.1
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Glulam design values are for materials conforming to ANSI 117-2015 and manufactured in accordance with ANSI A190.1-2012
4. GLULAM: bxd = actual breadth x actual depth.
5. Glulam Beams shall be laterally supported according to the provisions of NDS Clause 3.3.3.
6. GLULAM: bearing length based on smaller of Fcp(tension), Fcp(comp'n).

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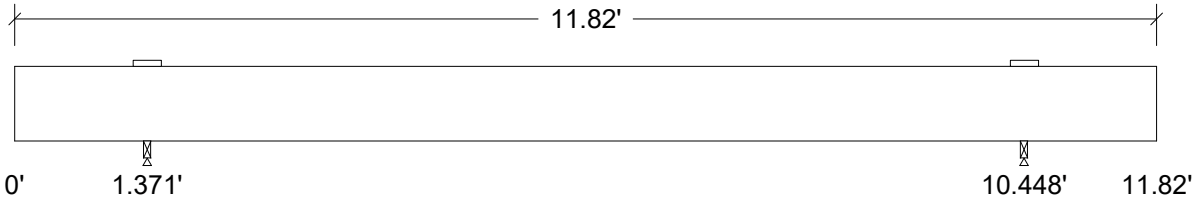
Design Check Calculation Sheet

WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
1	Dead	Full UDL	No			60.0		plf
2	Live	Full UDL	Yes			240.0		plf
Self-weight	Dead	Full UDL	No			6.7		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:				
Dead		394		394
Live		1443		1443
Factored:				
Total		1837		1837
Bearing:				
Capacity				
Beam		1837		1837
Support		2231		2231
Des ratio				
Beam		1.00		1.00
Support		0.82		0.82
Load comb		#5		#8
Length		0.92		0.92
Min req'd		0.92		0.92
Cb		1.41		1.41
Cb min		1.41		1.41
Cb support		1.11		1.11
Fcp sup		625		625

Lumber-soft, Hem-Fir, No.2, 4x10 (3-1/2"x9-1/4")

Supports: All - Timber-soft Beam, D.Fir-L No.2

Total length: 11.81'; Clear span: 1.313', 9.0', 1.313'; Volume = 2.7 cu.ft.

Lateral support: top = at supports, bottom = at supports;

This section PASSES the design code check.

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 54	Fv' = 150	psi	fv/Fv' = 0.36
Bending(+)	fb = 744	Fb' = 1003	psi	fb/Fb' = 0.74
Bending(-)	fb = 69	Fb' = 1018	psi	fb/Fb' = 0.07
Deflection:				
Interior Live	0.12 = L/891	0.30 = L/360	in	0.40
Total	0.17 = L/650	0.45 = L/240	in	0.37
Cantil. Live	-0.06 = L/278	0.09 = L/180	in	0.65
Total	-0.08 = L/205	0.14 = L/120	in	0.58

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	150	1.00	1.00	1.00	-	-	-	-	1.00	1.00	5
Fb'+	850	1.00	1.00	1.00	0.984	1.200	-	1.00	1.00	1.00	4
Fb'-	850	1.00	1.00	1.00	0.998	1.200	-	1.00	1.00	1.00	2
Fcp'	405	-	1.00	1.00	-	-	-	-	1.00	1.00	-
E'	1.3 million	1.00	1.00	1.00	-	-	-	-	1.00	1.00	4
Emin'	0.47 million	1.00	1.00	1.00	-	-	-	-	1.00	1.00	4

CRITICAL LOAD COMBINATIONS:

```
 Shear     : LC #5  = D + L (pattern: LL_)
 Bending(+): LC #4  = D + L (pattern: _L_)
 Bending(-): LC #2  = D + L
 Deflection: LC #4  = D + L (pattern: _L_)  (live)
             LC #4  = D + L (pattern: _L_)  (total)
 Bearing   : Support 1 - LC #5 = D + L (pattern: LL_)
             Support 2 - LC #8 = D + L (pattern: _LL)
 D=dead L=live
 All LC's are listed in the Analysis output
 Load Patterns: s=S/2,  X=L+S or L+Lr,  _=no pattern load in this span
 Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```

CALCULATIONS:

```
 V max = 1417, V design = 1169 lbs; M(+) = 3096 lbs-ft; M(-) = 288 lbs-ft
   EIy = 300.09 lb-in^2
 "Live" deflection is due to all non-dead loads (live, wind, snow…)
 Total deflection = 1.5 dead + "live"
 Lateral stability(+):  Lu = 9.06'  Le = 15.38'  RB = 11.8; Lu based on full span
 Lateral stability(-):  Lu = 1.38'  Le = 2.56'  RB = 4.8; Lu based on full span
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

WoodWorks® SOFTWARE FOR WOOD DESIGN	COMPANY	PROJECT
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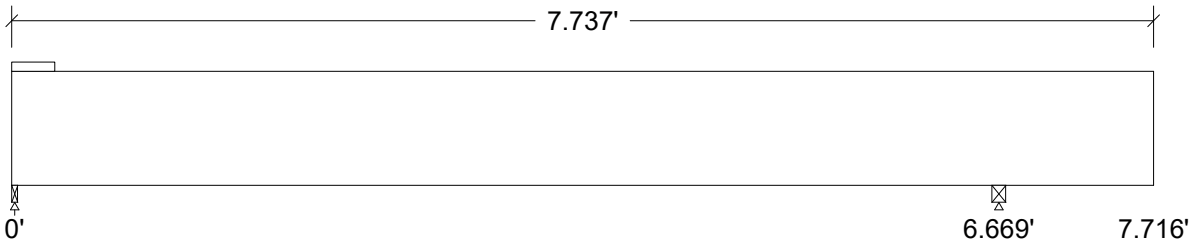
Design Check Calculation Sheet

WoodWorks Sizer 2019 (Update 4)

Loads:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
1	Dead	Point	No	7.74		394		lbs
2	Live	Point	No	7.74		1443		lbs
Self-weight	Dead	Full UDL	No			6.7		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:					
Dead	22		486		
Live	-227		1670		
Factored:					
Uplift	-267				
Total	22		2155		
Bearing:					
Capacity					
Beam	709		2155		
Support	1211		2775		
Des ratio					
Beam	0.03		1.00		
Support	0.02		0.78		
Load comb	#1		#2		
Length	0.50*		1.15		
Min req'd	0.50*		1.15		
Cb	1.00		1.33		
Cb min	1.00		1.33		
Cb support	1.11		1.11		
Fcp sup	625		625		

*Minimum bearing length setting used: 1/2" for end supports

Lumber-soft, Hem-Fir, No.2, 4x10 (3-1/2"x9-1/4")

Supports: All - Timber-soft Beam, D.Fir-L No.2

Total length: 7.75'; Clear span: 6.625', 1.0'; Volume = 1.7 cu.ft.

Lateral support: top = at supports, bottom = at supports;

This section PASSES the design code check.

Analysis vs. Allowable Stress and Deflection using NDS 2018 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	fv = 85	Fv' = 150	psi	fv/Fv' = 0.57
Bending(-)	fb = 464	Fb' = 1008	psi	fb/Fb' = 0.46
Deflection:				
Interior Live	-0.02 = < L/999	0.22 = L/360	in	0.11
Total	-0.03 = < L/999	0.33 = L/240	in	0.10
Cantil. Live	0.02 = L/535	0.07 = L/180	in	0.34
Total	0.03 = L/387	0.10 = L/120	in	0.31

Additional Data:

FACTORS:	F/E(psi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	150	1.00	1.00	1.00	-	-	-	-	1.00	1.00	2
Fb'-	850	1.00	1.00	1.00	0.988	1.200	-	1.00	1.00	1.00	2
Fcp'	405	-	1.00	1.00	-	-	-	-	1.00	1.00	-
E'	1.3 million	1.00	1.00	1.00	-	-	-	-	1.00	1.00	2
Emin'	0.47 million	1.00	1.00	1.00	-	-	-	-	1.00	1.00	2

CRITICAL LOAD COMBINATIONS:

```
Shear     : LC #2  = D + L
Bending(-): LC #2  = D + L
Deflection: LC #2  = D + L  (live)
            LC #2  = D + L  (total)
Bearing   : Support 1 - LC #1 = D only
            Support 2 - LC #2 = D + L
Uplift    : Support 1 - LC #2 = D + L
D=dead L=live
All LC's are listed in the Analysis output
Load combinations: ASD Basic from ASCE 7-16 2.4 / IBC 2018 1605.3.1
```

CALCULATIONS:

```
V max = 1844, V design = 1839 lbs; M(-) = 1928 lbs-ft
  EIy = 300.09 lb-in^2
"Live" deflection is due to all non-dead loads (live, wind, snow…)
Total deflection = 1.5 dead + "live"
Lateral stability(-):  Lu = 6.69'  Le = 11.94'  RB = 10.4
```

Design Notes:

1. Analysis and design are in accordance with the ICC International Building Code (IBC 2018) and the National Design Specification (NDS 2018), using Allowable Stress Design (ASD). Design values are from the NDS Supplement.
2. Please verify that the default deflection limits are appropriate for your application.
3. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
4. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.

WoodWorks® Shearwalls 2019 (Update 3)

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Project Information

DESIGN SETTINGS

Design Code	Wind Standard	Seismic Standard
IBC 2018/AWC SDPWS 2015	ASCE 7-16 Directional (All heights)	ASCE 7-16

Load Combinations		Building Code Capacity Modification	
For Design (ASD)	For Deflection (Strength)	Wind	Seismic
0.70 Seismic	1.00 Seismic	1.00	1.00
0.60 Wind	1.00 Wind		

Service Conditions and Load Duration				Max Shearwall Offset [ft]	
Duration Factor	Temperature Range	Moisture Content		Plan (within story)	Elevation (between stories)
		Fabrication	Service		
1.60	T<=100F	19% (<=19%)	10% (<=19%)	0.50	0.00

Maximum Height-to-width Ratio						
Wood panels		Fiberboard	Lumber		Gypsum	
Wind	Seismic		Wind	Seismic	Blocked	Unblocked
3.5	3.5	-	-	-	2.0	1.5

Ignore non-wood-panel shear resistance contribution...		Forces based on...	
Wind	Seismic	Hold-downs	Applied loads
when comb'd w/ wood panels	when comb'd w/ wood panels	Drag struts	Applied loads

Shearwall relative rigidity:	Deflection-based stiffness of wall segments
Perforated shearwall Co factor:	SDPWS Equation 4.3-5
Non-identical materials and construction on the shearline:	Allowed, except for material type
Deflection Equation:	3-term from SDPWS 4.3-1
Drift limit for wind design:	1 / 500 story height
Force-transfer strap:	Continuous at top of highest opening and bottom of lowest

SITE INFORMATION

Wind	
ASCE 7-16 Directional (All heights)	
Design Wind Speed	105 mph
Serviceability Wind Speed	100 mph
Exposure	Exposure B
Enclosure	Enclosed
Min Wind Loads: Walls	16 psf
Roofs	8 psf

Topographic Information [ft]		
Shape	Height	Length
-	-	-

Site Location: -

Elev: 0ft

Rigid building - Static analysis

Case 2	E-W loads	N-S loads
Eccentricity (%)	15	15
Loaded at	75%	

Seismic	
ASCE 7-16 12.8 Equivalent Lateral Force Procedure	
Risk Category	Category II - All others
Structure Type	Regular
Building System	Bearing Wall
Design Category	D
Site Class	D

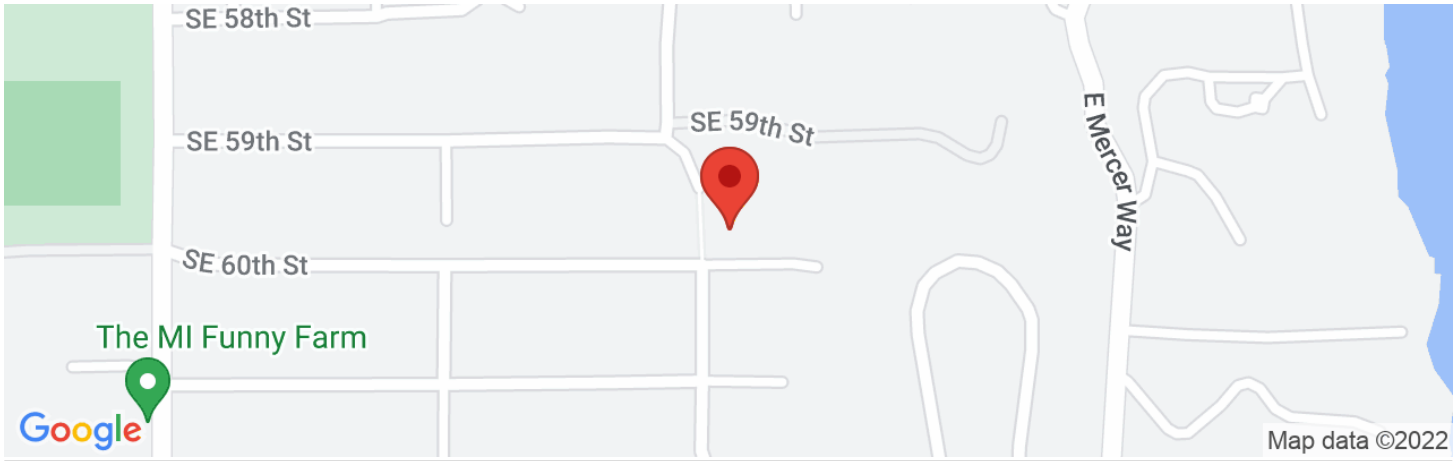
Spectral Response Acceleration	
S1: 0.500g	**Ss:** 1.450g

Fundamental Period	E-W	N-S
T Used	0.190s	0.190s
Approximate Ta	0.190s	0.190s
Maximum T	0.266s	0.266s
Response Factor R	2.00	2.00

Fa: 1.00 **Fv:** 1.80

9204 SE 60th St, Mercer Island, WA 98040, USA

Latitude, Longitude: 47.5493906, -122.2162641



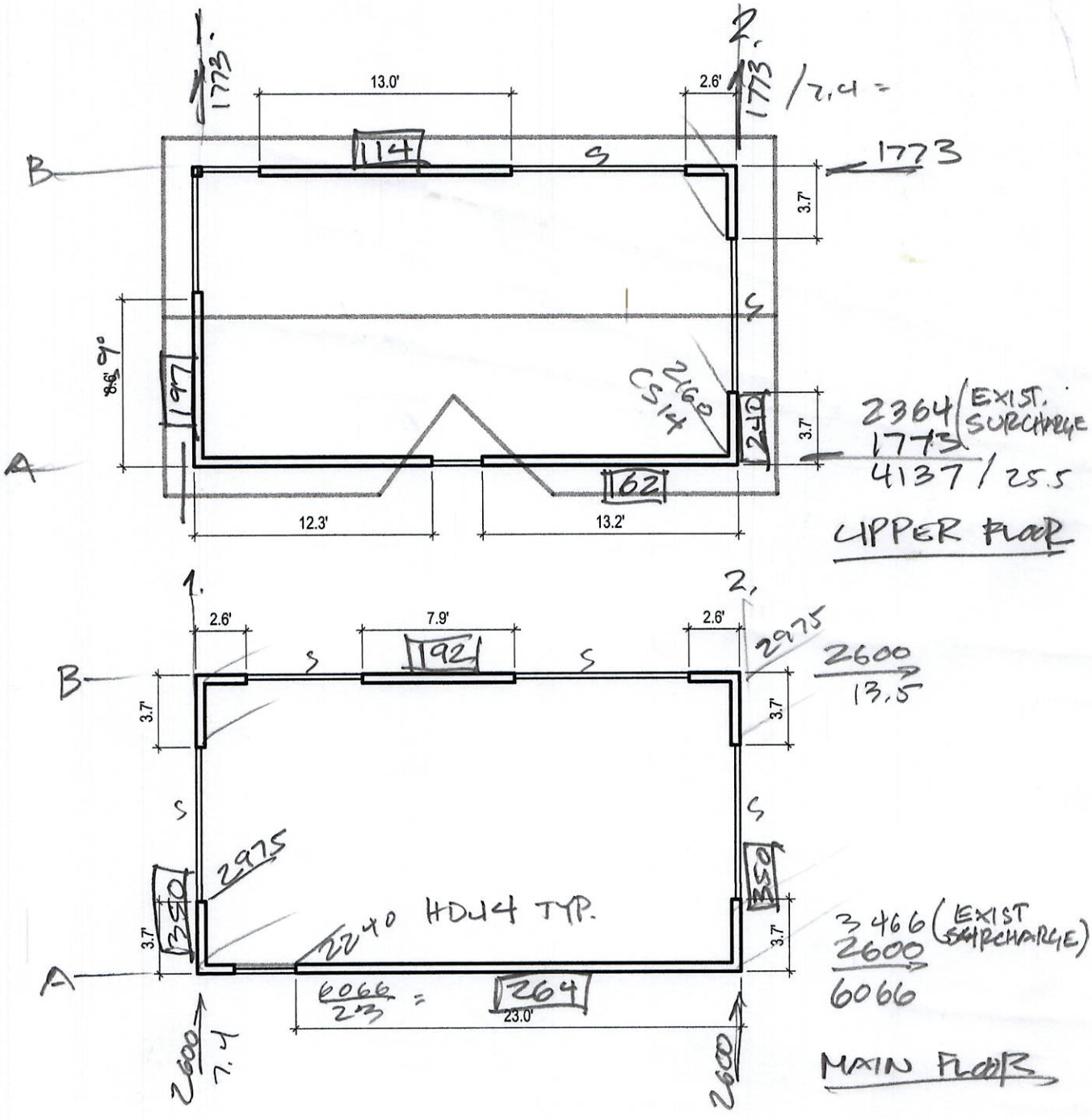
Date	11/10/2022, 2:25:39 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	1.453	MCE_R ground motion. (for 0.2 second period)
S_1	0.504	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.744	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.163	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

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.622	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.747	Site modified peak ground acceleration
T_L	6	Long-period transition period in seconds
SsRT	1.453	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.611	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	4.269	Factored deterministic acceleration value. (0.2 second)
S1RT	0.504	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.561	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	1.645	Factored deterministic acceleration value. (1.0 second)
PGAd	1.423	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.622	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.902	Mapped value of the risk coefficient at short periods

AHRENHOLZ LATERAL ANALYSIS

- LOADS & CODE DATA PER "WOODWORKS" ANALYSIS
- SEISMIC GOVERNS BOTH DIRECTIONS
- [XXX] = UNIT STRESSES ON S.W.S (PLF)
- ~~XXXX~~ = LOADING PER ANALYSIS (#'s ACT)
- +~~XXX~~ = UPLIFT / OVERTURNING FORCES (#'s ACT)



Design Code: IBC 2018/AWC SDPWS 2015

WIND LOAD GENERATION

MWFRS Procedure: ASCE 7-16 Directional (All heights)
C&C Procedure: ASCE 7 Ch. 30 Part 1 (h <= 60 ft.)

Site Information:
Enclosure = Enclosed
Internal gust factor Cgi = 2.0
Occupancy = Category II - All others
Exposure = Exposure B
Rigid building - Static analysis
Case 2 Loads at 75%
Eccentricity N-S loads = 15%, E-W loads = 15%
Ground Elevation: = 0 feet

Legend:
p - Design wind pressure (see Equations)
q - Velocity pressure
G - Gust factor
Cp - External pressure factor
GCp - Combined exposure and gust factor
GCpi - Internal pressure coefficient
Kz - Velocity pressure exposure coefficient
Kd - Wind directionality factor
zg - Ground elevation
h - Mean roof height
z - Height of interest
theta - Roof angle
B - Building width
L - Building length
V - Basic wind speed
Ke - Ground elevation factor
Kzt - Topographic factor
c, zmin, epsilon-bar, l - Terrain exposure constants used to calculate G
hE, zg, alpha - Terrain exposure constants used to calculate K

Equations:
MWFRS Pressure Equation: p = q * G * Cp
C&C Pressure Equation: p = q * (GCp - GCpi)
Other Equations: q = 0.00256 * Kz * Kd * Kzt * Ke * V^2
Ke = e^(-0.0000362 zg)
Kz = 2.01 * (max(z, hE) / zg) ^ (2 / a))
Gz = min(0.85, 0.925 * (1 + 5.8 * (c * (max(0.6 * h, zmin) / 33) ^ (-1/6)) * ((1 / (1 + 0.63 * (((B + h) / (l * ((max(0.6 * h, zmin) / 33)) ^ (e))) ^ (0.63)))) ^ (1/2))) / (1 + 5.8 * (c * (max(0.6 * h, zmin) / 33) ^ (-1/6))))

Data (all loads):
Kd = 0.85, GCpi = 0.18, Ke = 1.000
Terrain Exposure Constants:
zmin = 30
c = 0.30
zg = 1200
hE = 15
epsilon-bar = 0.33
l = 320
alpha = 7.0

Units: ft, lbs, ft/s

MAIN WIND FORCE RESISTING SYSTEM (MWFRS)

MWFRS - Block 1: EW x NS = 15.50 x 28.50 Mean Roof Height = 20.07

Level	Face	Direction	p	q	GCp	Cp	Gz	z-G	Kz	z-K	Kzt	z-Kzt	theta	L/B	h/L
1	North	Windward	9.38	13.8	0.68	0.80	0.85	6.4	0.57	6.4	1.00	-	90.0	1.84	0.70
1	North	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
1	North	Windward	9.38	13.8	0.68	0.80	0.85	11.1	0.57	11.1	1.00	-	90.0	1.84	0.70
1	North	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
1	East	Windward	9.38	13.8	0.68	0.80	0.85	6.4	0.57	6.4	1.00	-	30.0	0.54	1.29
1	East	Leeward	-6.37	15.0	-0.43	-0.50	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
1	East	Windward	9.38	13.8	0.68	0.80	0.85	11.1	0.57	11.1	1.00	-	30.0	0.54	1.29
1	East	Leeward	-6.37	15.0	-0.43	-0.50	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
1	South	Windward	9.38	13.8	0.68	0.80	0.85	6.4	0.57	6.4	1.00	-	90.0	1.84	0.70
1	South	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
1	South	Windward	9.38	13.8	0.68	0.80	0.85	11.1	0.57	11.1	1.00	-	90.0	1.84	0.70
1	South	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
1	West	Windward	9.38	13.8	0.68	0.80	0.85	6.4	0.57	6.4	1.00	-	30.0	0.54	1.29
1	West	Leeward	-6.37	15.0	-0.43	-0.50	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
1	West	Windward	9.38	13.8	0.68	0.80	0.85	11.1	0.57	11.1	1.00	-	30.0	0.54	1.29
1	West	Leeward	-6.37	15.0	-0.43	-0.50	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
2	North	Windward	9.53	14.0	0.68	0.80	0.85	15.6	0.58	15.6	1.00	-	90.0	1.84	0.70
2	North	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
2	North	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
2	North	Windward	10.07	14.8	0.68	0.80	0.85	19.2	0.62	19.2	1.00	-	90.0	1.84	0.70
2	North	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
2	North	Windward	10.07	14.8	0.68	0.80	0.85	19.2	0.62	19.2	1.00	-	90.0	1.84	0.70
2	East	Windward	9.53	14.0	0.68	0.80	0.85	15.6	0.58	15.6	1.00	-	30.0	0.54	1.29
2	East	Leeward	-6.37	15.0	-0.43	-0.50	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
Roof	East	Leeward	-7.64	15.0	-0.51	-0.60	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
Roof	East	Windward	2.55	15.0	0.17	0.20	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
2	South	Windward	9.53	14.0	0.68	0.80	0.85	15.6	0.58	15.6	1.00	-	90.0	1.84	0.70
2	South	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
2	South	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
2	South	Windward	10.07	14.8	0.68	0.80	0.85	19.2	0.62	19.2	1.00	-	90.0	1.84	0.70
2	South	Leeward	-4.23	15.0	-0.28	-0.33	0.85	20.1	0.62	20.1	1.00	-	90.0	1.84	0.70
2	South	Windward	10.07	14.8	0.68	0.80	0.85	19.2	0.62	19.2	1.00	-	90.0	1.84	0.70
2	West	Windward	9.53	14.0	0.68	0.80	0.85	15.6	0.58	15.6	1.00	-	30.0	0.54	1.29
2	West	Leeward	-6.37	15.0	-0.43	-0.50	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
Roof	West	Leeward	-7.64	15.0	-0.51	-0.60	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29
Roof	West	Windward	2.55	15.0	0.17	0.20	0.85	20.1	0.62	20.1	1.00	-	30.0	0.54	1.29

COMPONENTS AND CLADDING (C&C)

C&C - Block 1: EW x NS = 15.50 x 28.50 Mean Roof Height = 20.07

Level	Face	Direction	p	q	GCp	Cp	Gz	z-G	Kz	z-K	Kzt	z-Kzt	theta	L/B	h/L
1	North E	Leeward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
1	North	Leeward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
1	North E	Windward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
1	North	Windward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
1	East E	Leeward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
1	East	Leeward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
1	East E	Windward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
1	East	Windward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
1	South E	Leeward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
1	South	Leeward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
1	South E	Windward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
1	South	Windward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
1	West E	Leeward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
1	West	Leeward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
1	West E	Windward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
1	West	Windward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
2	North E	Leeward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
2	North	Leeward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
2	North E	Windward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
2	North	Windward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
2	East E	Leeward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
2	East	Leeward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
2	East E	Windward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
2	East	Windward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
2	South E	Leeward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
2	South	Leeward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
2	South E	Windward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
2	South	Windward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	90.0	1.84	0.70
2	West E	Leeward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
2	West	Leeward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
2	West E	Windward	-26.56	16.8	-1.40	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29
2	West	Windward	-21.51	16.8	-1.10	0.00	0.00	0.0	0.70	20.1	1.00	-	30.0	0.54	1.29

Design Code: IBC 2018/AWC SDPWS 2015

SEISMIC LOAD GENERATION

ASCE 7-16 12.8 Equivalent Lateral Force Procedure

Site Information:
Risk Category II - All others
SFRS = Bearing wall structure
Regular
Site class D
S1 = 0.50, (Fv = 1.80)
SS = 1.45, (Fa = 1.00)
Seismic Design Category D
Ta: Calculated - refer to Equations and to Base Shear table, below
R: Refer to Base Shear table below

Legend:

V - Total design base shear	Cvx - Vertical distribution factor, level x
Vx - Design story shear, level x	R - Response modification factor
Fx - Lateral force induced in level x	Ie - Seismic importance factor
Fpx - Diaphragm design force, level x	Cu - Coefficient for upper limit on period T
W - Total seismic dead load on structure	Cs - Seismic design coefficient
wx - Dead load tributary to story x	SDS - Design short period spectral acceleration
hx - Ceiling height of level x (floor of x+1)	SD1 - Design 1s spectral response acceleration
hn - Height of structure to mid-roof	SS - Mapped short period spectral acceleration
Fi,wi,hi,Vi - Fx, etc. summed over levels	S1 - Mapped 1s spectral response acceleration
Vjx - Design force on shearline j, level x	Fa - Acceleration-based site coefficient
Vpjx - Diaphragm design shearline force	Fv - Velocity-based site coefficient
Vdjx - Vert. discontinuous shearline force	T - Fundamental period of vibration
Vcjx - Collector shearline force	Tmax - Maximumum period of vibration
Fe,Fpe,we - Force,load from mass element e	Ta - Approximate period of vibration
Fej,Fpej - Portion of Fe,Fpe applied to line j	Omega - Overstrength factor
SDC - Seismic Design Category	SFRS - Seismic force resisting system

Equations:

Fx	= Cvx V	Eqn 12.8-11 (SDC B-F)
Fx	= 0.01 wx	Eqn 1.4-1 (SDC A)
Fpx	= wx SUM(Fi)/SUM(wi), i = x to n	Eqn 12.10-1
V	= Cs W	Eqn 12.8-1
Vx	= SUM(Fi),i = x to n	Eqn 12.8-13
Cvx	= hx^k wx/SUM(wi hi^k) i = 1 to n	Eqn 12.8-12
k	= k(T)	Note, 12.8-12
Cscalc	= Sds Ie/R	Eqn 12.8-2
Csmax	= Sd1 Ie/(R T)	Eqn 12.8-3
Csmin	= max (0.044 Ie Sds, 0.01)	Eqn 12.8-5
Csmin	= 0.5 S1 Ie/R (Sds >= 0.6g)	Eqn 12.8-6
Ta	= Ct hn^(3/4), hn in m	Eqn 12.8-7
Ie	= Ie(risk category)	Table 1.5-2
Tmax	= Ta Cu	12.8.2
Cu	= Cu(SD1)	Table 12.8-1
SDS	= 2/3 Fa SS	Eqns 11.4-1,4-3
SD1	= 2/3 Fv S1	Eqns 11.4-2,4-4
Fa	= Fa(SS, Site Class)	Table 11.4-1
Fv	= Fv(S1, Site Class)	Table 11.4-2
SDC	= SDC(SDS, SD1, occupancy)	Tables 11.6-1,6-2
Omega	= Omega(SFRS)	Table 12.2-1
Fe	= Fx we / wx	Assumption
Fpe	= Fpx we / wx	Assumption
Vjx (flexible diaphragm)	= SUM(Fej) + Vj,x+1	12.8.4
Vjx (rigid diaphragm)	=	See Torsional Analysis Details, F = Vx, CL = centroid of Fe's and Vj,x+1's
Vpjx	= Vjx using Fpe, and Omega * Vdj,x+1	12.10.1.1
Vcjx	= Vjx	12.10.2 (SDC A,B)
Vcjx	= max(Vjx,Vpjx)	12.10.2.1 - Exception (SDC C-F)

User Input and Source:

Site Classes A-F	Table 20.3-1
Risk Category	Table 1.5-1
Fa and Fv for site profile F, maybe E	Site specific study
R (also calculated)	Table 12.2-1
T (also calculated using Ta)	deformational analysis
Irregularities	12.3.2,3; Tables 12.3-1,2
SFRS	Table 12.2-1

Total Design Base Shear:

Ie	SDC	W (lbs)	SDS	SD1	Cu	Tmax	Ta	k
1.00	D	15364	0.967	0.600	1.400	0.266	0.190	1.000

	R	T	SS	SDS	Cscalc	Csmax	Csmin	Cs	V (lbs)
N-S	2.0	0.190	1.45	0.967	0.483	1.582	0.043	0.483	7426
E-W	2.0	0.190	1.45	0.967	0.483	1.582	0.043	0.483	7426

The first SDS value shown, used for Seismic Design Category, diaphragm design force limits, and out-of-plane forces, is not limited by ASCE 7 12.8.1.3.
SDS values shown in lower table are for Cs and Ev calculations and may implement 12.8.1.3.

Manually added or modified seismic loads and forces do not contribute to base shear.

Distribution of Base Shear to Levels:

Level	hx (ft)	wx (lbs)	hx * wx (ft-lbs)	Cvx	Fx (lbs) N-S	Fx (lbs) E-W	Vx (lbs) N-S	Vx (lbs) E-W

1	8.83	7445	65739	0.32	2359	2359	7426	7426
2	17.83	7919	141196	0.68	5067	5067	5067	5067

Manually added or modified seismic loads and forces are not included in the distribution of base shear.

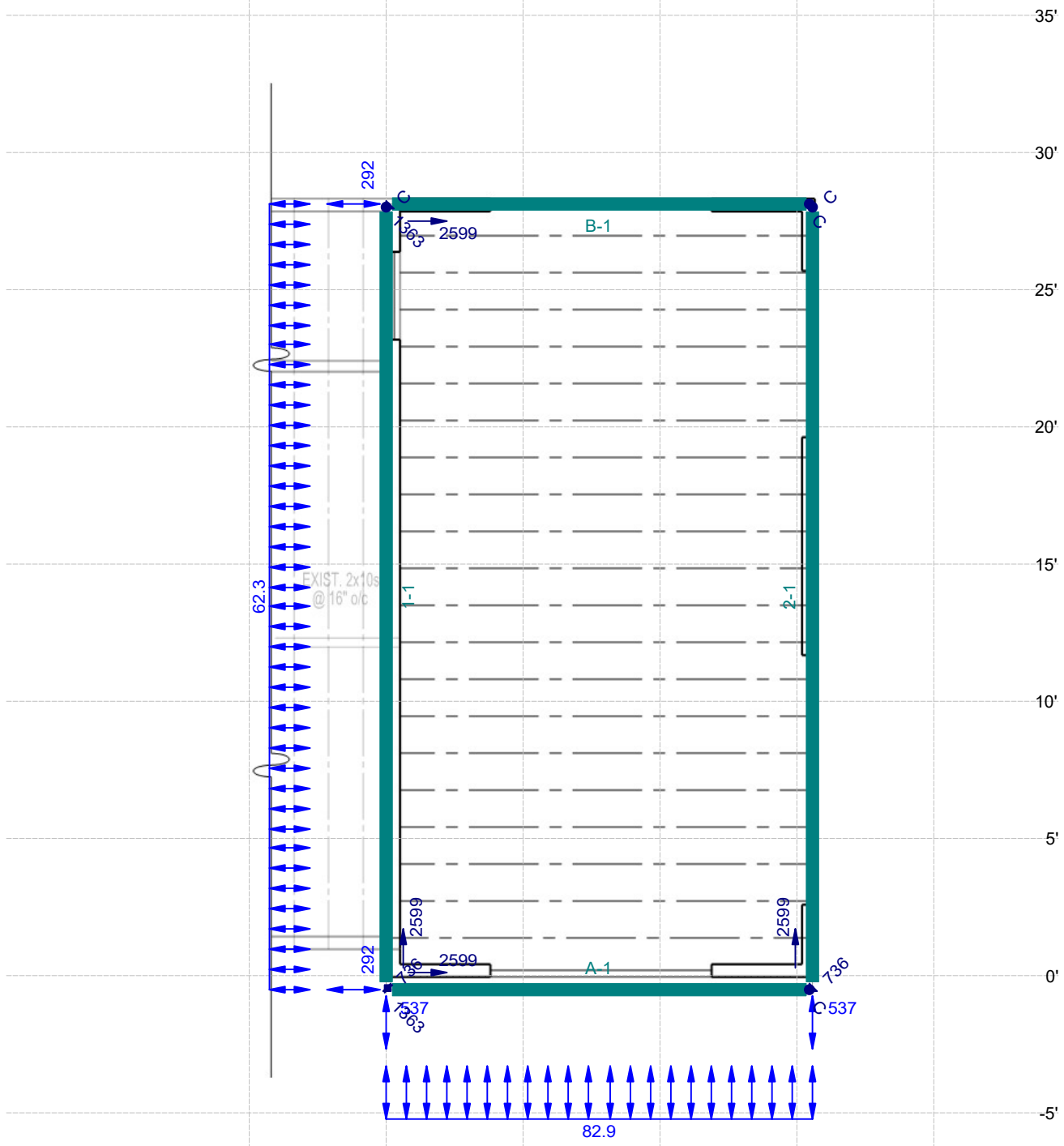
Unfactored seismic loads for Level 1 -

Dir. No.	Start	End	Profile	Magnitude (lbs, plf) From	To
N<->S 1	0.00	15.50	Line	82.9	82.9
N<->S 2	0.00	0.00	Point	537	537
N<->S 3	15.50	15.50	Point	537	537
W<->E 1	-0.50	28.00	Line	62.3	62.3
W<->E 2	-0.50	-0.50	Point	292	292
W<->E 3	28.00	28.00	Point	292	292

Unfactored seismic loads for Level 2 -

Dir. No.	Start	End	Profile	Magnitude (lbs, plf) From	To
N<->S 1	-1.50	0.00	Line	161.2	161.2
N<->S 2	0.00	7.75	Line	201.5	241.6
N<->S 3	0.00	0.00	Point	574	574
N<->S 4	7.75	15.50	Line	241.6	201.5
N<->S 5	15.50	17.00	Line	161.2	161.2
N<->S 6	15.50	15.50	Point	574	574
W<->E 1	-2.00	-0.50	Line	94.7	94.7
W<->E 2	-0.50	28.00	Line	135.0	135.0
W<->E 3	-0.50	-0.50	Point	468	468
W<->E 4	28.00	29.50	Line	94.7	94.7
W<->E 5	28.00	28.00	Point	468	468

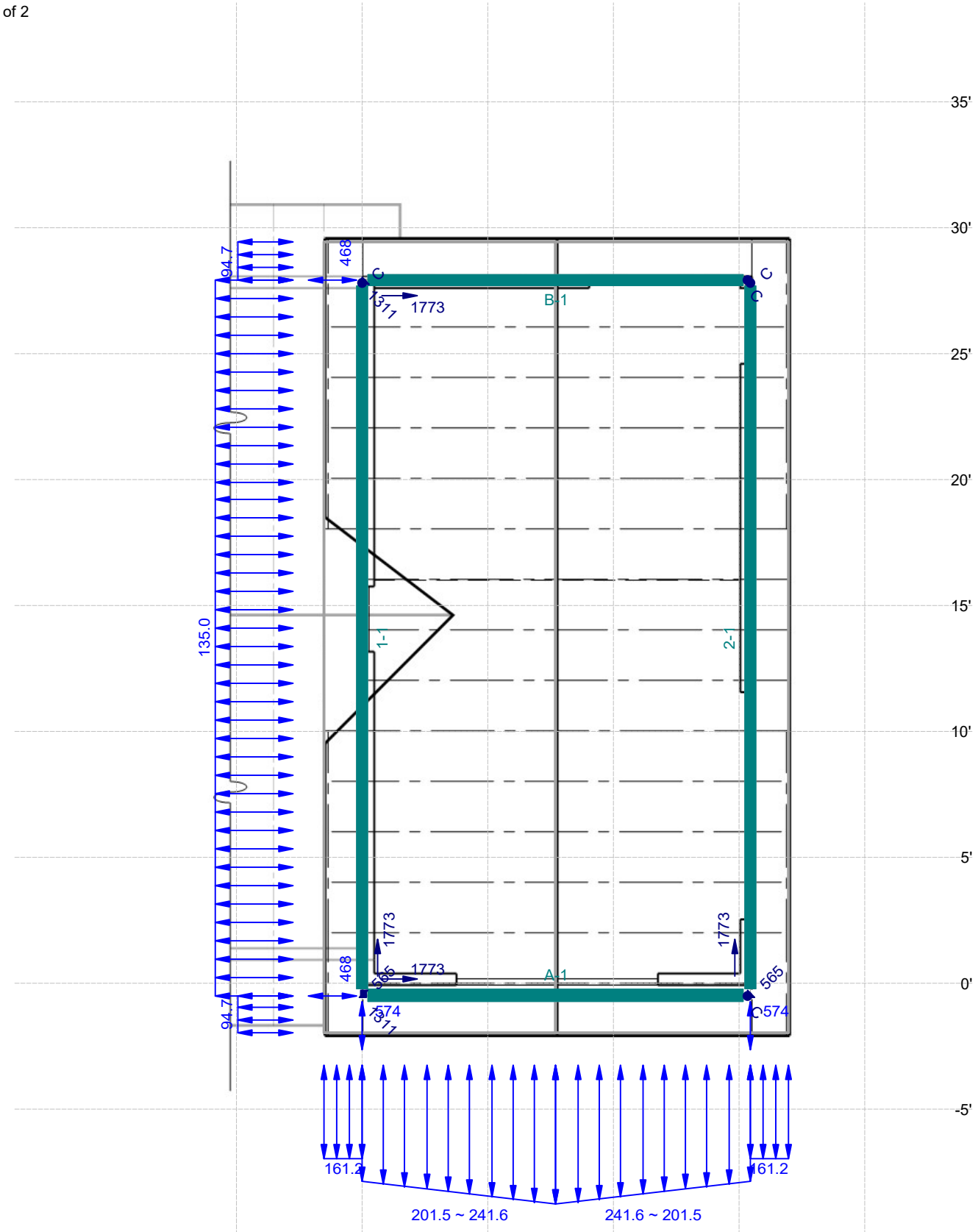
Level 1 of 2



Factored shearline force (lbs)
Factored holddown force (lbs)
C Compression force exists
Vertical element required
Unfactored applied shear load (plf)
Unfactored dead load (plf,lbs)
Applied point load or discontinuous shearline force (lbs)

Loads: Seismic (Qe); Forces: 0.7E + 0.6D; E = pQe + 0.2 Sds D; p(NS) = 1.0; p(EW) = 1.0; Sds = 0.97; Flexible distribution

Level 2 of 2



Factored shearline force (lbs)
Factored holddown force (lbs)
C Compression force exists
Vertical element required
Unfactored applied shear load (plf)
Unfactored dead load (plf,lbs)
Applied point load or discontinuous shearline force (lbs)

Loads: Seismic (Qe); Forces: 0.7E + 0.6D; E = pQe + 0.2 Sds D; p(NS) = 1.0; p(EW) = 1.0; Sds = 0.97; Flexible distribution