

STRUCTURAL ENGINEERING CALCULATIONS:
NIKKI H RESIDENCE



PREPARED BY: PHIL HAREZLAK, PE

DATE: 07/18/2024

PROJECT SCOPE:



NEW DESIGN FOR AN ADDITION AND REMODEL TO AN EXISTING SINGLE FAMILY RESIDENCE PER THE PLANS AND DETAILS ATTACHED. EXISTING CRAWL SPACE FRAMING AND FOUNDATIONS TO BE FIELD VERIFIED.

LATERAL DESIGN WILL BE ACCOMPLISHED BY PLYWOOD SHEATHED WOOD SHEAR WALLS. LATERAL FORCE RESISTING SYSTEM WILL BE ANALYZED FOR ADDITION INCORPORATING SEVERAL NEW OPENINGS.

BASIS OF DESIGN

<u>PROJECT INFORMATION</u>			
PROJECT NAME	NIKKI RES	PROJECT NO.	
CLIENT INFORMATION		JURISDICTION	
TYPE OF STRUCTURE	SINGLE FAMILY RESIDENCE ADDITION	TYPE OF BUILDING	

<u>DESIGN CRITERIA</u>			
DESIGN CODE	IBC	CODE EDITION	2021
CODE FOR LOADS	ASCE 7	CODE EDITION	2016

<u>GRAVITY LOADS</u>									
<u>DEAD LOADS</u>									
ROOF	15 PSF	FLOOR	15 PSF	WALL	12 PSF	PARTITION WALL	10 PSF		
<u>LIVE LOADS</u>									
ROOF, LL _R	25 PSF	FLOOR, LL	40 PSF	DECK, LL	60 PSF	STAIRS	100 PSF	RAILING	50 PLF
<u>SNOW LOADS</u>									
GROUND SNOW, P _G	25 PSF	C _e	1.0	C _t	1.0	FLAT ROOF SNOW LOAD, P _F	25 PSF		

LATERAL LOADS

<u>WIND LOAD PARAMETERS</u>	
V _{ULTIMATE}	98 MPH
V _{SERVICE}	83 MPH
RISK CATEGORY	II
EXPOSURE CATAGORY	B
K _{zt}	1
K _d	1
K _e	1
G	0.85

<u>SEISMIC DESIGN PARAMETERS</u>	
S _s	1.402
S ₁	0.488
S _{DS}	1.122
S _{D1}	0.524
SDC	D
SSC	D-DEFAULT
l _e	1
R	6.5

ALLOWABLE SOIL VALUES (ASSUMED VALUES PER IBC TABLE 1806.2)									
BEARING PRESSURE	1500 PSF	ACTIVE	35 PCF	AT-REST	60 PCF	PASSIVE	250 PCF	μ	0.35

ALLOWABLE DEFLECTION CRITERIA			
ROOF LIVE LOAD	L/360	FLOOR LIVE LOAD	L/360
ROOF TOTAL LOAD	L/240	FLOOR TOTAL LOAD	L/240
WALLS	L/240	BRICK/STONE LOAD	-

GRAVITY STRUCTURAL SYSTEMS	
ROOF	PRE-MFR. PRESS PLATE WOOD TRUSSES ON WOOD STUD BEARING WALLS
FOUNDATION	TYPICAL CONCRETE STEM WALLS AND STRIP FOOTINGS
LATERAL STRUCTURAL SYSTEMS	
LONGITUDINAL	LIGHT FRAME (WOOD) WALLS SHEATHED WITH WOOD STRUCTURAL PANELS RATED FOR SHEAR RESISTANCE
TRANSVERSE	LIGHT FRAME (WOOD) WALLS SHEATHED WITH WOOD STRUCTURAL PANELS RATED FOR SHEAR RESISTANCE
FOUNDATION	TYPICAL CONCRETE STEM WALLS AND STRIP FOOTINGS



Address: 6324 South C Street, Tacoma, Washington 98408

Building Code: IBC 2021

BUIDING LOADS

Roof Loads

Dead Loads

Composite Roofing	2.0	Psf
19/32" Plywood Sheathing	2.0	Psf
Pre-MFR Trusses @ 24" OC	3.0	Psf
Insulation	2.2	Psf
5/8" Gypboard Ceiling	2.8	Psf
Mep/Misc	3.0	Psf
Flat Roof Dead Load =	15	psf

Live Loads

Roof Live Load	20psf
Snow Load	25psf

Exterior wall weight 2x6 H.F./D.F. #2 Studs @ 16" O.C.

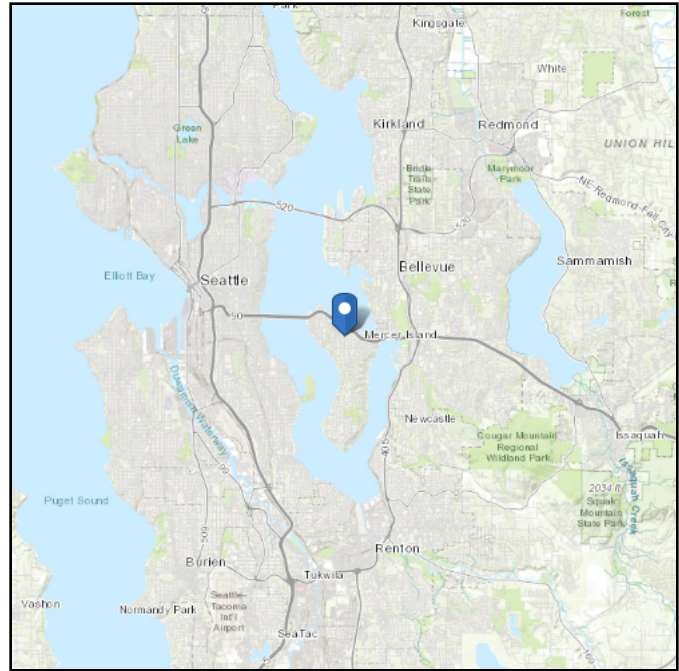
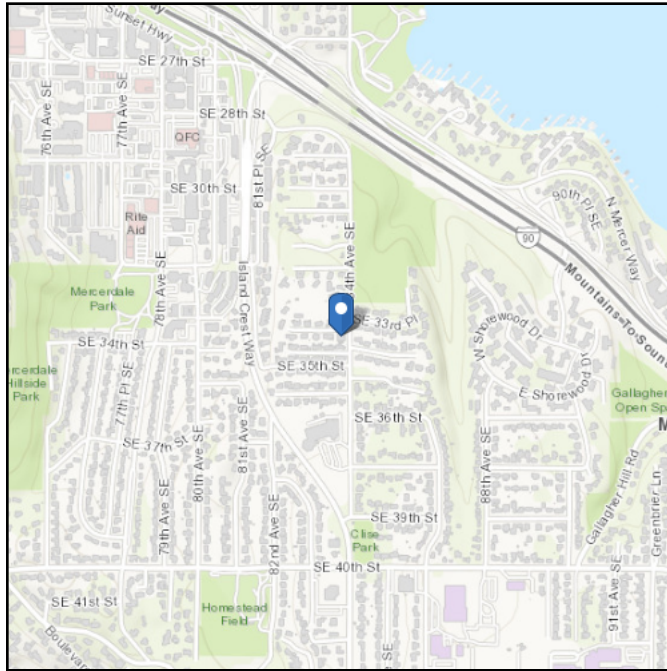
Wood Siding	4.0	Psf
2x6 @ 16" o.c.	1.7	Psf
1/2" Plywood Sheathing	1.7	Psf
5/8" in Gypsum Board	2.8	Psf
R-21 Insulation	0.5	Psf
Miscellaneous	1.5	Psf
Total	12	psf

ASCE Hazards Report

Address:
3325 84th Ave SE
Mercer Island, Washington
98040

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Default (see Section 11.4.3)

Latitude: 47.58011
Longitude: -122.227245
Elevation: 263.12934035583413 ft (NAVD 88)



Wind

Results:

Wind Speed	98 Vmph
10-year MRI	67 Vmph
25-year MRI	74 Vmph
50-year MRI	78 Vmph
100-year MRI	83 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2

Date Accessed: Thu Jul 11 2024

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

Site Soil Class: D - Default (see Section 11.4.3)

Results:

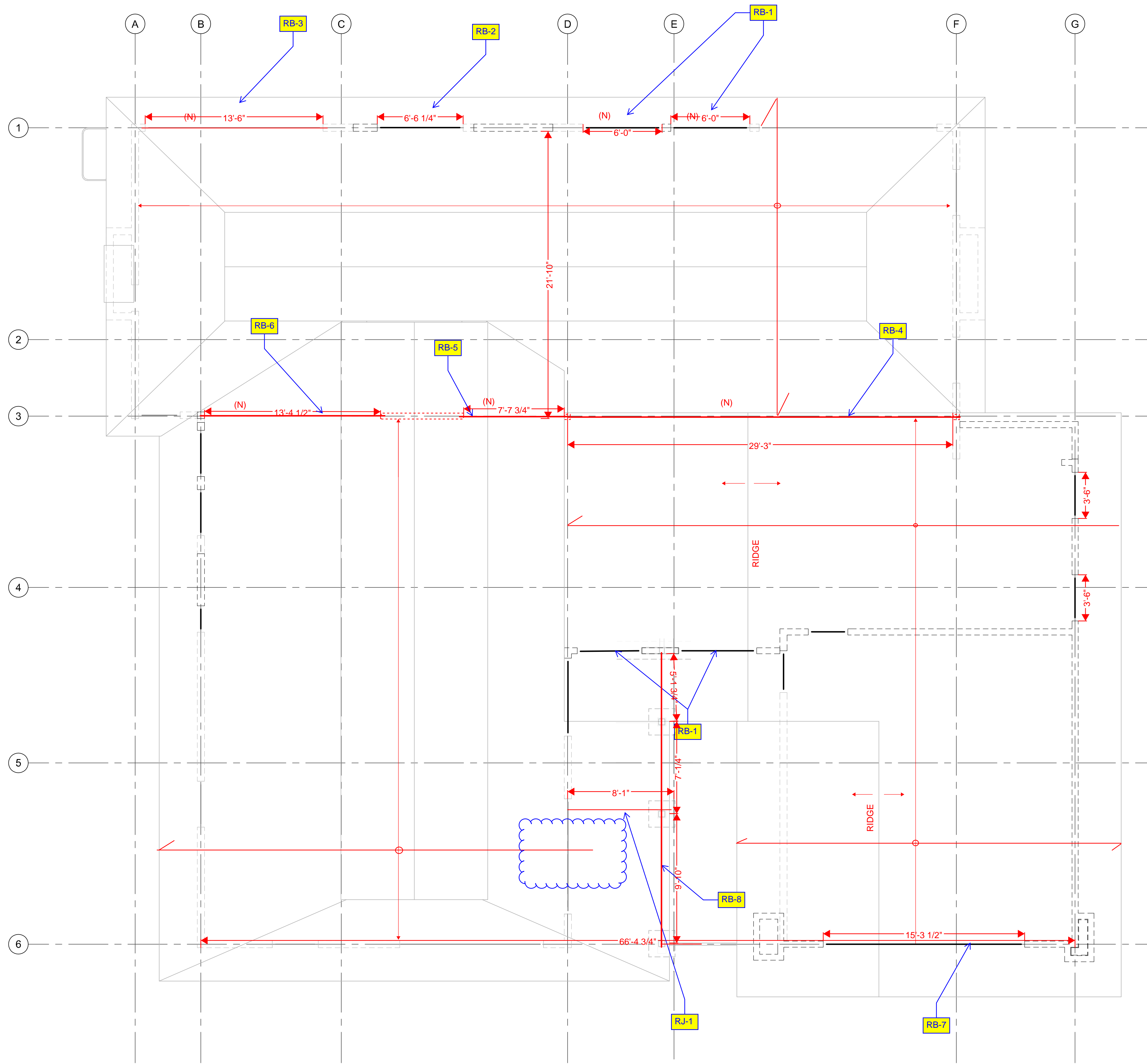
S_s :	1.402	S_{D1} :	N/A
S_1 :	0.488	T_L :	6
F_a :	1.2	PGA :	0.6
F_v :	N/A	PGA _M :	0.72
S_{MS} :	1.683	F_{PGA} :	1.2
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.122	C_v :	1.38

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Thu Jul 11 2024

Date Source: [USGS Seismic Design Maps](#)

HAREZLAK ENGINEERING
NIKKI H RESIDENCE--GRAVITY CALCULATIONS



ROOF FRAMING PLAN

SCALE: 1/4" = 1'-0"



HAREZLAK ENGINEERING

HAREZLAK ENGINEERING
COVINGTON, VA

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CONSULTANT STAMP:

DRAWN BY: TA
CHECKED BY: MBH
APPROVED BY: PAH

PROJECT INFORMATION:
NIKKI H HOUSE

PROJECT ADDRESS:
**3325 84TH AVE SE
MERCER ISLAND, WA 98040**

REVISIONS:

NO.	DESCRIPTION	DATE

SHEET NAME:
ROOF FRAMING PLAN

SHEET NUMBER:
S2.1

Wood Beam

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

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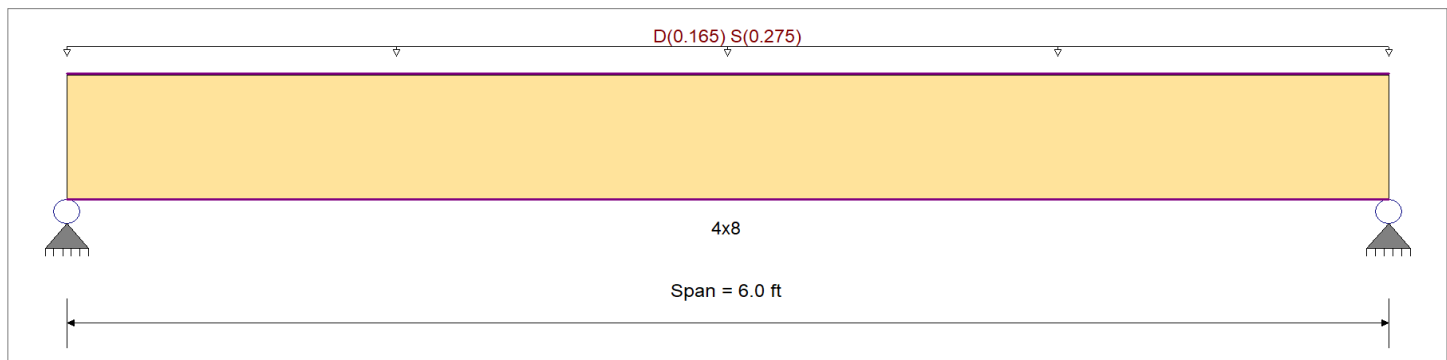
DESCRIPTION: RB-1

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	575 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : ASCE 7-16	Fb -	575 psi	Ebend- xx	1100ksi
	Fc - Prll	575 psi	Eminbend - xx	400ksi
Wood Species : Hem-Fir	Fc - Perp	405 psi		
Wood Grade : No.2	Fv	140 psi		
	Ft	375 psi	Density	26.84pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 11.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.901 : 1	Maximum Shear Stress Ratio	=	0.389 : 1
Section used for this span		4x8	Section used for this span		4x8
fb: Actual	=	774.91 psi	fv: Actual	=	62.65 psi
F'b	=	859.63psi	F'v	=	161.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	3.000ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.066 in	Ratio = 1091 >=360	Span: 1 : S Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.106 in	Ratio = 682 >=180	Span: 1 : +D+S		
Max Upward Total Deflection	0 in	Ratio = 0 <180	n/a		

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v		
D Only																				
Length = 6.0 ft	1		0.432	0.186	0.90	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.74	290.6	672.8	0.0	0.00	0.0	0.0	126.0
+D+S																				
Length = 6.0 ft	1		0.901	0.389	1.15	1.00	1.00	1.00	1.300	1.00	1.00	1.00	1.98	774.9	859.6	1.06	0.00	0.0	0.0	161.0
+D+0.750S																				
Length = 6.0 ft	1		0.761	0.328	1.15	1.00	1.00	1.00	1.300	1.00	1.00	1.00	1.67	653.8	859.6	0.89	0.00	0.0	0.0	161.0
+0.60D																				
Length = 6.0 ft	1		0.146	0.063	1.60	1.00	1.00	1.00	1.300	1.00	1.00	1.00	0.45	174.4	1,196.0	0.24	0.00	0.0	0.0	224.0

Wood Beam

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

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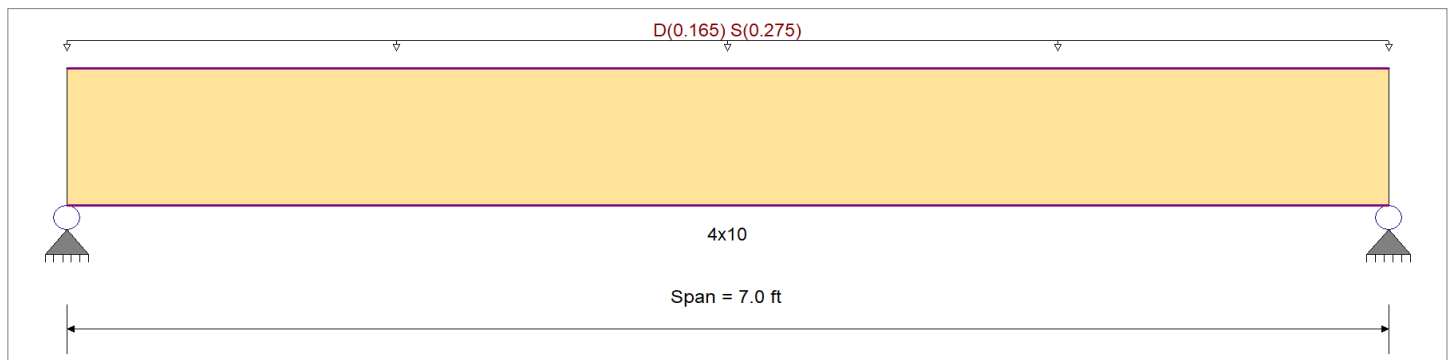
DESCRIPTION: RB-2

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	575.0 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : ASCE 7-16	Fb -	575.0 psi	Ebend- xx	1,100.0ksi
	Fc - Prll	575.0 psi	Eminbend - xx	400.0ksi
Wood Species : Hem-Fir	Fc - Perp	405.0 psi		
Wood Grade : No.2	Fv	140.0 psi		
	Ft	375.0 psi	Density	26.840pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 11.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.817 : 1	Maximum Shear Stress Ratio	=	0.346 : 1
Section used for this span		4x10	Section used for this span		4x10
fb: Actual	=	647.95psi	fv: Actual	=	55.73 psi
F'b	=	793.50psi	F'v	=	161.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	3.500ft	Location of maximum on span	=	6.234 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.059 in	Ratio =	1427 >=360	Span: 1 : S Only	
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a	
Max Downward Total Deflection	0.094 in	Ratio =	892 >=180	Span: 1 : +D+S	
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a	

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 7.0 ft	1	0.391	0.166	0.90	1.00	1.00	1.00	1.200	1.00	1.00	1.00	1.01	243.0	621.0	0.0	0.00	0.0	0.0
+D+S	Length = 7.0 ft	1	0.817	0.346	1.15	1.00	1.00	1.00	1.200	1.00	1.00	1.00	2.70	647.9	793.5	1.20	55.7	161.0	0.0
+D+0.750S	Length = 7.0 ft	1	0.689	0.292	1.15	1.00	1.00	1.00	1.200	1.00	1.00	1.00	2.27	546.7	793.5	1.01	47.0	161.0	0.0
+0.60D	Length = 7.0 ft	1	0.132	0.056	1.60	1.00	1.00	1.00	1.200	1.00	1.00	1.00	0.61	145.8	1,104.0	0.27	12.5	224.0	0.0

Wood Beam

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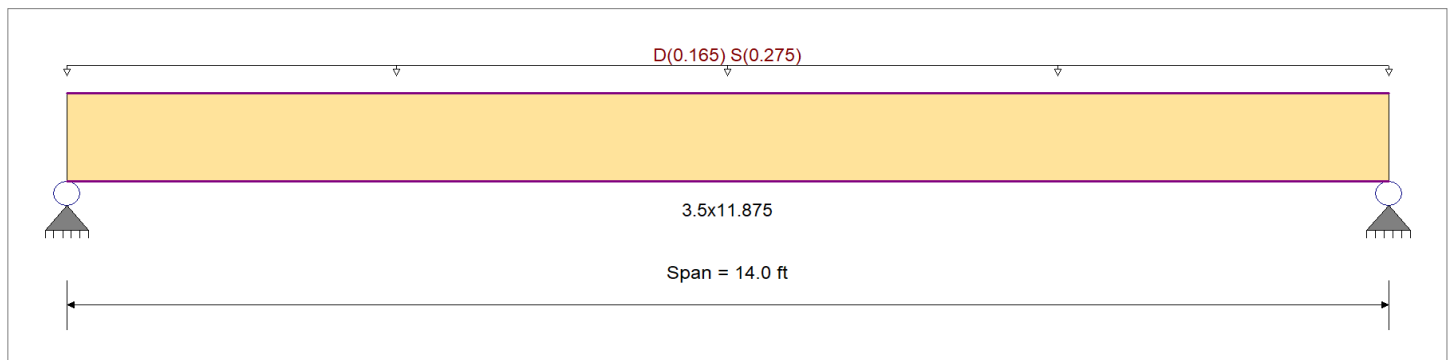
DESCRIPTION: RB-3

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	2800 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2800 psi	Ebend- xx 2000ksi
	Fc - Prll	3000 psi	Eminbend - xx 2530120482ksi
Wood Species : Boise Cascade	Fc - Perp	750 psi	
Wood Grade : Versa Lam 2800	Fv	285 psi	
	Ft	2100 psi	Density 41.76pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 11.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio = 0.487 : 1	Maximum Shear Stress Ratio = 0.292 : 1
Section used for this span = 3.5x11.875	Section used for this span = 3.5x11.875
fb: Actual = 1,571.27 psi	fv: Actual = 95.70 psi
F'b = 3,223.60 psi	F'v = 327.75 psi
Load Combination = +D+S	Load Combination = +D+S
Location of maximum on span = 7.000ft	Location of maximum on span = 13.029 ft
Span # where maximum occurs = Span # 1	Span # where maximum occurs = Span # 1
Maximum Deflection	
Max Downward Transient Deflection = 0.244 in Ratio = 687 >=360	Span: 1 : S Only
Max Upward Transient Deflection = 0 in Ratio = 0 <360	n/a
Max Downward Total Deflection = 0.391 in Ratio = 429 >=180	Span: 1 : +D+S
Max Upward Total Deflection = 0 in Ratio = 0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v		
D Only	Length = 14.0 ft	1	0.234	0.140	0.90	1.00	1.00	1.00	1.001	1.00	1.00	1.00	4.04	589.2	2,522.8	0.00	0.00	0.0	0.0	256.5
+D+S	Length = 14.0 ft	1	0.487	0.292	1.15	1.00	1.00	1.00	1.001	1.00	1.00	1.00	10.78	1,571.3	3,223.6	0.00	0.00	0.0	0.0	327.8
+D+0.750S	Length = 14.0 ft	1	0.411	0.246	1.15	1.00	1.00	1.00	1.001	1.00	1.00	1.00	9.10	1,325.8	3,223.6	0.00	0.00	0.0	0.0	327.8
+0.60D	Length = 14.0 ft	1	0.079	0.047	1.60	1.00	1.00	1.00	1.001	1.00	1.00	1.00	2.43	353.5	4,485.0	0.00	0.00	0.0	0.0	456.0

Wood Beam

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

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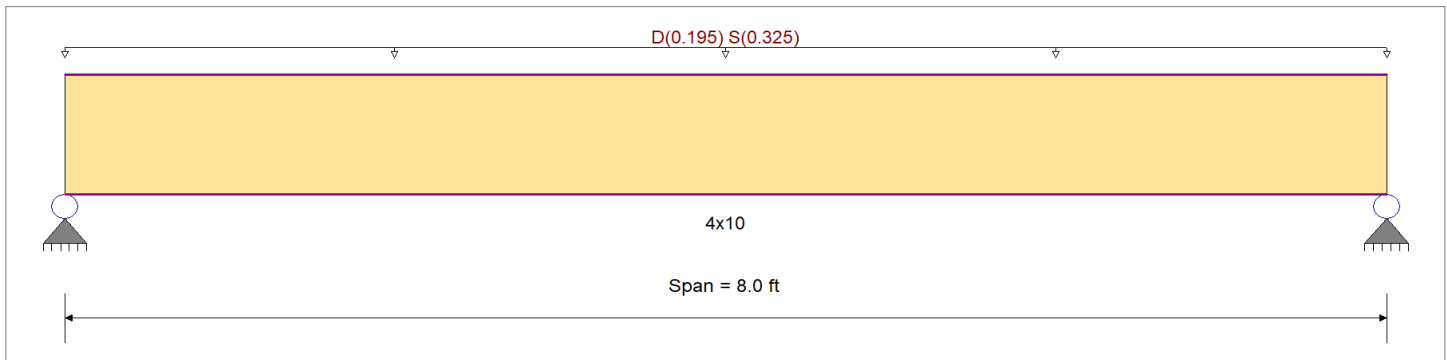
DESCRIPTION: RB-5

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	850.0 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : ASCE 7-16	Fb -	850.0 psi	Ebend- xx	1,300.0ksi
	Fc - Prll	1,300.0 psi	Eminbend - xx	470.0ksi
Wood Species : Hem-Fir	Fc - Perp	405.0 psi		
Wood Grade : No.2	Fv	150.0 psi		
	Ft	525.0 psi	Density	26.840pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 13.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.853 < 1	Maximum Shear Stress Ratio	=	0.453 < 1
Section used for this span		4x10	Section used for this span		4x10
fb: Actual	=	1,000.17psi	fv: Actual	=	78.08 psi
F'b	=	1,173.00psi	F'v	=	172.50 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	4.000ft	Location of maximum on span	=	7.241 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.100 in	Ratio =	956 >=360	Span: 1 : S Only	
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a	
Max Downward Total Deflection	0.161 in	Ratio =	597 >=180	Span: 1 : +D+S	
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a	

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 8.0 ft	1	0.409	0.217	0.90	1.00	1.00	1.00	1.200	1.00	1.00	1.00	1.56	375.1	918.0	0.0	0.00	0.0	0.0
+D+S	Length = 8.0 ft	1	0.853	0.453	1.15	1.00	1.00	1.00	1.200	1.00	1.00	1.00	4.16	1,000.2	1,173.0	0.0	0.00	0.0	0.0
+D+0.750S	Length = 8.0 ft	1	0.719	0.382	1.15	1.00	1.00	1.00	1.200	1.00	1.00	1.00	3.51	843.9	1,173.0	0.0	0.00	0.0	0.0
+0.60D	Length = 8.0 ft	1	0.138	0.073	1.60	1.00	1.00	1.00	1.200	1.00	1.00	1.00	0.94	225.0	1,632.0	0.0	0.00	0.0	0.0

Wood Beam

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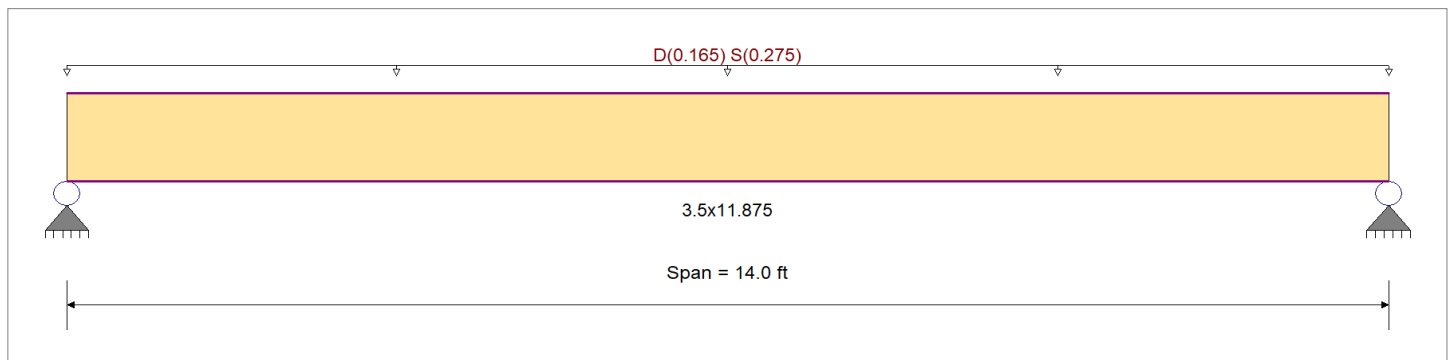
DESCRIPTION: RB-6

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	2,800.0 psi	<i>E : Modulus of Elasticity</i>
Load Combination : ASCE 7-16	Fb -	2,800.0 psi	Ebend- xx 2,000.0ksi
	Fc - Prll	3,000.0 psi	Eminbend - xx 1,036.83ksi
Wood Species : Boise Cascade	Fc - Perp	750.0 psi	
Wood Grade : Versa Lam 2800	Fv	285.0 psi	
	Ft	2,100.0 psi	Density 41.760pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 11.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.487 : 1	Maximum Shear Stress Ratio	=	0.292 : 1
Section used for this span	=	3.5x11.875	Section used for this span	=	3.5x11.875
fb: Actual	=	1,571.27 psi	fv: Actual	=	95.70 psi
F'b	=	3,223.60 psi	F'v	=	327.75 psi
Load Combination	=	+D+S	Load Combination	=	+D+S
Location of maximum on span	=	7.000ft	Location of maximum on span	=	13.029 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.244 in	Ratio = 687 >=360	Span: 1 : S Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.391 in	Ratio = 429 >=180	Span: 1 : +D+S		
Max Upward Total Deflection	0 in	Ratio = 0 <180	n/a		

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v		
D Only	Length = 14.0 ft	1	0.234	0.140	0.90	1.00	1.00	1.00	1.001	1.00	1.00	1.00	4.04	589.2	2,522.8	0.00	0.00	0.0	0.0	256.5
+D+S	Length = 14.0 ft	1	0.487	0.292	1.15	1.00	1.00	1.00	1.001	1.00	1.00	1.00	10.78	1,571.3	3,223.6	2.65	95.7	327.8	0.0	0.0
+D+0.750S	Length = 14.0 ft	1	0.411	0.246	1.15	1.00	1.00	1.00	1.001	1.00	1.00	1.00	9.10	1,325.8	3,223.6	2.24	80.7	327.8	0.0	0.0
+0.60D	Length = 14.0 ft	1	0.079	0.047	1.60	1.00	1.00	1.00	1.001	1.00	1.00	1.00	2.43	353.5	4,485.0	0.60	21.5	456.0	0.0	0.0

Wood Beam

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

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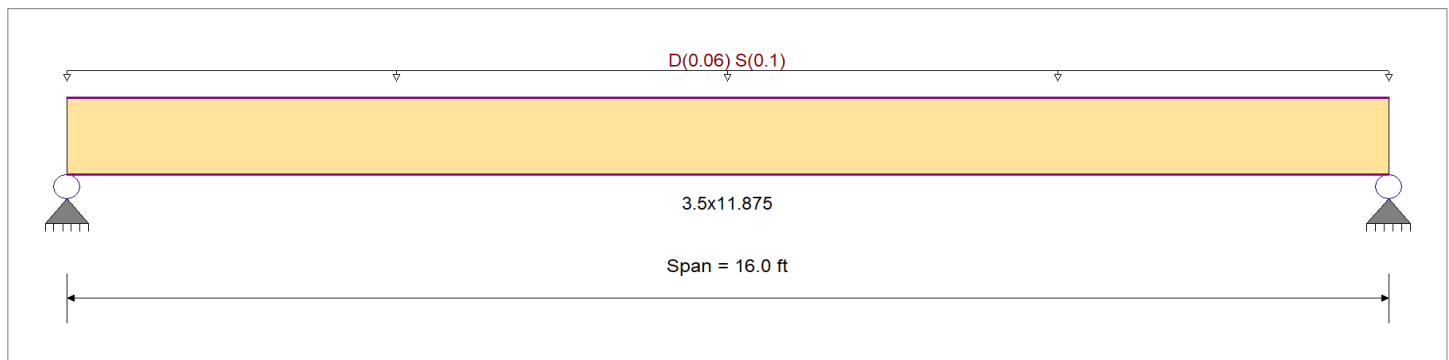
DESCRIPTION: RB-7

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	2,800.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	2,800.0 psi	Ebend- xx
	Fc - Prll	3,000.0 psi	Eminbend - xx
Wood Species : Boise Cascade	Fc - Perp	750.0 psi	
Wood Grade : Versa Lam 2800	Fv	285.0 psi	
	Ft	2,100.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			41.760pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.232	1	Maximum Shear Stress Ratio	=	0.124	: 1
Section used for this span		3.5x11.875		Section used for this span		3.5x11.875	
fb: Actual	=	746.28psi		fv: Actual	=	40.78 psi	
F'b	=	3,223.60psi		F'v	=	327.75 psi	
Load Combination		+D+S		Load Combination		+D+S	
Location of maximum on span	=	8.000ft		Location of maximum on span	=	15.066 ft	
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.152 in	Ratio =	1266	>=360	Span: 1 : S Only	
Max Upward Transient Deflection		0 in	Ratio =	0	<360	n/a	
Max Downward Total Deflection		0.243 in	Ratio =	791	>=180	Span: 1 : +D+S	
Max Upward Total Deflection		0 in	Ratio =	0	<180	n/a	

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 16.0 ft	1	0.111	0.060	0.90	1.00	1.00	1.00	1.001	1.00	1.00	1.00	1.92	279.9	2,522.8	0.0	0.00	0.0	0.0
+D+S	Length = 16.0 ft	1	0.232	0.124	1.15	1.00	1.00	1.00	1.001	1.00	1.00	1.00	5.12	746.3	3,223.6	1.13	40.8	327.8	0.0
+D+0.750S	Length = 16.0 ft	1	0.195	0.105	1.15	1.00	1.00	1.00	1.001	1.00	1.00	1.00	4.32	629.7	3,223.6	0.95	34.4	327.8	0.0
+0.60D	Length = 16.0 ft	1	0.037	0.020	1.60	1.00	1.00	1.00	1.001	1.00	1.00	1.00	1.15	167.9	4,485.0	0.25	9.2	456.0	0.0

Wood Beam

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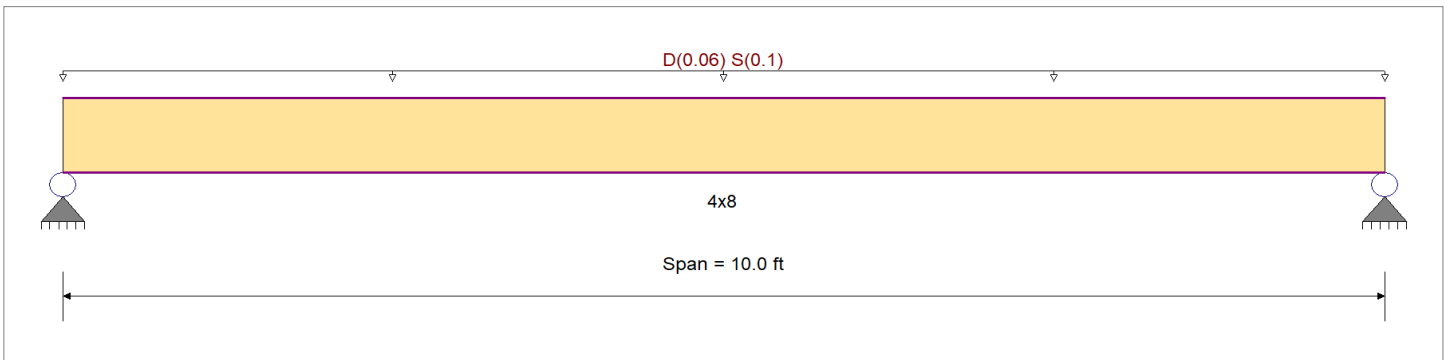
DESCRIPTION: RB-8

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	850.0 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : ASCE 7-16	Fb -	850.0 psi	Ebend- xx	1,300.0ksi
	Fc - Prll	1,300.0 psi	Eminbend - xx	470.0ksi
Wood Species : Hem-Fir	Fc - Perp	405.0 psi		
Wood Grade : No.2	Fv	150.0 psi		
	Ft	525.0 psi	Density	26.840pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling				



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 4.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.770 : 1	Maximum Shear Stress Ratio	=	0.303 : 1
Section used for this span		4x8	Section used for this span		4x8
fb: Actual	=	782.74psi	fv: Actual	=	41.77 psi
F'b	=	1,016.60psi	F'v	=	138.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	5.000ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.165 in	Ratio = 727 >=360	Span: 1 : S Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.264 in	Ratio = 454 >=180	Span: 1 : +D+S		
Max Upward Total Deflection	0 in	Ratio = 0 <180	n/a		

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values					
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v			
D Only																					
Length = 10.0 ft	1		0.369	0.145	0.90	1.00	1.00	1.00	1.300	1.00	0.80	1.00	0.75	293.5	795.6	0.0	0.00	0.0	0.0	0.0	108.0
+D+S																					
Length = 10.0 ft	1		0.770	0.303	1.15	1.00	1.00	1.00	1.300	1.00	0.80	1.00	2.00	782.7	1,016.6	0.0	0.00	0.0	0.0	0.0	138.0
+D+0.750S																					
Length = 10.0 ft	1		0.650	0.255	1.15	1.00	1.00	1.00	1.300	1.00	0.80	1.00	1.69	660.4	1,016.6	0.0	0.00	0.0	0.0	0.0	138.0
+0.60D																					
Length = 10.0 ft	1		0.125	0.049	1.60	1.00	1.00	1.00	1.300	1.00	0.80	1.00	0.45	176.1	1,414.4	0.0	0.00	0.0	0.0	0.0	192.0

Wood Beam

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

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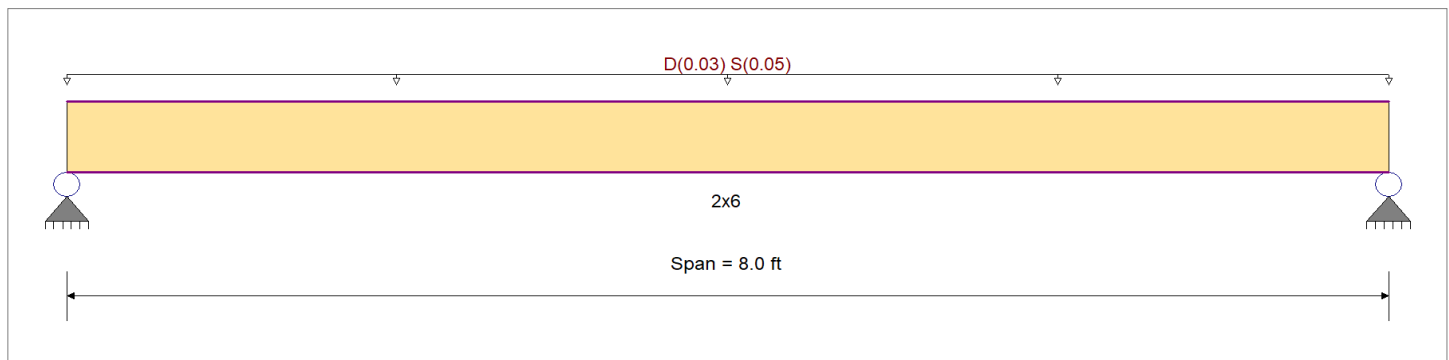
DESCRIPTION: RJ-1

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	850 psi	E : Modulus of Elasticity	
Load Combination : ASCE 7-16	Fb -	850 psi	Ebend- xx	1300ksi
	Fc - Prll	1300 psi	Eminbend - xx	470ksi
Wood Species : Hem-Fir	Fc - Perp	405 psi		
Wood Grade : No.2	Fv	150 psi		
	Ft	525 psi	Density	26.84pcf
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			Repetitive Member Stress Increase	



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 2.0 ft

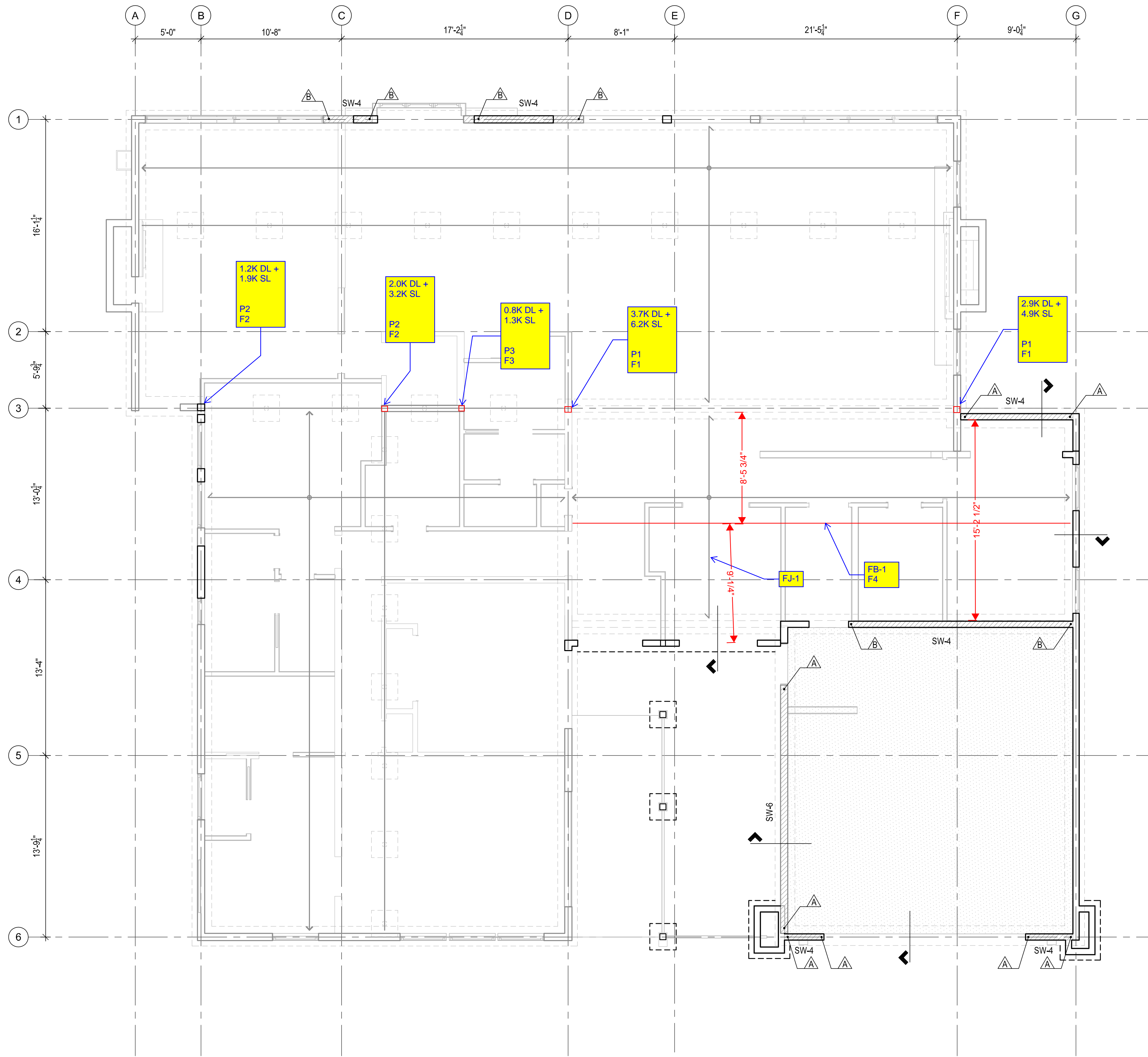
DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.695 1	Maximum Shear Stress Ratio	=	0.300 : 1
Section used for this span		2x6	Section used for this span		2x6
fb: Actual	=	1,015.54psi	fv: Actual	=	51.81 psi
F'b	=	1,461.36psi	F'v	=	172.50 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	4.000ft	Location of maximum on span	=	7.562 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.171 in	Ratio = 559 >=360	Span: 1 : S Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.274 in	Ratio = 349 >=180	Span: 1 : +D+S		
Max Upward Total Deflection	0 in	Ratio = 0 <180	n/a		

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 8.0 ft	1	0.333	0.144	0.90	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.24	380.8	1,143.7	0.0	0.00	0.0	0.0
+D+S	Length = 8.0 ft	1	0.695	0.300	1.15	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.64	1,015.5	1,461.4	0.28	51.8	172.5	0.0
+D+0.750S	Length = 8.0 ft	1	0.586	0.253	1.15	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.54	856.9	1,461.4	0.24	43.7	172.5	0.0
+0.60D	Length = 8.0 ft	1	0.112	0.049	1.60	1.00	1.00	1.00	1.300	1.00	1.00	1.15	0.14	228.5	2,033.2	0.06	11.7	240.0	0.0



MAIN FLOOR & FOUNDATION PLAN

SCALE: 1/4" = 1'-0"



HAREZLAK ENGINEERING

HAREZLAK ENGINEERING
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NIKKI H HOUSE

PROJECT ADDRESS:
**3325 84TH AVE SE
MERCER ISLAND, WA 98040**

REVISIONS:

NO.	DESCRIPTION	DATE

PROJECT NUMBER:
23-125
ISSUE DATE:
07.15.2024
CURRENT REVISION:
PERMIT

SHEET NAME:

MAIN FLOOR & FOUNDATION PLAN

SHEET NUMBER:

S2.0

Wood Beam

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

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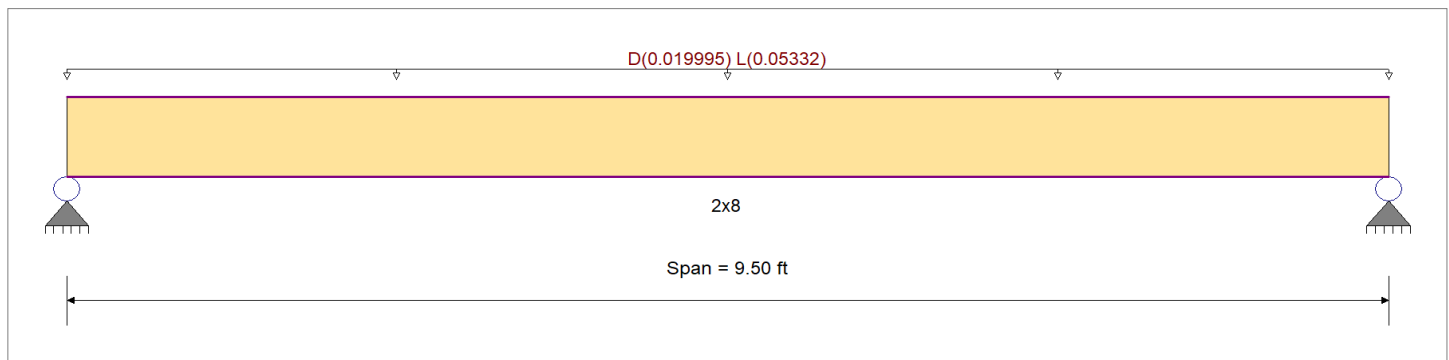
DESCRIPTION: FJ-1

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
 Load Combination Set : ASCE 7-16

Material Properties

Analysis Method : Allowable Stress Design	Fb +	850.0 psi	E : Modulus of Elasticity
Load Combination : ASCE 7-16	Fb -	850.0 psi	Ebend- xx
	Fc - Prll	1,300.0 psi	Eminbend - xx
Wood Species : Hem-Fir	Fc - Perp	405.0 psi	
Wood Grade : No.2	Fv	150.0 psi	
	Ft	525.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			Repetitive Member Stress Increase



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
 Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 1.333 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.644 1	Maximum Shear Stress Ratio	=	0.280 : 1
Section used for this span		2x8	Section used for this span		2x8
fb: Actual	=	755.29psi	fv: Actual	=	42.07 psi
F'b	=	1,173.00psi	F'v	=	150.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	4.750ft	Location of maximum on span	=	8.911 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.159 in	Ratio = 718 >=360	Span: 1 : L Only		
Max Upward Transient Deflection	0 in	Ratio = 0 <360	n/a		
Max Downward Total Deflection	0.218 in	Ratio = 522 >=240	Span: 1 : +D+L		
Max Upward Total Deflection	0 in	Ratio = 0 <240	n/a		

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 9.50 ft	1	0.195	0.085	0.90	1.00	1.00	1.00	1.200	1.00	1.00	1.15	0.23	206.0	1,055.7	0.0	0.00	0.0	0.0
+D+L	Length = 9.50 ft	1	0.644	0.280	1.00	1.00	1.00	1.00	1.200	1.00	1.00	1.15	0.83	755.3	1,173.0	0.31	42.1	150.0	0.0
+D+0.750L	Length = 9.50 ft	1	0.421	0.184	1.25	1.00	1.00	1.00	1.200	1.00	1.00	1.15	0.68	618.0	1,466.3	0.25	34.4	187.5	0.0
+0.60D	Length = 9.50 ft	1	0.066	0.029	1.60	1.00	1.00	1.00	1.200	1.00	1.00	1.15	0.14	123.6	1,876.8	0.05	6.9	240.0	0.0

Wood Beam

Project File: Nikki H RES.ec6

LIC#: KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

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DESCRIPTION: FB-1

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16

Load Combination Set : ASCE 7-16

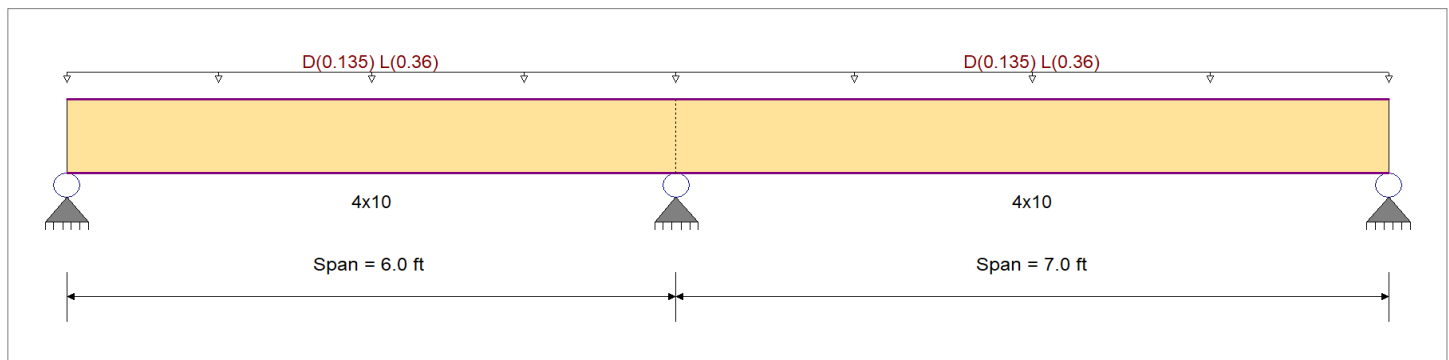
Material Properties

Analysis Method : Allowable Stress Design
 Load Combination : ASCE 7-16

Wood Species : Hem-Fir
 Wood Grade : No.2

Beam Bracing : Beam is Fully Braced against lateral-torsional buckling

Fb +	575.0 psi	E : Modulus of Elasticity	
Fb -	575.0 psi	Ebend- xx	1,100.0ksi
Fc - Prll	575.0 psi	Eminbend - xx	400.0ksi
Fc - Perp	405.0 psi		
Fv	140.0 psi		
Ft	375.0 psi	Density	26.840pcf



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added

Load for Span Number 1

Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 9.0 ft

Load for Span Number 2

Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 9.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.927 : 1	Maximum Shear Stress Ratio	=	0.577 : 1
Section used for this span		4x10	Section used for this span		4x10
fb: Actual	=	639.68psi	fv: Actual	=	80.84 psi
F'b	=	690.00psi	F'v	=	140.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	6.000ft	Location of maximum on span	=	6.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.037 in	Ratio =	2258 >=360	Span: 2 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.051 in	Ratio =	1642 >=240	Span: 2 : +D+L
Max Upward Total Deflection	-0.001 in	Ratio =	85678 >=240	Span: 1 : +D+L

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v		
D Only																				
	Length = 6.0 ft	1	0.281	0.175	0.90	1.00	1.00	1.00	1.200	1.00	1.00	1.00	0.73	174.5	621.0	0.00	0.00	0.0	0.0	126.0
	Length = 7.0 ft	2	0.281	0.175	0.90	1.00	1.00	1.00	1.200	1.00	1.00	1.00	0.73	174.5	621.0	0.48	22.0	80.8	80.8	126.0
+D+L																				
	Length = 6.0 ft	1	0.927	0.577	1.00	1.00	1.00	1.00	1.200	1.00	1.00	1.00	2.66	639.7	690.0	1.74	80.8	80.8	80.8	140.0
	Length = 7.0 ft	2	0.927	0.577	1.00	1.00	1.00	1.00	1.200	1.00	1.00	1.00	2.66	639.7	690.0	1.74	80.8	80.8	80.8	140.0
+D+0.750L																				
	Length = 6.0 ft	1	0.607	0.378	1.25	1.00	1.00	1.00	1.200	1.00	1.00	1.00	2.18	523.4	862.5	1.43	66.1	66.1	66.1	175.0

General Footing

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

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DESCRIPTION: F1

Code References

Calculations per ACI 318-19, IBC 2021, ASCE 7-16
 Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Soil Design Values

Allowable Soil Bearing	=	1.50 ksf
Soil Density	=	110.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Increases based on footing depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth when footing base is below	=	ksf ft

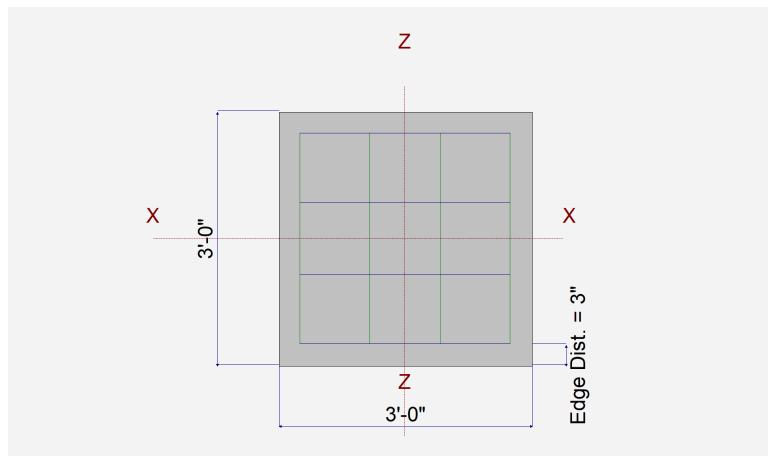
Increases based on footing plan dimension

Allowable pressure increase per foot of depth when max. length or width is greater than	=	ksf ft
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Dimensions

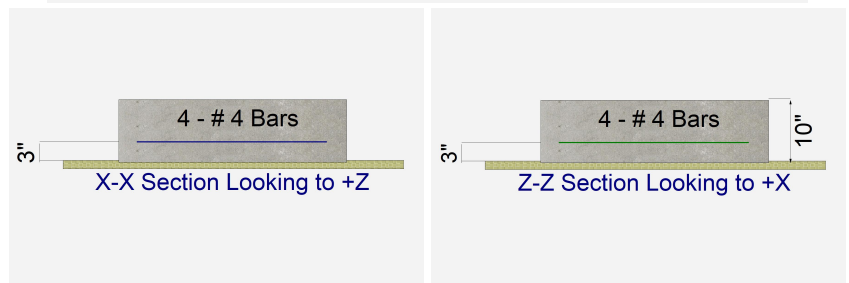
Width parallel to X-X Axis	=	3.0 ft
Length parallel to Z-Z Axis	=	3.0 ft
Footing Thickness	=	10.0 in

Pedestal dimensions...	=	in
px : parallel to X-X Axis	=	in
pz : parallel to Z-Z Axis	=	in
Height	=	in
Rebar Centerline to Edge of Concrete... at Bottom of footing	=	3.0 in



Reinforcing

Bars parallel to X-X Axis	=	
Number of Bars	=	4
Reinforcing Bar Size	=	# 4
Bars parallel to Z-Z Axis	=	
Number of Bars	=	4
Reinforcing Bar Size	=	# 4
Bandwidth Distribution Check (ACI 15.4.4.2)		
Direction Requiring Closer Separation		n/a
# Bars required within zone		n/a
# Bars required on each side of zone		n/a



Applied Loads

	D	Lr	L	S	W	E	H
P : Column Load	=	3.70		6.20			k
OB : Overburden	=						ksf
M-xx	=						k-ft
M-zz	=						k-ft
V-x	=						k
V-z	=						k

General Footing

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

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DESCRIPTION: F1

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.8140	Soil Bearing	1.221 ksf	1.50 ksf	+D+S about Z-Z axis
PASS	n/a	Overturing - X-X	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Overturing - Z-Z	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.2237	Z Flexure (+X)	1.795 k-ft/ft	8.024 k-ft/ft	+1.20D+1.60S
PASS	0.2237	Z Flexure (-X)	1.795 k-ft/ft	8.024 k-ft/ft	+1.20D+1.60S
PASS	0.2237	X Flexure (+Z)	1.795 k-ft/ft	8.024 k-ft/ft	+1.20D+1.60S
PASS	0.2237	X Flexure (-Z)	1.795 k-ft/ft	8.024 k-ft/ft	+1.20D+1.60S
PASS	0.4006	1-way Shear (+X)	17.665 psi	44.091 psi	+1.20D+1.60S
PASS	0.4006	1-way Shear (-X)	17.665 psi	44.091 psi	+1.20D+1.60S
PASS	0.4006	1-way Shear (+Z)	17.665 psi	44.091 psi	+1.20D+1.60S
PASS	0.4006	1-way Shear (-Z)	17.665 psi	44.091 psi	+1.20D+1.60S
PASS	0.4689	2-way Punching	70.335 psi	150.0 psi	+1.20D+1.60S

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc		Actual Soil Bearing Stress @ Location				Actual / Allow Ratio
		Zecc (in)		Bottom, -Z	Top, +Z	Left, -X	Right, +X	
X-X, D Only	1.50	n/a	0.0	0.5319	0.5319	n/a	n/a	0.355
X-X, +D+S	1.50	n/a	0.0	1.221	1.221	n/a	n/a	0.814
X-X, +D+0.750S	1.50	n/a	0.0	1.049	1.049	n/a	n/a	0.699
X-X, +0.60D	1.50	n/a	0.0	0.3192	0.3192	n/a	n/a	0.213
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.5319	0.5319	0.355
Z-Z, +D+S	1.50	0.0	n/a	n/a	n/a	1.221	1.221	0.814
Z-Z, +D+0.750S	1.50	0.0	n/a	n/a	n/a	1.049	1.049	0.699
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.3192	0.3192	0.213

Overturing Stability

Rotation Axis & Load Combination...	Overturing Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturing				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.6475	+Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.40D	0.6475	-Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.20D	0.5550	+Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.20D	0.5550	-Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.20D+0.50S	0.9425	+Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.20D+0.50S	0.9425	-Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.20D+1.60S	1.795	+Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.20D+1.60S	1.795	-Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +0.90D	0.4163	+Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +0.90D	0.4163	-Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.20D+0.20S	0.710	+Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
X-X, +1.20D+0.20S	0.710	-Z	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
Z-Z, +1.40D	0.6475	-X	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
Z-Z, +1.40D	0.6475	+X	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
Z-Z, +1.20D	0.5550	-X	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
Z-Z, +1.20D	0.5550	+X	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK
Z-Z, +1.20D+0.50S	0.9425	-X	Bottom	0.2160	ACI 7.6.1.1	0.2667	8.024	OK

General Footing

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

(c) ENERCALC INC 1983-2023

DESCRIPTION: F2

Code References

Calculations per ACI 318-19, IBC 2021, ASCE 7-16
 Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Soil Design Values

Allowable Soil Bearing	=	1.50 ksf
Soil Density	=	110.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Increases based on footing depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth when footing base is below	=	ksf ft

Increases based on footing plan dimension

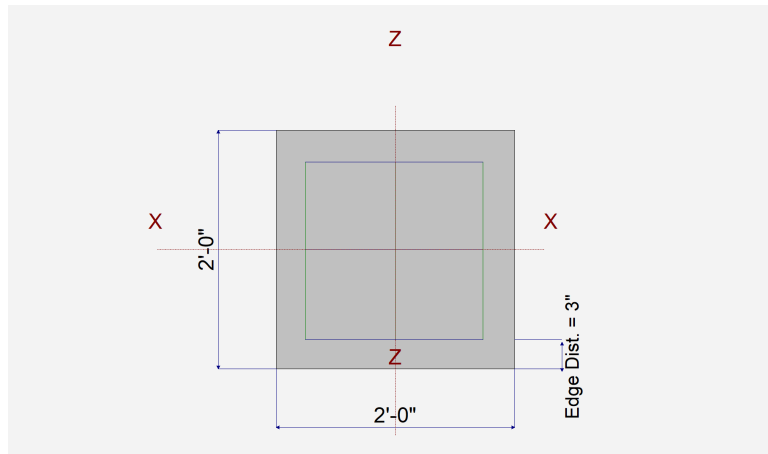
Allowable pressure increase per foot of depth when max. length or width is greater than	=	ksf ft
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Dimensions

Width parallel to X-X Axis	=	2.0 ft
Length parallel to Z-Z Axis	=	2.0 ft
Footing Thickness	=	10.0 in

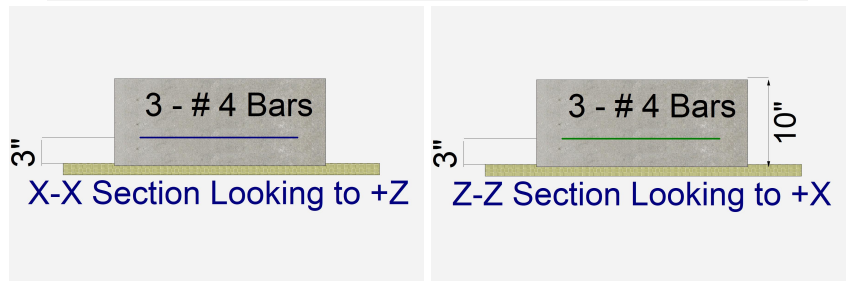
Pedestal dimensions...

px : parallel to X-X Axis	=	in
pz : parallel to Z-Z Axis	=	in
Height	=	in
Rebar Centerline to Edge of Concrete... at Bottom of footing	=	3.0 in



Reinforcing

Bars parallel to X-X Axis	=	
Number of Bars	=	3
Reinforcing Bar Size	=	# 4
Bars parallel to Z-Z Axis	=	
Number of Bars	=	3
Reinforcing Bar Size	=	# 4
Bandwidth Distribution Check (ACI 15.4.4.2)		
Direction Requiring Closer Separation	=	n/a
# Bars required within zone	=	n/a
# Bars required on each side of zone	=	n/a



Applied Loads

	D	Lr	L	S	W	E	H
P : Column Load	=	2.0			3.20		k
OB : Overburden	=						ksf
M-xx	=						k-ft
M-zz	=						k-ft
V-x	=						k
V-z	=						k

General Footing

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

(c) ENERCALC INC 1983-2023

DESCRIPTION: F2

DESIGN SUMMARY

Design OK

Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS 0.9473	Soil Bearing	1.421 ksf	1.50 ksf	+D+S about Z-Z axis
PASS n/a	Overturing - X-X	0.0 k-ft	0.0 k-ft	No Overturing
PASS n/a	Overturing - Z-Z	0.0 k-ft	0.0 k-ft	No Overturing
PASS n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS 0.1048	Z Flexure (+X)	0.940 k-ft/ft	8.974 k-ft/ft	+1.20D+1.60S
PASS 0.1048	Z Flexure (-X)	0.940 k-ft/ft	8.974 k-ft/ft	+1.20D+1.60S
PASS 0.1048	X Flexure (+Z)	0.940 k-ft/ft	8.974 k-ft/ft	+1.20D+1.60S
PASS 0.1048	X Flexure (-Z)	0.940 k-ft/ft	8.974 k-ft/ft	+1.20D+1.60S
PASS 0.2050	1-way Shear (+X)	9.40 psi	45.857 psi	+1.20D+1.60S
PASS 0.2050	1-way Shear (-X)	9.40 psi	45.857 psi	+1.20D+1.60S
PASS 0.2050	1-way Shear (+Z)	9.40 psi	45.857 psi	+1.20D+1.60S
PASS 0.2050	1-way Shear (-Z)	9.40 psi	45.857 psi	+1.20D+1.60S
PASS 0.2328	2-way Punching	34.914 psi	150.0 psi	+1.20D+1.60S

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc		Actual Soil Bearing Stress @ Location				Actual / Allow Ratio
		Zecc (in)		Bottom, -Z	Top, +Z	Left, -X	Right, +X	
X-X, D Only	1.50	n/a	0.0	0.6208	0.6208	n/a	n/a	0.414
X-X, +D+S	1.50	n/a	0.0	1.421	1.421	n/a	n/a	0.947
X-X, +D+0.750S	1.50	n/a	0.0	1.221	1.221	n/a	n/a	0.814
X-X, +0.60D	1.50	n/a	0.0	0.3725	0.3725	n/a	n/a	0.248
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.6208	0.6208	0.414
Z-Z, +D+S	1.50	0.0	n/a	n/a	n/a	1.421	1.421	0.947
Z-Z, +D+0.750S	1.50	0.0	n/a	n/a	n/a	1.221	1.221	0.814
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.3725	0.3725	0.248

Overturing Stability

Rotation Axis & Load Combination...	Overturing Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturing				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.350	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.40D	0.350	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D	0.30	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D	0.30	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+0.50S	0.50	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+0.50S	0.50	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+1.60S	0.940	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+1.60S	0.940	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +0.90D	0.2250	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +0.90D	0.2250	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+0.20S	0.380	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+0.20S	0.380	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.40D	0.350	-X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.40D	0.350	+X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.20D	0.30	-X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.20D	0.30	+X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.20D+0.50S	0.50	-X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK

General Footing

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

(c) ENERCALC INC 1983-2023

DESCRIPTION: F3

Code References

Calculations per ACI 318-19, IBC 2021, ASCE 7-16
 Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Soil Design Values

Allowable Soil Bearing	=	1.50 ksf
Soil Density	=	110.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Increases based on footing depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth when footing base is below	=	ksf ft

Increases based on footing plan dimension

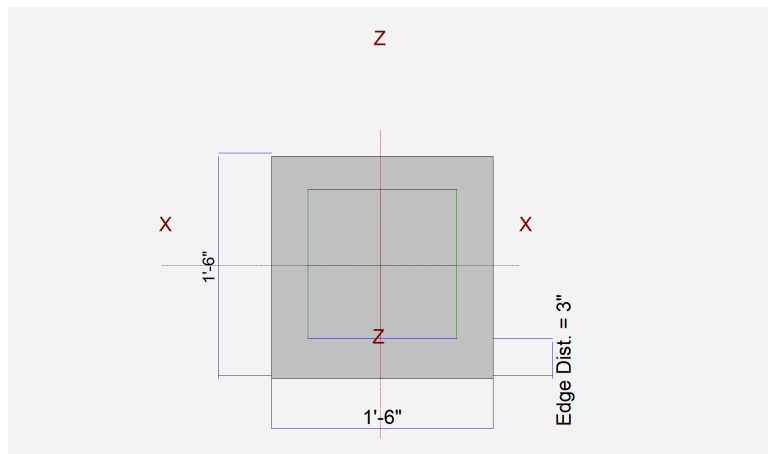
Allowable pressure increase per foot of depth when max. length or width is greater than	=	ksf ft
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Dimensions

Width parallel to X-X Axis	=	1.50 ft
Length parallel to Z-Z Axis	=	1.50 ft
Footing Thickness	=	10.0 in

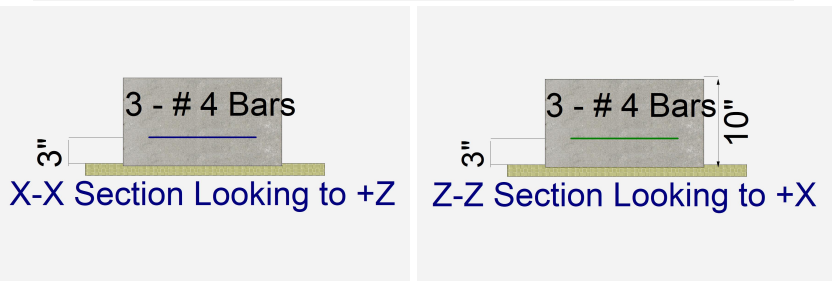
Pedestal dimensions...

px : parallel to X-X Axis	=	in
pz : parallel to Z-Z Axis	=	in
Height	=	in
Rebar Centerline to Edge of Concrete... at Bottom of footing	=	3.0 in



Reinforcing

Bars parallel to X-X Axis	=	
Number of Bars	=	3.0
Reinforcing Bar Size	=	# 4
Bars parallel to Z-Z Axis	=	
Number of Bars	=	3.0
Reinforcing Bar Size	=	# 4
Bandwidth Distribution Check (ACI 15.4.4.2)		
Direction Requiring Closer Separation		n/a
# Bars required within zone		n/a
# Bars required on each side of zone		n/a



Applied Loads

	D	Lr	L	S	W	E	H
P : Column Load	=	0.80		1.30			k
OB : Overburden	=						ksf
M-xx	=						k-ft
M-zz	=						k-ft
V-x	=						k
V-z	=						k

General Footing

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

(c) ENERCALC INC 1983-2023

DESCRIPTION: F3

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.7027	Soil Bearing	1.054 ksf	1.50 ksf	+D+S about Z-Z axis
PASS	n/a	Overturing - X-X	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Overturing - Z-Z	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.03233	Z Flexure (+X)	0.380 k-ft/ft	11.753 k-ft/ft	+1.20D+1.60S
PASS	0.03233	Z Flexure (-X)	0.380 k-ft/ft	11.753 k-ft/ft	+1.20D+1.60S
PASS	0.03233	X Flexure (+Z)	0.380 k-ft/ft	11.753 k-ft/ft	+1.20D+1.60S
PASS	0.03233	X Flexure (-Z)	0.380 k-ft/ft	11.753 k-ft/ft	+1.20D+1.60S
PASS	0.05258	1-way Shear (+X)	2.654 psi	50.472 psi	+1.20D+1.60S
PASS	0.05258	1-way Shear (-X)	2.654 psi	50.472 psi	+1.20D+1.60S
PASS	0.05258	1-way Shear (+Z)	2.654 psi	50.472 psi	+1.20D+1.60S
PASS	0.05258	1-way Shear (-Z)	2.654 psi	50.472 psi	+1.20D+1.60S
PASS	0.08847	2-way Punching	13.271 psi	150.0 psi	+1.20D+1.60S

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc		Actual Soil Bearing Stress @ Location				Actual / Allow Ratio
		Zecc (in)		Bottom, -Z	Top, +Z	Left, -X	Right, +X	
X-X, D Only	1.50	n/a	0.0	0.4764	0.4764	n/a	n/a	0.318
X-X, +D+S	1.50	n/a	0.0	1.054	1.054	n/a	n/a	0.703
X-X, +D+0.750S	1.50	n/a	0.0	0.9097	0.9097	n/a	n/a	0.607
X-X, +0.60D	1.50	n/a	0.0	0.2858	0.2858	n/a	n/a	0.191
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.4764	0.4764	0.318
Z-Z, +D+S	1.50	0.0	n/a	n/a	n/a	1.054	1.054	0.703
Z-Z, +D+0.750S	1.50	0.0	n/a	n/a	n/a	0.9097	0.9097	0.607
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.2858	0.2858	0.191

Overturing Stability

Rotation Axis & Load Combination...	Overturing Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturing				

All units k

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.140	+Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.40D	0.140	-Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.20D	0.120	+Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.20D	0.120	-Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.20D+0.50S	0.2013	+Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.20D+0.50S	0.2013	-Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.20D+1.60S	0.380	+Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.20D+1.60S	0.380	-Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +0.90D	0.090	+Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +0.90D	0.090	-Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.20D+0.20S	0.1525	+Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
X-X, +1.20D+0.20S	0.1525	-Z	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
Z-Z, +1.40D	0.140	-X	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
Z-Z, +1.40D	0.140	+X	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
Z-Z, +1.20D	0.120	-X	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
Z-Z, +1.20D	0.120	+X	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK
Z-Z, +1.20D+0.50S	0.2013	-X	Bottom	0.2160	ACI 7.6.1.1	0.40	11.753	OK

General Footing

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

HAREZLAK ENGINEERING

(c) ENERCALC INC 1983-2023

DESCRIPTION: F4

Code References

Calculations per ACI 318-19, IBC 2021, ASCE 7-16
 Load Combinations Used : ASCE 7-16

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.50 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Soil Design Values

Allowable Soil Bearing	=	1.50 ksf
Soil Density	=	110.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing depth

Footing base depth below soil surface	=	ft
Allow press. increase per foot of depth when footing base is below	=	ksf ft

Increases based on footing plan dimension

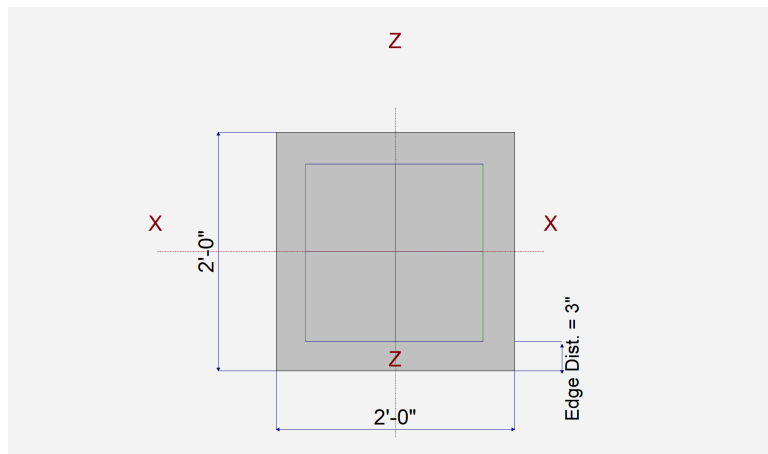
Allowable pressure increase per foot of depth when max. length or width is greater than	=	ksf ft
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Dimensions

Width parallel to X-X Axis	=	2.0 ft
Length parallel to Z-Z Axis	=	2.0 ft
Footing Thickness	=	10.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	in
pz : parallel to Z-Z Axis	=	in
Height	=	in
Rebar Centerline to Edge of Concrete... at Bottom of footing	=	3.0 in



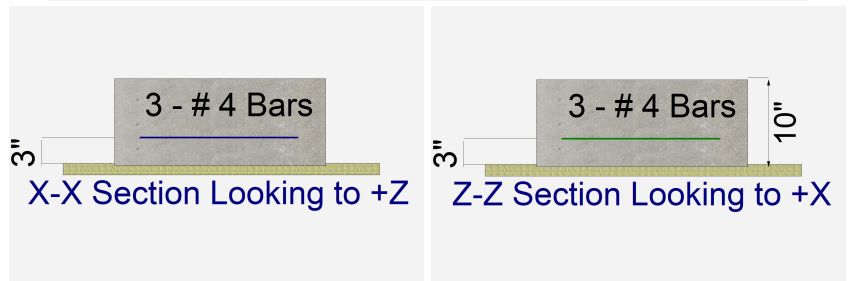
Reinforcing

Bars parallel to X-X Axis	=	
Number of Bars	=	3.0
Reinforcing Bar Size	=	# 4

Bars parallel to Z-Z Axis	=	
Number of Bars	=	3.0
Reinforcing Bar Size	=	# 4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	=	n/a
# Bars required within zone	=	n/a
# Bars required on each side of zone	=	n/a



Applied Loads

	D	Lr	L	S	W	E	H	
P : Column Load	=	1.10			2.90			k
OB : Overburden	=							ksf
M-xx	=							k-ft
M-zz	=							k-ft
V-x	=							k
V-z	=							k

General Footing

Project File: Nikki H RES.ec6

LIC# : KW-06017599, Build:20.24.03.04

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DESCRIPTION: F4

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.7473	Soil Bearing	1.121 ksf	1.50 ksf	+D+S about Z-Z axis
PASS	n/a	Overturing - X-X	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Overturing - Z-Z	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.08302	Z Flexure (+X)	0.7450 k-ft/ft	8.974 k-ft/ft	+1.20D+1.60S
PASS	0.08302	Z Flexure (-X)	0.7450 k-ft/ft	8.974 k-ft/ft	+1.20D+1.60S
PASS	0.08302	X Flexure (+Z)	0.7450 k-ft/ft	8.974 k-ft/ft	+1.20D+1.60S
PASS	0.08302	X Flexure (-Z)	0.7450 k-ft/ft	8.974 k-ft/ft	+1.20D+1.60S
PASS	0.1625	1-way Shear (+X)	7.450 psi	45.857 psi	+1.20D+1.60S
PASS	0.1625	1-way Shear (-X)	7.450 psi	45.857 psi	+1.20D+1.60S
PASS	0.1625	1-way Shear (+Z)	7.450 psi	45.857 psi	+1.20D+1.60S
PASS	0.1625	1-way Shear (-Z)	7.450 psi	45.857 psi	+1.20D+1.60S
PASS	0.1845	2-way Punching	27.671 psi	150.0 psi	+1.20D+1.60S

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc		Actual Soil Bearing Stress @ Location				Actual / Allow Ratio
		Zecc (in)		Bottom, -Z	Top, +Z	Left, -X	Right, +X	
X-X, D Only	1.50	n/a	0.0	0.3958	0.3958	n/a	n/a	0.264
X-X, +D+S	1.50	n/a	0.0	1.121	1.121	n/a	n/a	0.747
X-X, +D+0.750S	1.50	n/a	0.0	0.9396	0.9396	n/a	n/a	0.626
X-X, +0.60D	1.50	n/a	0.0	0.2375	0.2375	n/a	n/a	0.158
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.3958	0.3958	0.264
Z-Z, +D+S	1.50	0.0	n/a	n/a	n/a	1.121	1.121	0.747
Z-Z, +D+0.750S	1.50	0.0	n/a	n/a	n/a	0.9396	0.9396	0.626
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.2375	0.2375	0.158

Overturing Stability

Rotation Axis & Load Combination...	Overturing Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturing				

All units k

Sliding Stability

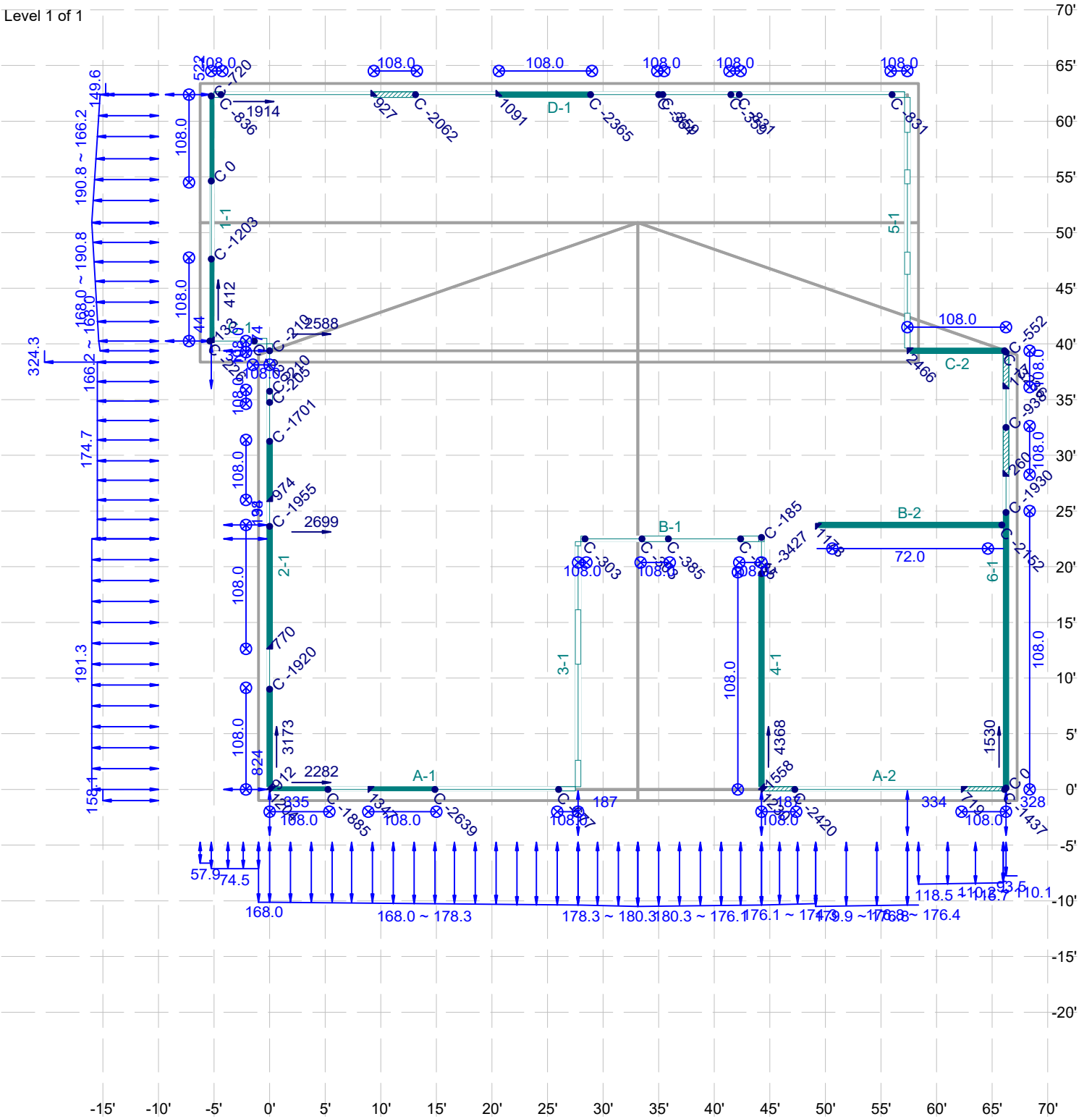
Force Application Axis Load Combination...	Sliding Force	Resisting Force	Stability Ratio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.1925	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.40D	0.1925	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D	0.1650	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D	0.1650	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+0.50S	0.3463	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+0.50S	0.3463	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+1.60S	0.7450	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+1.60S	0.7450	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +0.90D	0.1238	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +0.90D	0.1238	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+0.20S	0.2375	+Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
X-X, +1.20D+0.20S	0.2375	-Z	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.40D	0.1925	-X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.40D	0.1925	+X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.20D	0.1650	-X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.20D	0.1650	+X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK
Z-Z, +1.20D+0.50S	0.3463	-X	Bottom	0.2160	ACI 7.6.1.1	0.30	8.974	OK

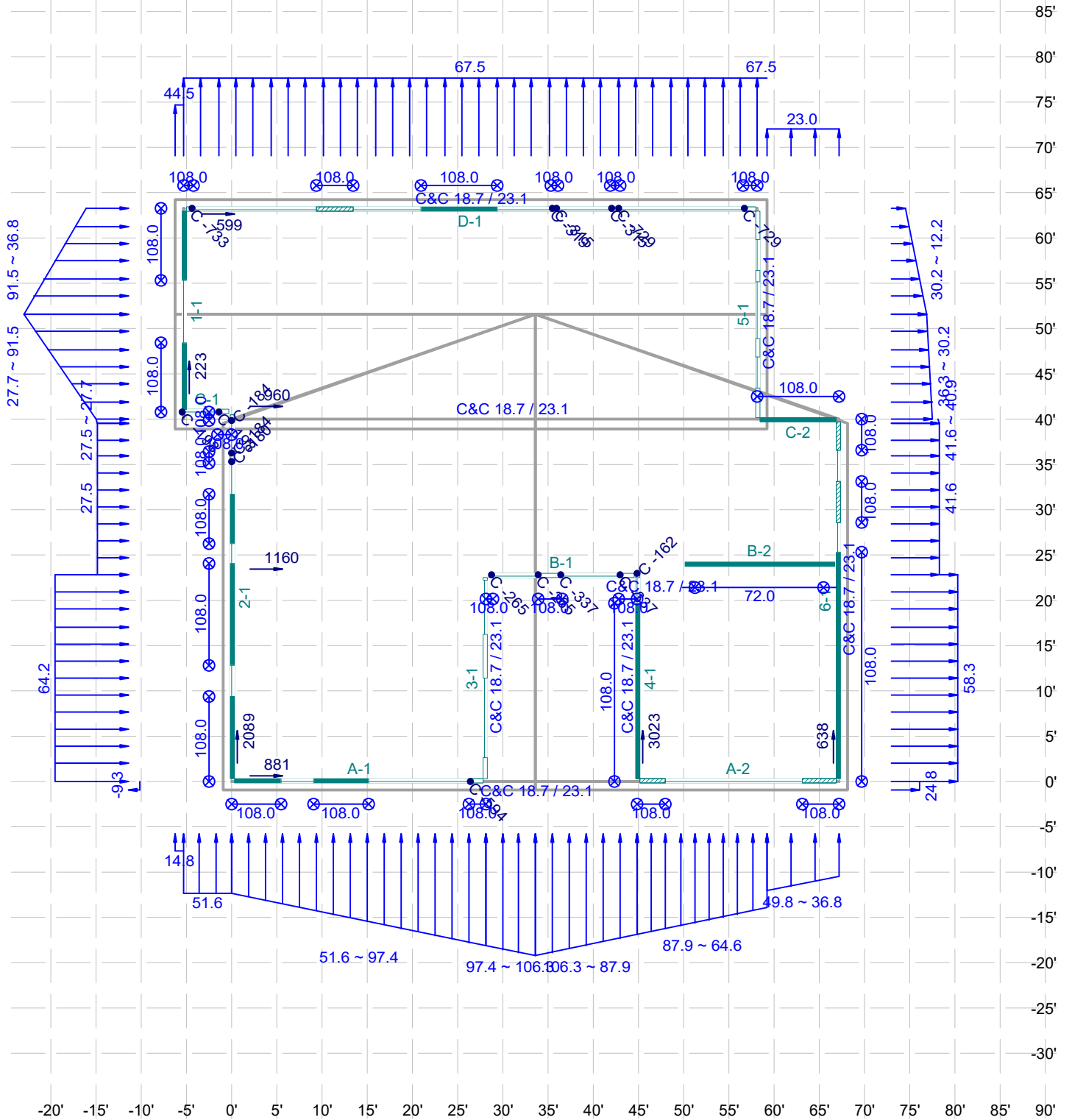
HAREZLAK ENGINEERING
NIKKI H RESIDENCE --LATERAL CALCULATIONS

Level 1 of 1



- Factored shearline force (lbs)
- Unfactored applied shear load (plf)
- Factored hold-down force (lbs)
- Unfactored dead load (plf, lbs)
- Factored compression force (lbs)
- Applied point load or discontinuous shearline force (lbs)
- Vertical element required

Level 1 of 1



- Factored shearline force (lbs)
 - ▲ Factored hold-down force (lbs)
 - C Factored compression force (lbs)
 - Vertical element required
 - ↑↑↑ Unfactored applied shear load (plf)
 - ⊗ Unfactored dead load (plf,lbs)
 - ⊙ Unfactored uplift wind load (plf,lbs)
 - Applied point load or discontinuous shearline force (lbs)
- Loads: Directional Case 1 Wind (W); Forces: 0.6W + 0.6D; Flexible distribution

WoodWorks® Shearwalls 13.1.2

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Project Information

COMPANY AND PROJECT INFORMATION

Company	Project
HAREZLAK ENGINEERING PAH	

DESIGN SETTINGS

Design Code IBC 2021/AWC SDPWS 2021		Wind Standard ASCE 7-16 Directional (All heights)		Seismic Standard ASCE 7-16	
Load Combinations			Building Code Capacity Modification		
For Design and MWFRS Deflection		For Deflection (Wind:Serviceability)		Wind	Seismic
0.7 Seismic + 0.6 Dead		1.0 Seismic + 0.9 Dead		1.00	1.00
0.6 Basic wind + 0.6 Dead		1.0 MRI wind + 1.0 Dead			
Duration Factor	Service Conditions and Load Duration Temperature Range		Moisture Content Fabrication Service		Max Shearwall Offset [ft]
1.60	T<=100F		19% (<=19%) 10% (<=19%)		Plan (within story)
					Elevation (between stories)
					5.00 -
Maximum Height-to-width Ratio					
Wood panels		Fiberboard	Lumber		Gypsum
Blocked	Unblocked		Wind	Seismic	Blocked Unblocked
3.5	2.0	-	-	-	2.0 1.5
Ignore shear resistance contribution of... Wall segments			Seismic		Forces based on...
Side with invalid aspect ratio			Any gypsum, lumber, fiberboard		Hold-downs Applied loads
					Drag struts Applied loads
Shearwall relative rigidity: Wall capacity					
Non-identical materials and construction on the shearline: Not allowed					
Deflection Equation: 3-term from SDPWS 4.3-1					
Drift limit for wind design: 1 / 350 story height					
FTAO strap: Continuous at top of highest opening and bottom of lowest					
Dead load in chord force for overturning design					
Tension end		Compression end		When completely counteracts overturning	
Wall length / 2		Wall length / 2		Wall length / 2	

SITE INFORMATION

Wind ASCE 7-16 Directional (All heights)			Seismic ASCE 7-16 12.8 Equivalent Lateral Force Procedure		
Design Wind Speed	98 mph		Risk Category	Category II - All others	
Serviceability Wind Speed	83 mph		Structure Type	Regular	
Exposure	Exposure B		Building System	Bearing Wall	
Enclosure	Enclosed		Design Category	D	
Min Wind Loads: Walls	16 psf		Site Class	D	
Roofs	8 psf		Spectral Response Acceleration		
Topographic Information [ft]			S1: 0.480g	Ss: 1.400g	
Shape	Height	Length	Fundamental Period T Used	E-W	N-S
-	-	-	0.132s	0.132s	0.132s
Site Location: -			Approximate Ta	0.132s	0.132s
Elev: 0ft			Maximum T	0.184s	0.184s
Rigid building - Static analysis			Response Factor R	6.50	6.50
Case 2	E-W loads	N-S loads	Fa: 1.20	Fv: 1.82	
Eccentricity (%)	15	15			
Loaded at	75%				

Design Summary

SHEARWALL DESIGN

Wind Shear Loads, Flexible Diaphragm

All shearwalls have sufficient design capacity.

Components and Cladding Wind Loads, Out-of-plane Sheathing

All shearwalls have sufficient design capacity.

Components and Cladding Wind Loads, Nail Withdrawal

All shearwalls have sufficient design capacity.

Seismic Loads, Flexible Diaphragm

All shearwalls have sufficient design capacity.

HOLD-DOWN DESIGN

Wind Loads, Flexible Diaphragm

All hold-downs have sufficient design capacity.

Seismic Loads, Flexible Diaphragm

All hold-downs have sufficient design capacity.

COMPRESSION FORCE DESIGN

Wind Loads, Flexible Diaphragm

Bottom plate has sufficient perpendicular-to-grain compressive capacity under all wall end studs.

Seismic Loads, Flexible Diaphragm

Bottom plate has sufficient perpendicular-to-grain compressive capacity under all wall end studs.

This Design Summary does not include failures that occur due to excessive story drift from ASCE 7 CC.2.2 (wind) or 12.12 (seismic).

Refer to Story Drift table in this report to verify this design criterion.

Refer to the Deflection table for possible issues regarding fastener slippage (SDPWS Table C4.2.3D).

Flexible Diaphragm Wind Design
ASCE 7 Directional (All Heights) Loads

SHEAR RESULTS

N-S Shearlines	W Gp	For Dir	ASD Shear Force [plf]			Asp-Cub		Allowable Shear [plf]				Resp. Ratio		
			v	vmax/vft	V [lbs]	Int	Ext	Int	Ext	Co	C		Cmb	V [lbs]
Line 1														
Level 1														
Ln1, Lev1	-	Both	-	-	239	-	-	145	312	-	A	-	7088	-
Wall 1-1	4	Both	-	-	239	1.0	1.0	145	312	-	-	-	7088	-
Seg. 1	-	Both	15.4	-	117	1.0	1.0	145	312	-	-	457	3468	0.03
Seg. 2	-	Both	15.4	-	122	1.0	1.0	145	312	-	-	457	3620	0.03
Line 2														
Ln2, Lev1	-	Both	-	-	2242	-	-	145	312	-	A	-	11775	-
Wall 2-1	4	Both	-	-	2242	1.0	1.0	145	312	-	-	-	11775	-
Seg. 1	-	Both	87.1	-	798	1.0	1.0	145	312	-	-	457	4192	0.19
Seg. 2	-	Both	87.1	-	972	1.0	1.0	145	312	-	-	457	5106	0.19
Seg. 3	-	Both	87.1	-	472	1.0	1.0	145	312	-	-	457	2477	0.19
Seg. 4	-	Both	0.0	-	0	1.0	1.0	145	312	-	-	312	-	-
Seg. 5	-	Both	0.0	-	0	1.0	1.0	145	312	-	-	312	-	-
Line 4														
Ln4, Lev1	-	Both	-	-	3222	-	-	145	456	-	A	-	11712	-
Wall 4-1	1	Both	-	-	3222	1.0	1.0	145	456	-	-	-	11712	-
Seg. 1	-	Both	165.2	-	3222	1.0	1.0	145	456	-	-	601	11712	0.28
Seg. 2	-	Both	0.0	-	0	1.0	1.0	145	456	-	-	456	-	-
Line 6														
Ln6, Lev1	-	Both	-	-	713	-	-	145	312	-	A	-	14544	-
Wall 6-1	4	Both	-	-	713	1.0	1.0	145	312	-	-	-	14544	-
Seg. 1	-	Both	22.4	-	561	1.0	1.0	145	312	-	-	457	11432	0.05
Seg. 2	-	Both	22.0	-	97	.98	.98	142	307	-	-	449	1982	0.05
Seg. 3	-	Both	16.6	-	55	.74	.74	107	231	-	-	339	1129	0.05
E-W														
Shearlines	W Gp	For Dir	ASD Shear Force [plf]			Asp-Cub		Allowable Shear [plf]				Resp. Ratio		
			v	vmax/vft	V [lbs]	Int	Ext	Int	Ext	Co	C		Cmb	V [lbs]
Line A														
Level 1														
LnA, Lev1	-	Both	-	-	1449	-	-	145	456	-	A	-	10261	-
Wall A-1	1	Both	-	-	968	1.0	1.0	145	456	-	-	-	6857	-
Seg. 1	-	Both	84.8	-	452	1.0	1.0	145	456	-	-	601	3203	0.14
Seg. 2	-	Both	84.8	-	516	1.0	1.0	145	456	-	-	601	3654	0.14
Seg. 3	-	Both	0.0	-	0	1.0	1.0	145	456	-	-	456	-	-
Wall A-2	1	Both	-	-	481	1.0	1.0	145	456	-	-	-	3404	-
Seg. 1	-	Both	58.1	-	179	.69	.69	99	312	-	-	412	1269	0.14
Seg. 2	-	Both	75.4	-	302	.89	.89	129	405	-	-	534	2135	0.14
Line B														
LnB, Lev1	-	Both	-	-	1964	-	-	100	437	-	A	-	9084	-
Wall B-2	2	Both	116.1	-	1964	1.0	1.0	100	437	-	-	537	9084	0.22
Line C														
LnC, Lev1	-	Both	-	-	1621	-	-	100	437	-	A	-	4788	-
Wall C-2	2	Both	181.8	-	1621	1.0	1.0	100	437	-	-	537	4788	0.34
Line D														
LnD, Lev1	-	Both	-	-	899	-	-	145	312	-	A	-	5475	-
Wall D-1	4	Both	-	-	899	1.0	1.0	145	312	-	-	-	5475	-
Seg. 1	-	Both	0.0	-	0	1.0	1.0	145	312	-	-	312	-	-
Seg. 2	-	Both	66.7	-	267	.89	.89	129	278	-	-	406	1626	0.16
Seg. 3	-	Both	75.1	-	632	1.0	1.0	145	312	-	-	457	3849	0.16
Seg. 4	-	Both	0.0	-	0	1.0	1.0	145	312	-	-	312	-	-
Seg. 5	-	Both	0.0	-	0	1.0	1.0	145	312	-	-	312	-	-
Seg. 6	-	Both	0.0	-	0	1.0	1.0	145	312	-	-	312	-	-

Legend:

W Gp - Wall design group defined in Sheathing and Framing Materials tables, where it shows associated Standard Wall. "A" means that this wall is critical for all walls in the Standard Wall group.

For Dir - Direction of wind force along shearline.

v - Design shear force on segment = ASD-factored shear force per unit length of full-height sheathing (FHS)

vmax/vft - Perforated walls: Collector and in-plane anchorage force as per SDPWS eqn. 4.3-9 = V/FHS/Co. FHS is factored for narrow segments as per 4.3.3.4

FTAO walls: Shear force in piers above and below either openings or piers beside opening(s). Aspect ratio factor does not apply to these piers.

V - ASD factored shear force. For shearline: total shearline force. For wall: total of all segments on wall. For segment: force on segment

Asp/Cub - Unblocked wood structural panel factor Cub from SDPWS 4.3.5.3 or Aspect Ratio factor from 4.3.5.5.1, which for perforated walls is sum bi / FHS from 4.3.5.6 with bi defined in 4.3.3.4. For multi-segment walls, wall row shows Cub and segment rows show Asp. For single-segment walls and perforated walls, value shown is Asp for blocked walls and Cub for unblocked walls.

Hold-Down and Compression Design (flexible wind design)

Level 1					Tensile Hold-down				Hold-down	Cap [lbs]	Crit Resp.
Line-Wall	Posit'n	Location [ft]		Load Case	or Compressive Stud Force [lbs]						
		X	Y		Shear	Dead	Uplift	Cmb'd			
Line 1											
1-1	L End	-5.25	40.46	Min	186	186		0	Not required	4340	0.00
1-1	L End	-5.25	40.46	Min	186			186	Compression	6682	0.03
1-1	L Op 1	-5.25	47.79	Min	186	675		861	Compression	6682	0.13
1-1	R Op 1	-5.25	54.79	Min	180	664		844	Compression	6682	0.13
1-1	R End	-5.25	62.46	Min	180	180		0	Not required	4340	0.00
1-1	R End	-5.25	62.46	Min	180			180	Compression	6682	0.03
Line 2											
2-1	L End	0.00	0.12	Min	806	297		509	HDU5-SDS	4340	0.12
2-1	L End	0.00	0.12	Min	806	495		1301	Compression	6682	0.19
2-1	L Op 1	0.00	9.04	Min	806	410		395	HDU5-SDS	4340	0.09
2-1	L Op 1	0.00	9.04	Min	806	684		1490	Compression	6682	0.22
2-1	R Op 1	0.00	12.79	Min	802	475		326	HDU5-SDS	4340	0.08
2-1	R Op 1	0.00	12.79	Min	802	792		1594	Compression	6682	0.24
2-1	L Op 2	0.00	23.71	Min	802	432		370	HDU5-SDS	4340	0.09
2-1	L Op 2	0.00	23.71	Min	802	720		1522	Compression	6682	0.23
2-1	R Op 2	0.00	26.13	Min	822	246		576	HDU5-SDS	4340	0.13
2-1	R Op 2	0.00	26.13	Min	822	410		1231	Compression	6682	0.18
2-1	L Op 3	0.00	31.29	Min	822	284		538	HDU5-SDS	4340	0.12
2-1	L Op 3	0.00	31.29	Min	822	473		1294	Compression	6682	0.19
	V Elem	0.00	34.88	1	0	180		180	Compression		
	V Elem	0.00	35.79	1	0	185		184	Compression		
	V Elem	0.00	39.46	1	0	185		184	Compression		
Line 4											
4-1	L End	44.42	0.12	Min	1506	632		874	HDU5-SDS	4340	0.20
4-1	L End	44.42	0.12	Min	1506	1053		2559	Compression	6682	0.38
4-1	L Op 1	44.42	19.38	Min	1506	729		777	HDU5-SDS	4340	0.18
4-1	L Op 1	44.42	19.38	Min	1506	1215		2721	Compression	6682	0.41
	V Elem	44.42	22.63	1	0	162		162	Compression		
Line 6											
6-1	L End	66.50	0.12	Min	204	204		0	Not required	4340	0.00
6-1	L End	66.50	0.12	Min	204	164		368	Compression	6682	0.06
6-1	L Op 1	66.50	24.88	Min	204	204		0	Not required	4340	0.00
6-1	L Op 1	66.50	24.88	Min	204	515		719	Compression	6682	0.11
6-1	R Op 1	66.50	28.38	Min	210	210		0	Not required	4340	0.00
6-1	R Op 1	66.50	28.38	Min	210	336		546	Compression	6682	0.08
6-1	L Op 2	66.50	32.54	Min	210	210		0	Not required	4340	0.00
6-1	L Op 2	66.50	32.54	Min	210	363		573	Compression	6682	0.09
6-1	R Op 2	66.50	36.29	Min	162	162		0	Not required	4340	0.00
6-1	R Op 2	66.50	36.29	Min	162	369		531	Compression	6682	0.08
6-1	R End	66.50	39.38	Min	162	108		54	HDU5-SDS	4340	0.01
6-1	R End	66.50	39.38	Min	162	80		242	Compression	6682	0.04
Line A											
A-1	L End	0.12	0.00	Min	848	173		675	HDU5-SDS	4340	0.16
A-1	L End	0.12	0.00	Min	848	288		1136	Compression	6682	0.17
A-1	L Op 1	5.21	0.00	Min	848	289		559	HDU5-SDS	4340	0.13
A-1	L Op 1	5.21	0.00	Min	848	482		1330	Compression	6682	0.20
A-1	R Op 1	9.04	0.00	Min	1008	313		695	HDU5-SDS	4340	0.16
A-1	R Op 1	9.04	0.00	Min	1008	522		1530	Compression	6682	0.23
A-1	L Op 2	14.88	0.00	Min	1008	554		454	HDU5-SDS	4340	0.10
A-1	L Op 2	14.88	0.00	Min	1008	923		1930	Compression	6682	0.29
	V Elem	26.13	0.00	1	0	594		594	Compression		
A-2	L End	44.54	0.00	Min	829	100		729	HDU5-SDS	4340	0.17
A-2	L End	44.54	0.00	Min	829	167		996	Compression	6682	0.15
A-2	L Op 1	47.38	0.00	Min	829	586		243	HDU5-SDS	4340	0.06
A-2	L Op 1	47.38	0.00	Min	829	977		1806	Compression	6682	0.27
A-2	R Op 1	62.63	0.00	Min	756	616		140	HDU5-SDS	4340	0.03
A-2	R Op 1	62.63	0.00	Min	756	1026		1782	Compression	6682	0.27
A-2	R End	66.38	0.00	Min	756	130		626	HDU5-SDS	4340	0.14
A-2	R End	66.38	0.00	Min	756	216		972	Compression	6682	0.15
Line B											
	V Elem	28.46	22.50	1	0	266		265	Compression		
	V Elem	33.63	22.50	1	0	266		265	Compression		
	V Elem	36.04	22.50	1	0	338		337	Compression		
	V Elem	42.54	22.50	1	0	338		337	Compression		
B-2	L End	49.46	23.75	Min	1061	365		695	HDU5-SDS	5645	0.12
B-2	L End	49.46	23.75	Min	1061	609		1670	Compression	10312	0.16
B-2	R End	66.13	23.75	Min	1061	365		695	HDU5-SDS	5645	0.12
B-2	R End	66.13	23.75	Min	1061	609		1670	Compression	10312	0.16

COLLECTOR FORCES (flexible wind design)

Level 1 Line-Wall	Position on Wall or Opening	Location [ft]		Load Case	Drag Strut Force [lbs]		Strap/Blocking Force [lbs]	
		X	Y		--->	<---	--->	<---
Line 1								
1-1	Left Opening 1	-5.25	47.92		36	-36		
1-1	Right Opening 1	-5.25	54.67		-37	37		
Line 2								
2-1	Left Opening 1	0.00	9.17		470	-470		
2-1	Right Opening 1	0.00	12.67		344	-344		
2-1	Left Opening 2	0.00	23.83		917	-917		
2-1	Right Opening 2	0.00	26.00		839	-839		
2-1	Left Opening 3	0.00	31.42		1117	-1117		
Line 4								
4-1	Left Opening 1	44.42	19.50		2218	-2218		
Line 6								
6-1	Left Opening 1	66.50	25.00		109	-109		
6-1	Right Opening 1	66.50	28.25		51	-51		
6-1	Left Opening 2	66.50	32.67		68	-68		
6-1	Right Opening 2	66.50	36.17		5	-5		
Line A								
A-1	Left Opening 1	5.33	0.00		336	-336		
A-1	Right Opening 1	8.92	0.00		258	-258		
A-1	Left Opening 2	15.00	0.00		641	-641		
A-2	Left Wall End	44.42	0.00		0	0		
A-2	Left Opening 1	47.50	0.00		112	-112		
A-2	Right Opening 1	62.50	0.00		-214	214		
Line B								
B-2	Left Wall End	49.33	23.75		-1457	1457		
B-2	Right Wall End	66.25	23.75		7	-7		
Line C								
C-2	Left Wall End	57.58	39.50		-1532	1532		
Line D								
D-1	Right Opening 1	9.33	62.58		-209	209		
D-1	Left Opening 2	13.33	62.58		1	-1		
D-1	Right Opening 2	20.67	62.58		-104	104		
D-1	Left Opening 3	29.08	62.58		408	-408		

Legend:

Line-Wall - Shearline and wall number

Position... - Side of opening or wall end that drag strut is attached to

Location - Co-ordinates in Plan View

Load Case - Results are for critical load case:

ASCE 7 All heights Case 1 or 2

ASCE 7 Low-rise corner; Case A or B

Drag strut Force - Axial force in transfer element at openings, gaps, or changes in design shear along shearline. + : tension; - : compression.

Based on ASD-factored shearline force (vmax from 4.3.6.4.1.1 for perforated walls)

Strap/Blocking Force – For FTAO walls, force transferred from above and below opening to shearwall pier.

-> Due to shearline force in the west-to-east or south-to-north direction

<- Due to shearline force in the east-to-west or north-to-south direction

SERVICEABILITY DEFLECTION (flexible wind design)

These deflections are used to determine story drift

Wall, segment	W Gp	Dir	Srf	v plf	b ft	h ft	Bending		Ga kips/in	Nail slip		Shear Defl in	Hold Defl in	Total Defl in
							A sq.in	Defl in		Vn lbs	en in			
Level 1														
Line 1														
1-1,1	4	Both	ExtS	18.5	7.58	9.00	16.5	.001	28.3	187	.012	.006	0.00	0.01
1-1,2		Both	ExtS	18.5	7.92	9.00	16.5	.001	28.3	187	.012	.006	0.00	0.01
Line 2														
2-1,1	4	S->N	ExtS	104.1	9.17	9.00	16.5	.003	28.3	187	.012	.033	0.27	0.31
		N->S	ExtS	104.1	9.17	9.00	16.5	.003	28.3	187	.012	.033	0.27	0.30
2-1,2		Both	ExtS	104.1	11.17	9.00	16.5	.003	28.3	187	.012	.033	0.22	0.25
2-1,3		S->N	ExtS	104.1	5.42	9.00	16.5	.006	28.3	187	.012	.033	0.47	0.51
		N->S	ExtS	104.1	5.42	9.00	16.5	.006	28.3	187	.012	.033	0.47	0.50
Line 4														
4-1,1	1	Both	ExtS	197.5	19.50	9.00	16.5	.003	37.6	182	.011	.047	0.13	0.18
Line 6														
6-1,1	4	Both	ExtS	26.8	25.00	9.00	16.5	.000	28.3	187	.012	.009	0.00	0.01
6-1,2		Both	ExtS	26.3	4.42	9.00	16.5	.002	28.3	187	.012	.008	0.01	0.02
6-1,3		S->N	ExtS	19.9	3.33	9.00	16.5	.002	28.3	187	.012	.006	0.00	0.01
		N->S	ExtS	19.9	3.33	9.00	16.5	.002	28.3	187	.012	.006	0.73	0.74
Line A														
A-1,1	1	W->E	ExtS	101.4	5.33	9.00	16.5	.006	37.6	182	.011	.024	0.48	0.51
		E->W	ExtS	101.4	5.33	9.00	16.5	.006	37.6	182	.011	.024	0.47	0.50
A-1,2		W->E	ExtS	101.4	6.08	9.00	16.5	.005	37.6	182	.011	.024	0.42	0.45
		E->W	ExtS	101.4	6.08	9.00	16.5	.005	37.6	182	.011	.024	0.41	0.44
A-2,1	1	W->E	ExtS	69.5	3.08	9.00	16.5	.007	37.6	182	.011	.017	0.87	0.90
		E->W	ExtS	69.5	3.08	9.00	16.5	.007	37.6	182	.011	.017	0.82	0.85
A-2,2		W->E	ExtS	90.1	4.00	9.00	16.5	.007	37.6	182	.011	.022	0.61	0.64
		E->W	ExtS	90.1	4.00	9.00	16.5	.007	37.6	182	.011	.022	0.65	0.68
Line B														
B-2	2	Both	1S	138.8	16.92	9.00	16.5	.002	14.2	261*	.029	.088	0.14	0.23
Line C														
C-2	2	Both	ExtS	217.3	8.92	9.00	16.5	.006	14.2	261*	.029	.138	0.29	0.44
Line D														
D-1,2	4	W->E	ExtS	79.8	4.00	9.00	16.5	.006	28.3	187	.012	.025	0.61	0.64
		E->W	ExtS	79.8	4.00	9.00	16.5	.006	28.3	187	.012	.025	0.63	0.66
D-1,3		Both	ExtS	89.7	8.42	9.00	16.5	.003	28.3	187	.012	.029	0.28	0.32

Legend:

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B.

W Gp – Wall design group, refer to Sheathing and Framing Materials tables.

Dir – Force direction.

Srf – Wall surface = Int(erior) or Ext(erior) for perimeter walls, 1 or 2 for interior partitions; Comb = Combined v and Ga for identical materials on each side; S = Ga from side with stronger shear resistance; W = 2 x Ga of weaker side.

v – Shear force per unit distance on wall segment using 1.0 Wa = wind load based on serviceability wind speeds from ASCE 7 CC.2.2, Figs. CC.2-1 - CC.2-4.

Unblocked walls = v / Cub as per SDPWS 4.3.4.3, Cub = Unblocked factor from 4.3.5.3, shown in the Shear Results table.

Perforated walls = vmax from Eqn. 4.3-9, as per 4.3.4.2.

FTAO walls = Unit shear force in pier beside opening(s).

b – Wall or segment length.

Segmented wall or FTAO wall segments = Width of wall segment between openings.

Perforated wall = Sum of FHS segments, modified as in 4.3.3.4 per 4.3.4.2.

FTAO wall = Length of wall including openings.

h – Wall height.

FTAO piers = Distance from bottom of opening to top of wall; for end segments, results using that distance and the wall height are averaged.

Defl – Horizontal shear wall deflection due to given term:

Bending = $8vh^3 / EA$; A = Effective cross sectional area of segment end stud(s), E = stud mod. of elasticity in Framing Materials table

For i studs at one end and j at the other, $A = 2ij / (i + j) \times$ area of one stud, based on Ex. C4.3.4-3

Shear = $vh / 1000 Ga$; Ga = Factor x vw / (Factor x vw / Gvtv + 0.75 en), adapted from SDPWS Ex. C4.3.4-1.

Factor = Ps / Pm / 0.6 for WSP, 1.0 for other materials.

vw = ASD sheathing capacity.

Gvtv = Shear stiffness from C4.3.4, shown in Sheathing Materials table.

en = Nail slip from Table C4.2.3D of form aVn^b for WSP, varies linearly to value at capacity for other materials.

Ps = Serviceability wind pressure; Pm = MWFRS wind pressure.

Vn = Serviceability force per nail along panel edge at ASD capacity = Factor x vw.

Hold – Anchorage system (hold-down) = $da \times h / beff$.

da = Vertical hold-down displacement; refer to Hold-down Displacement table for components.

beff = Effective wall segment length = $b - (tension\ stud\ pack\ width + hold-down\ anchor\ bolt\ offset) - (1/2\ compression\ stud\ pack\ width)$

beff is given in the Shear Wall Dimensions table.

For FTAO walls, hold-down device at end of wall is applied to all segments, as per APA T555.

Out-of-plane Wind Design

COMPONENTS AND CLADDING by SHEARLINE

North-South Shearlines			Sheathing [psf]			Fastener Withdrawal [lbs]					Service Cond Factors	
Line	Lev	Grp	Force	Cap	Force/Cap	Force End	Force Int	Cap	Force/Cap End	Force/Cap Int	Temp	Moist
3	1	2	13.9	221.9	0.06	18.5	15.0	126.5	0.15	0.12	1.00	1.00
4	1	1	13.9	265.6	0.05	18.5	15.0	75.5	0.25	0.20	1.00	1.00
5	1	2	13.9	221.9	0.06	18.5	15.0	126.5	0.15	0.12	1.00	1.00
6	1	4	13.9	265.6	0.05	18.5	15.0	75.5	0.25	0.20	1.00	1.00
East-West Shearlines			Sheathing [psf]			Fastener Withdrawal [lbs]					Service Cond Factors	
Line	Lev	Grp	Force	Cap	Force/Cap	Force End	Force Int	Cap	Force/Cap End	Force/Cap Int	Temp	Moist
A	1	1	13.9	265.6	0.05	18.5	15.0	75.5	0.25	0.20	1.00	1.00
B	1	2	13.9	221.9	0.06	18.5	15.0	126.5	0.15	0.12	1.00	1.00
C	1	2	13.9	221.9	0.06	18.5	15.0	126.5	0.15	0.12	1.00	1.00
		3	13.9	221.9	0.06	18.5	15.0	126.5	0.15	0.12	1.00	1.00
D	1	4	13.9	265.6	0.05	18.5	15.0	75.5	0.25	0.20	1.00	1.00

Legend:

Grp - Wall Design Group (results for all design groups for rigid, flexible design listed for each wall)

Sheathing:

Force - C&C end zone exterior pressures using negative (suction) coefficient in ASCE 7 Figure 30.3-1 added to interior pressure using coefficients from Table 26.13-1

Cap - Out-of-plane capacity of exterior sheathing from SDPWS Tables 3.2.1A/B, divided by 1.6 for short-term ASD loads as per 3.2.1. Assumes continuous over 2 spans (table note 3).

Fastener Withdrawal:

Force - Force tributary to each nail in end zone and interior zone

Cap - Factored withdrawal capacity of individual nail according to NDS 12.2-3

Flexible Diaphragm Seismic Design

SEISMIC INFORMATION

Level	Mass [lbs]	Area [sq.ft]	Story Shear Fx [lbs]		Shear Resistance [lbs]		Diaphragm Force [lbs]			
			E-W	N-S	E-W	N-S	E-W		N-S	
							Fpx	Design	Fpx	Design
1	88059	3699.7	9483	9483	16294	22642	13808	13808	13808	13808
All	88059	-	9483	9483	-	-	-	-	-	-

Legend:

Mass – Sum of all generated and input building masses on level = wx in ASCE 7 Eqn. 12.8-12.

Story Shear – Total ASD-factored shear force induced at level x from Eqn. 12.8-11.

Shear Resistance – Lateral design strength of all shear-resisting elements on story, for use in weak story evaluation (4.1.8).

Diaphragm Force – used by Shearwalls only for drag strut forces, as per Exception to 12.10.2.1.

Fpx - Minimum ASD-factored force for diaphragm design from Eqns. 12.10-1, -2, and -3.

Design = The greater of the story shear and Fpx + transfer forces from discontinuous shearlines, factored by overstrength (omega) as per 12.10.1.1. Omega = 2.5 as per 12.2-1.

Redundancy Factor p (rho):

E-W 1.00, N-S 1.00

Input by user (overriding calculated value).

Vertical Earthquake Load Ev

Ev = 0.2 Sds D; Sds = 1.00; Ev = 0.200 D unfactored; 0.140 D factored; total dead load factor: 0.6 - 0.140 = 0.460 tension, 1.0 + 0.140 = 1.140 compression.

SHEAR RESULTS (flexible seismic design)

N-S Shearlines	W Gp	For Dir	ASD Shear Force [plf]			Asp-Cub		Allowable Shear [plf]					Resp. Ratio	
			v	vmax/vft	V [lbs]	Int	Ext	Int	Ext	Co	C	Cmb		V [lbs]
Line 1														
Level 1														
Ln1, Lev1	-	Both	-	-	412	-	-	0	223	-	S	-	3458	-
Wall 1-1	4	Both	-	-	412	1.0	1.0	0	223	-	-	-	3458	-
Seg. 1	-	Both	26.6	-	202	1.0	1.0	0	223	-	-	223	1692	0.12
Seg. 2	-	Both	26.6	-	211	1.0	1.0	0	223	-	-	223	1766	0.12
Line 2														
Ln2, Lev1	-	Both	-	-	3173	-	-	0	223	-	S	-	5744	-
Wall 2-1	4	Both	-	-	3173	1.0	1.0	0	223	-	-	-	5744	-
Seg. 1	-	Both	123.2	-	1130	1.0	1.0	0	223	-	-	223	2045	0.55
Seg. 2	-	Both	123.2	-	1376	1.0	1.0	0	223	-	-	223	2491	0.55
Seg. 3	-	Both	123.2	-	667	1.0	1.0	0	223	-	-	223	1208	0.55
Seg. 4	-	Both	0.0	-	0	1.0	1.0	0	223	-	-	223	-	-
Seg. 5	-	Both	0.0	-	0	1.0	1.0	0	223	-	-	223	-	-
Line 4														
Ln4, Lev1	-	Both	-	-	4368	-	-	0	325	-	S	-	6346	-
Wall 4-1	1^	Both	-	-	4368	1.0	1.0	0	325	-	-	-	6346	-
Seg. 1	-	Both	224.0	-	4368	1.0	1.0	0	325	-	-	325	6346	0.69
Seg. 2	-	Both	0.0	-	0	1.0	1.0	0	325	-	-	325	-	-
Line 6														
Ln6, Lev1	-	Both	-	-	1530	-	-	0	223	-	S	-	7094	-
Wall 6-1	4	Both	-	-	1530	1.0	1.0	0	223	-	-	-	7094	-
Seg. 1	-	Both	48.1	-	1203	1.0	1.0	0	223	-	-	223	5577	0.22
Seg. 2	-	Both	47.2	-	209	.98	.98	0	219	-	-	219	967	0.22
Seg. 3	-	Both	35.6	-	119	.74	.74	0	165	-	-	165	551	0.22
Line A														
Level 1														
LnA, Lev1	-	Both	-	-	2282	-	-	0	325	-	S	-	5560	-
Wall A-1	1	Both	-	-	1525	1.0	1.0	0	325	-	-	-	3715	-
Seg. 1	-	Both	133.6	-	712	1.0	1.0	0	325	-	-	325	1736	0.41
Seg. 2	-	Both	133.6	-	813	1.0	1.0	0	325	-	-	325	1980	0.41
Seg. 3	-	Both	0.0	-	0	1.0	1.0	0	325	-	-	325	-	-
Wall A-2	1	Both	-	-	757	1.0	1.0	0	325	-	-	-	1845	-
Seg. 1	-	Both	91.5	-	282	.69	.69	0	223	-	-	223	688	0.41
Seg. 2	-	Both	118.7	-	475	.89	.89	0	289	-	-	289	1157	0.41
Line B														
LnB, Lev1	-	Both	-	-	2699	-	-	0	312	-	S	-	5280	-
Wall B-2	2	Both	159.6	-	2699	1.0	1.0	0	312	-	-	312	5280	0.51
Line C														
LnC, Lev1	-	Both	-	-	2588	-	-	0	312	-	S	-	2783	-
Wall C-2	2^	Both	290.3	-	2588	1.0	1.0	0	312	-	-	312	2783	0.93
Line D														
LnD, Lev1	-	Both	-	-	1914	-	-	0	223	-	S	-	2671	-
Wall D-1	4^	Both	-	-	1914	1.0	1.0	0	223	-	-	-	2671	-
Seg. 1	-	Both	0.0	-	0	1.0	1.0	0	223	-	-	223	-	-
Seg. 2	-	Both	142.1	-	568	.89	.89	0	198	-	-	198	793	0.72
Seg. 3	-	Both	159.8	-	1345	1.0	1.0	0	223	-	-	223	1877	0.72
Seg. 4	-	Both	0.0	-	0	1.0	1.0	0	223	-	-	223	-	-
Seg. 5	-	Both	0.0	-	0	1.0	1.0	0	223	-	-	223	-	-
Seg. 6	-	Both	0.0	-	0	1.0	1.0	0	223	-	-	223	-	-

Legend:

W Gp - Wall design group defined in Sheathing and Framing Materials tables, where it shows associated Standard Wall. "^" means that this wall is critical for all walls in the Standard Wall group.

For Dir – Direction of seismic force along shearline.

v – Design shear force on segment = ASD-factored shear force per unit length of full-height sheathing (FHS)

vmax/vft - Perforated walls: Collector and in-plane anchorage force as per SDPWS eqn. 4.3-9 = V/FHS/Co. FHS is factored for narrow segments as per 4.3.3.4

FTAO walls: Shear force in piers above and below either openings or piers beside opening(s). Aspect ratio factor does not apply to these piers.

V – ASD factored shear force. For shearline: total shearline force. For wall: total of all segments on wall. For segment: force on segment

Asp/Cub – Unblocked wood structural panel factor Cub from SDPWS 4.3.5.3 or Aspect Ratio factor from 4.3.5.5.1, which for perforated walls is sum bi / FHS from 4.3.5.6 with bi defined in 4.3.3.4. For multi-segment walls, wall row shows Cub and segment rows show Asp. For single-segment walls and perforated walls, value shown is Asp for blocked walls and Cub for unblocked walls.

Int, Ext - Nominal unit shear capacity of interior and exterior sheathing, factored by Table 4.3-1 Note 3 for framing specific gravity and Note 10 for presence of hold-downs. For wall segments, also include unblocked factor Cub and aspect ratio adjustments.

Co - Adjustment factor for perforated walls from SDPWS Equation 4.3-6.

C - Sheathing combination rule, A = Add capacities, S = Strongest side or twice weakest, G = Stiffness-based using Eqns. 4.3-3,-4.

Hold-Down and Compression Design (flexible seismic design)

Level 1		Location [ft]		Tensile Hold-down or Compressive Stud Force [lbs]				Cap	Crit	
Line-Wall	Posit'n	X	Y	Shear	Dead	Ev	Cmb'd	Hold-down	[lbs]	Resp.
Line 1										
1-1	L End	-5.25	40.46	321	246	57	133	HDU5-SDS	4340	0.03
1-1	L End	-5.25	40.46	321	388	54	763	Compression	6682	0.11
1-1	L Op 1	-5.25	47.79	321	419	98	0	Not required	4340	0.00
1-1	L Op 1	-5.25	47.79	321	774	108	1203	Compression	6682	0.18
1-1	R Op 1	-5.25	54.79	310	404	94	0	Not required	4340	0.00
1-1	R Op 1	-5.25	54.79	310	792	111	1213	Compression	6682	0.18
1-1	R End	-5.25	62.46	310	257	60	113	HDU5-SDS	4340	0.03
1-1	R End	-5.25	62.46	310	360	50	720	Compression	6682	0.11
Line 2										
2-1	L End	0.00	0.12	1140	297	69	912	HDU5-SDS	4340	0.21
2-1	L End	0.00	0.12	1140	495	69	1704	Compression	6682	0.25
2-1	L Op 1	0.00	9.04	1140	410	96	825	HDU5-SDS	4340	0.19
2-1	L Op 1	0.00	9.04	1140	684	96	1920	Compression	6682	0.29
2-1	R Op 1	0.00	12.79	1134	475	111	770	HDU5-SDS	4340	0.18
2-1	R Op 1	0.00	12.79	1134	792	111	2037	Compression	6682	0.30
2-1	L Op 2	0.00	23.71	1134	432	101	803	HDU5-SDS	4340	0.19
2-1	L Op 2	0.00	23.71	1134	720	101	1955	Compression	6682	0.29
2-1	R Op 2	0.00	26.13	1163	246	57	974	HDU5-SDS	4340	0.22
2-1	R Op 2	0.00	26.13	1163	410	57	1629	Compression	6682	0.24
2-1	L Op 3	0.00	31.29	1163	284	66	945	HDU5-SDS	4340	0.22
2-1	L Op 3	0.00	31.29	1163	473	66	1701	Compression	6682	0.25
	V Elem	0.00	34.88	0	180	25	205	Compression		
	V Elem	0.00	35.79	0	185	26	210	Compression		
	V Elem	0.00	39.46	0	185	26	210	Compression		
Line 4										
4-1	L End	44.42	0.12	2042	632	147	1558	HDU5-SDS	4340	0.36
4-1	L End	44.42	0.12	2042	1053	147	3242	Compression	6682	0.49
4-1	L Op 1	44.42	19.38	2042	729	170	1483	HDU5-SDS	4340	0.34
4-1	L Op 1	44.42	19.38	2042	1215	170	3427	Compression	6682	0.51
	V Elem	44.42	22.63	0	162	23	185	Compression		
Line 6										
6-1	L End	66.50	0.12	437	570	133	0	Not required	4340	0.00
6-1	L End	66.50	0.12	437	902	126	1465	Compression	6682	0.22
6-1	L Op 1	66.50	24.88	437	570	133	0	Not required	4340	0.00
6-1	L Op 1	66.50	24.88	437	1310	183	1930	Compression	6682	0.29
6-1	R Op 1	66.50	28.38	450	248	58	260	HDU5-SDS	4340	0.06
6-1	R Op 1	66.50	28.38	450	414	58	922	Compression	6682	0.14
6-1	L Op 2	66.50	32.54	450	257	60	254	HDU5-SDS	4340	0.06
6-1	L Op 2	66.50	32.54	450	428	60	938	Compression	6682	0.14
6-1	R Op 2	66.50	36.29	347	221	52	177	HDU5-SDS	4340	0.04
6-1	R Op 2	66.50	36.29	347	369	52	767	Compression	6682	0.11
6-1	R End	66.50	39.38	347	108	25	264	HDU5-SDS	4340	0.06
6-1	R End	66.50	39.38	347	180	25	552	Compression	6682	0.08
Line A										
A-1	L End	0.12	0.00	1336	173	40	1204	HDU5-SDS	4340	0.28
A-1	L End	0.12	0.00	1336	288	40	1664	Compression	6682	0.25
A-1	L Op 1	5.21	0.00	1336	289	67	1115	HDU5-SDS	4340	0.26
A-1	L Op 1	5.21	0.00	1336	482	67	1885	Compression	6682	0.28
A-1	R Op 1	9.04	0.00	1588	313	73	1347	HDU5-SDS	4340	0.31
A-1	R Op 1	9.04	0.00	1588	522	73	2183	Compression	6682	0.33
A-1	L Op 2	14.88	0.00	1588	554	129	1163	HDU5-SDS	4340	0.27
A-1	L Op 2	14.88	0.00	1588	923	129	2639	Compression	6682	0.39
	V Elem	26.13	0.00	0	594	83	677	Compression		
A-2	L End	44.54	0.00	1306	100	23	1230	HDU5-SDS	4340	0.28
A-2	L End	44.54	0.00	1306	167	23	1496	Compression	6682	0.22
A-2	L Op 1	47.38	0.00	1306	586	137	857	HDU5-SDS	4340	0.20
A-2	L Op 1	47.38	0.00	1306	977	137	2420	Compression	6682	0.36
A-2	R Op 1	62.63	0.00	1191	616	144	719	HDU5-SDS	4340	0.17
A-2	R Op 1	62.63	0.00	1191	1026	144	2360	Compression	6682	0.35
A-2	R End	66.38	0.00	1191	130	30	1091	HDU5-SDS	4340	0.25
A-2	R End	66.38	0.00	1191	216	30	1437	Compression	6682	0.22
Line B										
	V Elem	28.46	22.50	0	266	37	303	Compression		
B-1	R Op 2	33.63	22.50	0	266	37	303	Compression		-
B-1	L Op 2	36.04	22.50	0	338	47	385	Compression		-
	V Elem	42.54	22.50	0	338	47	385	Compression		
B-2	L End	49.46	23.75	1458	365	85	1178	HDU5-SDS	5645	0.21
B-2	L End	49.46	23.75	1458	609	85	2152	Compression	10312	0.21

Hold-Down and Compression Design (flexible seismic design, continued)

B-2	R End	66.13	23.75	1458	365	85	1178	HDU5-SDS	5645	0.21
B-2	R End	66.13	23.75	1458	609	85	2152	Compression	10312	0.21
Line C										
	V Elem	-5.37	40.33	0	198	28	226	Compression		
	V Elem	-1.46	40.33	0	198	28	226	Compression		
C-2	L End	57.71	39.50	2688	289	67	2466	HDU5-SDS	5645	0.44
C-2	L End	57.71	39.50	2688	482	67	3236	Compression	10312	0.31
C-2	R End	66.38	39.50	2688	289	67	2466	HDU5-SDS	5645	0.44
C-2	R End	66.38	39.50	2688	482	67	3236	Compression	10312	0.31
Line D										
	V Elem	-4.37	62.58	0	734	103	836	Compression		
D-1	R Op 1	9.46	62.58	1364	570	133	927	HDU5-SDS	4340	0.21
D-1	R Op 1	9.46	62.58	1364	949	133	2446	Compression	6682	0.37
D-1	L Op 2	13.21	62.58	1364	367	86	1082	HDU5-SDS	4340	0.25
D-1	L Op 2	13.21	62.58	1364	612	86	2062	Compression	6682	0.31
D-1	R Op 2	20.79	62.58	1483	510	119	1091	HDU5-SDS	4340	0.25
D-1	R Op 2	20.79	62.58	1483	851	119	2452	Compression	6682	0.37
D-1	L Op 3	28.96	62.58	1483	464	108	1127	HDU5-SDS	4340	0.26
D-1	L Op 3	28.96	62.58	1483	774	108	2365	Compression	6682	0.35
	V Elem	35.12	62.58	0	320	45	364	Compression		
	V Elem	35.54	62.58	0	315	44	359	Compression		
	V Elem	41.63	62.58	0	315	44	359	Compression		
	V Elem	42.38	62.58	0	729	102	831	Compression		
	V Elem	56.13	62.58	0	729	102	831	Compression		

Legend:

Line-Wall:

At wall or opening – Shearline and wall number

At vertical element – Shearline

Posit'n – Position of stud pack that hold-down is attached to:

V Elem – Vertical element: column or strengthened studs required where not at wall end or opening

L or R End – At left or right wall end

L or R Op n – At left or right side of opening n

t @ Op n – Uplift force t at opening n from offset opening in perforated wall above, from SDPWS 4.3.6.4.2.1

Location – Co-ordinates in Plan View

Tensile Hold-down or Compressive Stud Force – Upwards force on hold-down at one end of the wall or downward force on bottom plate under studs at the other end, for each force direction. Includes forces transferred from upper levels.

Shear – Overturning component = $V \times h / beff$ from SDPWS Eqn. 4.3-7; V = force on segment, ASD-factored by 0.70; h = wall height, beff = wall segment length – (tension stud pack width + hold-down anchor bolt offset) – (1/2 compression stud pack width). For perforated walls = $V \times h / Co$ sum (bi) from SDPWS Eqn. 4.3-8.

Dead – Dead load resisting component, factored for ASD by 0.60 for tension and 1.0 for compression

Ev – Vertical seismic load effect from ASCE 7 12.4.2.2 = $-0.2 Sds \times ASD \text{ factor} \times \text{unfactored } D = 0.233 SDS \times \text{factored } D$. Refer to Seismic Information table for more details.

Cmb'd – Sum of ASD-factored overturning, dead and vertical seismic forces. May also include the uplift force t from perforated walls from SDPWS 4.3.6.4.2.1 when openings are staggered.

Hold-down – Device model number from hold-down database; "Compression" for bearing of end stud pack on bottom plate

Cap – Hold-downs: Allowable ASD tension load from database; Compression: Allowable ASD bearing force = $Ct CM Cb Fcp A$; A = cross sectional area of end studs. Refer to Framing materials table for details.

Crit. Resp. – Critical Response = Combined ASD force/Allowable ASD tension load

Notes:

HDU5-SDS2.5 for studs with thickness > 0'-3" and depth > 0'-3.5" : Uses 14 1/4" x 2.5" SDS heavy-duty screws; 5/8" anchor bolt.

Combined force from ASCE 7 2.4.1 load combination 10 = $-(0.6D - 0.7Ev + 0.7Eh)$; Eh (from 12.4.2.1) = - shear overturning force

Refer to the Shear Line Dimensions table for wall height h, effective segment length beff and perforated wall adjusted sum of bi, to the Story Table for joist depth, and to the Shear Results table for perforated factor Co.

Designer is responsible for design of connection from wall to floor or foundation for shear force shown in Shear Results table. Refer to SDPWS 4.3.6.4.3 for foundation anchor bolt requirements.

COLLECTOR FORCES (flexible seismic design)

Level 1 Line-Wall	Position on Wall or Opening	Location [ft]		Drag Strut Force [lbs]		Strap/Blocking Force [lbs]	
		X	Y	--->	<---	--->	<---
Line 1							
	Shearline force			600	600		
1-1	Left Opening 1	-5.25	47.92	89	-89		
1-1	Right Opening 1	-5.25	54.67	-93	93		
Line 2							
	Shearline force			4620	4620		
2-1	Left Opening 1	0.00	9.17	968	-968		
2-1	Right Opening 1	0.00	12.67	710	-710		
2-1	Left Opening 2	0.00	23.83	1889	-1889		
2-1	Right Opening 2	0.00	26.00	1729	-1729		
2-1	Left Opening 3	0.00	31.42	2301	-2301		
Line 4							
	Shearline force			6359	6359		
4-1	Left Opening 1	44.42	19.50	4378	-4378		
Line 6							
	Shearline force			2228	2228		
6-1	Left Opening 1	66.50	25.00	341	-341		
6-1	Right Opening 1	66.50	28.25	158	-158		
6-1	Left Opening 2	66.50	32.67	212	-212		
6-1	Right Opening 2	66.50	36.17	15	-15		
Line A							
	Shearline force			3323	3323		
A-1	Left Opening 1	5.33	0.00	771	-771		
A-1	Right Opening 1	8.92	0.00	592	-592		
A-1	Left Opening 2	15.00	0.00	1471	-1471		
A-2	Left Wall End	44.42	0.00	1	-1		
A-2	Left Opening 1	47.50	0.00	258	-258		
A-2	Right Opening 1	62.50	0.00	-492	492		
Line B							
	Shearline force			3930	3930		
B-2	Left Wall End	49.33	23.75	-2916	2916		
B-2	Right Wall End	66.25	23.75	15	-15		
Line C							
	Shearline force			3768	3768		
C-2	Left Wall End	57.58	39.50	-3560	3560		
Line D							
	Shearline force			2786	2786		
D-1	Right Opening 1	9.33	62.58	-647	647		
D-1	Left Opening 2	13.33	62.58	3	-3		
D-1	Right Opening 2	20.67	62.58	-322	322		
D-1	Left Opening 3	29.08	62.58	1264	-1264		

Legend:

Line-Wall - Shearline and wall number

Position... - Side of opening or wall end that drag strut is attached to

Location - Co-ordinates in Plan View

Drag strut Force - Axial force in transfer element at openings, gaps, or changes in design shear along shearline. + : tension; - : compression.

Based on ASD-factored shearline force shown. For SDC C-F, it is the greater of the design shearline force and the diaphragm force F_{px} , added to shearline force from story above and to forces transferred from discontinuous shearlines factored by overstrength (ω) as per 12.10.1.1.

Refer to Seismic Information table for diaphragm forces and ω factor.

For SDC D-F, if horizontal torsional irregularities 2, 3, or 4 are input, or vertical irregularity 4 detected or input, 25% increase from 12.3.3.4 applied.

For perforated walls, this force is converted to v_{max} using 4.3.6.4.1.1.

Strap/Blocking Force – For FTAO walls, force transferred from above and below opening to shearwall pier.

-> Due to shearline force in the west-to-east or south-to-north direction

<- Due to shearline force in the east-to-west or north-to-south direction

DEFLECTION (flexible seismic design)

Wall, segment	W Gp	Dir	Srf	v plf	b ft	h ft	Bending A sq.in	Defl in	Ga kips/in	Nail slip Vn lbs	en in	Shear Defl in	Hold Defl in	Total Defl in
Level 1														
Line 1														
1-1,1	4	S->N	ExtS	38.0	7.58	9.00	16.5	.001	36.3	156	.006	.009	0.32	0.33
		N->S	ExtS	38.0	7.58	9.00	16.5	.001	36.3	156	.006	.009	0.00	0.02
1-1,2		S->N	ExtS	38.0	7.92	9.00	16.5	.001	36.3	156	.006	.009	0.00	0.02
		N->S	ExtS	38.0	7.92	9.00	16.5	.001	36.3	156	.006	.009	0.30	0.31
Line 2														
2-1,1	4	Both	ExtS	176.0	9.17	9.00	16.5	.006	36.3	156	.006	.044	0.30	0.34
2-1,2		Both	ExtS	176.0	11.17	9.00	16.5	.005	36.3	156	.006	.044	0.24	0.29
2-1,3		Both	ExtS	176.0	5.42	9.00	16.5	.010	36.3	156	.006	.044	0.51	0.56
Line 4														
4-1,1	1	Both	ExtS	320.0	19.50	9.00	16.5	.005	46.1	152	.006	.062	0.15	0.22
Line 6														
6-1,1	4	Both	ExtS	68.7	25.00	9.00	16.5	.001	36.3	156	.006	.017	0.00	0.02
6-1,2		Both	ExtS	67.5	4.42	9.00	16.5	.004	36.3	156	.006	.017	0.57	0.59
6-1,3		S->N	ExtS	50.9	3.33	9.00	16.5	.004	36.3	156	.006	.013	0.75	0.77
		N->S	ExtS	50.9	3.33	9.00	16.5	.004	36.3	156	.006	.013	0.76	0.78
Line A														
A-1,1	1	W->E	ExtS	190.8	5.33	9.00	16.5	.011	46.1	152	.006	.037	0.54	0.59
		E->W	ExtS	190.8	5.33	9.00	16.5	.011	46.1	152	.006	.037	0.53	0.58
A-1,2		W->E	ExtS	190.8	6.08	9.00	16.5	.009	46.1	152	.006	.037	0.48	0.53
		E->W	ExtS	190.8	6.08	9.00	16.5	.009	46.1	152	.006	.037	0.47	0.52
A-2,1	1	W->E	ExtS	130.8	3.08	9.00	16.5	.012	46.1	152	.006	.026	0.98	1.01
		E->W	ExtS	130.8	3.08	9.00	16.5	.012	46.1	152	.006	.026	0.92	0.95
A-2,2		W->E	ExtS	169.6	4.00	9.00	16.5	.012	46.1	152	.006	.033	0.68	0.72
		E->W	ExtS	169.6	4.00	9.00	16.5	.012	46.1	152	.006	.033	0.72	0.77
Line B														
B-2	2	Both	1S	228.0	16.92	9.00	16.5	.003	17.7	219	.016	.116	0.16	0.28
Line C														
C-2	2	Both	ExtS	414.6	8.92	9.00	16.5	.012	17.7	219	.016	.210	0.34	0.57
Line D														
D-1,2	4	W->E	ExtS	203.0	4.00	9.00	16.5	.015	36.3	156	.006	.050	0.71	0.77
		E->W	ExtS	203.0	4.00	9.00	16.5	.015	36.3	156	.006	.050	0.73	0.79
D-1,3		Both	ExtS	228.3	8.42	9.00	16.5	.008	36.3	156	.006	.057	0.33	0.40

Legend:

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B.

W Gp – Wall design group, refer to Sheathing and Framing Materials tables.

Dir – Force direction.

Srf – Wall surface = Int(erior) or Ext(erior) for perimeter walls, 1 or 2 for interior partitions; Comb = Combined v and Ga for identical materials on each side; S = Ga from side with stronger shear resistance; W = 2 x Ga of weaker side.

v – Unfactored (strength-level) shear force per unit distance on wall segment = ASD force / 0.70, as per ASCE 7 12.8.6.

Unblocked walls = v / Cub as per SDPWS 4.3.4.3, Cub = Unblocked factor from 4.3.5.3, shown in the Shear Results table.

Perforated walls = v_{max} from Eqn. 4.3-9, as per 4.3.4.2.

FTAO walls = Unit shear force in pier beside opening(s).

b – Wall or segment length.

Segmented wall or FTAO wall segments = Width of wall segment between openings.

Perforated wall = Sum of FHS segments, modified as in 4.3.3.4 per 4.3.4.2.

FTAO wall = Length of wall including openings.

h – Wall height.

FTAO piers = Distance from bottom of opening to top of wall; for end segments, results using that distance and the wall height are averaged.

Defl – Horizontal shear wall deflection due to given term:

Bending = $8vh^3 / EAb$; A = Effective cross sectional area of segment end stud(s), E = stud mod. of elasticity in Framing Materials table

For i studs at one end and j at the other, $A = 2ij / (i + j)$ x area of one stud, based on Ex. C4.3.4-3

Shear = $vh / 1000 Ga$; Ga = $1.4 vs / (1.4 vs / Gvtv + 0.75 en)$ from SDPWS Eqn. C4.2.3-3.

vs = ASD sheathing capacity.

Gvtv = Shear stiffness from C4.3.4, shown in Sheathing Materials table.

en = Nail slip from Table C4.2.3D, of form aVn^b for WSP, varies linearly to value at capacity for other materials.

Vn = Strength-level shear force per nail along panel edge at ASD capacity = 1.4 vs.

Hold – Anchorage system (hold-down) = $da \times h / beff$.

da = Vertical hold-down displacement; refer to Hold-down Displacement table for components.

beff = Effective wall segment length = $b - (tension\ stud\ pack\ width + hold-down\ anchor\ bolt\ offset) - (1/2\ compression\ stud\ pack\ width)$

beff is given in the Shear Wall Dimensions table.

For FTAO walls, hold-down device at end of wall is applied to all segments, as per APA T555.

Total Defl – Deflection from bending + shear + hold-down, as per Eqn. 4.3-2.

For FTAO walls, the average of the values for the segments, as per APA T555.

WARNING - Fastener slip based on lumber with specific gravity not less than 0.5, however specific gravity for at least some walls is less than 0.5.

HOLD-DOWN DISPLACEMENT (flexible seismic design)

Wall, segment	Dir	Hold-down	Tens. force lbs	Vert. Displacement			Slippage		Shrink +Extra in	Comp. force lbs	Crush da in	Total da in	Horz Defl in
				Manuf in	Add in	da in	Vf lbs	da in					
Level 1													
Line 1													
1-1,1	S->N	HDU5-SDS	133	.005	.000	0.005	-	-	.248	1697	0.01	0.26	0.32
	N->S	HDU5-SDS	0	.000	.000	0.000	-	-	.000	982	0.00	0.00	0.00
1-1,2	S->N	HDU5-SDS	0	.000	.000	0.000	-	-	.000	926	0.00	0.00	0.00
	N->S	HDU5-SDS	113	.004	.000	0.004	-	-	.248	1710	0.01	0.26	0.30
Line 2													
2-1,1	S->N	HDU5-SDS	912	.033	.001	0.034	-	-	.248	2723	0.01	0.29	0.30
	N->S	HDU5-SDS	825	.030	.001	0.031	-	-	.248	2421	0.01	0.29	0.29
2-1,2	S->N	HDU5-SDS	770	.028	.001	0.029	-	-	.248	2773	0.01	0.29	0.24
	N->S	HDU5-SDS	803	.029	.001	0.030	-	-	.248	2888	0.01	0.29	0.24
2-1,3	S->N	HDU5-SDS	974	.035	.001	0.036	-	-	.248	2417	0.01	0.29	0.51
	N->S	HDU5-SDS	945	.034	.001	0.035	-	-	.248	2316	0.01	0.29	0.51
Line 4													
4-1,1	S->N	HDU5-SDS	1558	.057	.001	0.058	-	-	.248	4861	0.02	0.33	0.15
	N->S	HDU5-SDS	1483	.054	.001	0.055	-	-	.248	4602	0.02	0.32	0.15
Line 6													
6-1,1	S->N	HDU5-SDS	0	.000	.000	0.000	-	-	.000	2547	0.01	0.01	0.00
	N->S	HDU5-SDS	0	.000	.000	0.000	-	-	.000	1916	0.01	0.01	0.00
6-1,2	S->N	HDU5-SDS	260	.009	.000	0.010	-	-	.248	1328	0.01	0.26	0.57
	N->S	HDU5-SDS	254	.009	.000	0.009	-	-	.248	1306	0.01	0.26	0.57
6-1,3	S->N	HDU5-SDS	177	.006	.000	0.007	-	-	.248	783	0.00	0.26	0.75
	N->S	HDU5-SDS	264	.010	.000	0.010	-	-	.248	1086	0.00	0.26	0.76
Line A													
A-1,1	W->E	HDU5-SDS	1204	.044	.001	0.045	-	-	.248	2679	0.01	0.30	0.54
	E->W	HDU5-SDS	1115	.041	.001	0.042	-	-	.248	2370	0.01	0.30	0.53
A-1,2	W->E	HDU5-SDS	1347	.049	.001	0.050	-	-	.248	3744	0.02	0.31	0.48
	E->W	HDU5-SDS	1163	.042	.001	0.043	-	-	.248	3103	0.01	0.30	0.47
A-2,1	W->E	HDU5-SDS	1230	.045	.001	0.046	-	-	.248	3429	0.01	0.31	0.98
	E->W	HDU5-SDS	857	.031	.001	0.032	-	-	.248	2133	0.01	0.29	0.92
A-2,2	W->E	HDU5-SDS	719	.026	.001	0.027	-	-	.248	2047	0.01	0.28	0.68
	E->W	HDU5-SDS	1091	.040	.001	0.041	-	-	.248	3343	0.01	0.30	0.72
Line B													
B-2	Both	HDU5-SDS	1178	.033	.001	0.034	-	-	.248	3057	0.01	0.29	0.16
Line C													
C-2	Both	HDU5-SDS	2466	.069	.002	0.071	-	-	.248	4610	0.01	0.33	0.34
Line D													
D-1,2	W->E	HDU5-SDS	927	.034	.001	0.035	-	-	.248	2928	0.01	0.29	0.71
	E->W	HDU5-SDS	1082	.039	.001	0.040	-	-	.248	3468	0.01	0.30	0.73
D-1,3	W->E	HDU5-SDS	1091	.040	.001	0.041	-	-	.248	3356	0.01	0.30	0.33
	E->W	HDU5-SDS	1127	.041	.001	0.042	-	-	.248	3479	0.01	0.30	0.33

Legend:

Wall, segment – Wall and segment between openings, e.g. B-3,2 = second segment on Wall 3 on Shearline B

Dir – Force direction

Tens., Comp. – Accumulated ASD hold-down tension force T and strength-level end compression force C from overturning, dead and vertical earthquake loads.

Tens. – ASD-factored force, used for proportion of manufacturer's maximum elongation

Comp. – Strength level force as per ASCE 12.8.6

da – Vertical displacements due to the following components:

Vert. Displacement – Elongation when slippage calculated separately; displacement when combined elongation/slippage used

Manuf – Using manufacturer's value for anchor bolt length, or no bolt contribution for connector-only elongation

Unless marked with * = (ASD tension force / ASD hold-down capacity) x max strength-level elongation or displacement

* - Maximum strength-level elongation or displacement is used. May result in higher than actual displacements for lightly loaded hold-downs, causing the segment to draw less force due to lower than actual stiffness.

Add – Due to longer anchor bolt length than manufacturer's value, or entire bolt length for connector-only elongation = $TL / (Ab \times Es)$

T = Strength level tension force (not shown)

Ab = bolt cross-sectional area

Es = steel modulus = 29000000 psi

L = Lb – Lh

Lb = Total bolt length shown in Storey Information table

Lh = Manufacturer's anchor bolt length for given displacement/elongation from hold-down database

Slippage – Due to vertical slippage of hold-down fasteners attached to stud(s) when not combined with elongation

Nails = en from SDPWS Table C4.2.3D using values for wood structural panels

Bolts = $Vf / (270,000 D^{1.5})$ (NDS 11.3.6); D = bolt diameter, Vf = Tension force T / number of fasteners

Shrink + Extra – Wood shrinkage plus extra displacement due to mis-cuts, gaps, etc.

Shrinkage = $0.002 \times (19\% \text{ fabrication} - 10\% \text{ in-service moisture contents}) \times Ls$

Ls = Length between anchor bolt fasteners subject to perp-to-grain shrinkage; see Storey Information table

STORY DRIFT (flexible seismic design)

Level	Dir	Actual Story Drift (in)							Allowable Story Drift			
		Const defl	Max dxe	Line	Max dx	Center of Mass	C of M dxe	C of M dx	hsx ft	Delta a in	Ratio Max	Ratio C of M
1	N<->S	0.67	0.78	6	1.12	36.21	0.32	0.68	9.00	2.70	0.42	0.25
	E<->W	0.72	0.95	A	1.65	30.17	0.39	1.04				

ASCE 7 Eqn. 12.8-15: $dx = dxc + (dxe - dxc) Cd / Ie$

Deflection amplification factor Cd from Table 12.2-1 = 4.0 (E-W), 4.0 (N-S)

Importance factor $Ie = 1.00$

Legend:

Const defl (dxc) – Deflection due to shrinkage, gaps, bolt hole, etc. (constant with respect to force)

Max dxe – Largest deflection for any shearline on level in this direction; refer to Deflections table

Line – Shearline with largest deflection on level in this direction

hsx – Story height in ASCE Table 12.12-1 = Height of walls plus joist depth between this level and the one above.

Max dx – Largest amplified deflection on level in this direction using ASCE 7 Eq'n 12.8-15

C of M dxe - Deflection at the center of mass of this level; from interpolating deflections at adjacent shearlines.

C of M dx - Amplified deflection at center of mass using Eq'n 12.8-15. Does not include differences between top and bottom diaphragm deflection.

Delta a = Allowable story drift on this level from ASCE 7 Table 12.12-1

Ratio - Proportion of allowable story drift experienced, on this level in this direction.