LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

Structural Package for:

Granbois Residence

8440 SE 82nd St
Mercer Island, WA 98052

Project No: S230110-1

April 6, 2023

STRUCTURAL ENGINEER
L120 ENGINEERING & DESIGN
13150 91ST PL NE
KIRKLAND, WA 98034
CONTACT: MANS THURFJELL, PE
PHONE: 425-636-3313
MTHURFJELL@L120ENGINEERING.COM

Project Number:	Plan Name:	Sheet Number:
S230110-1	Granbois	DC
Engineer:	Specifics:	Date:
HK	Design Criteria	4/6/2023

Gravity Criteria: Code: IBC 2018

ROOF SYSTEM		
Live Load:		
Snow	25.0	psf
Dead Load:		
Composite Roofing	2.0	psf
19/32" Plywood Sheathing	2.5	psf
Trusses at 24" o.c.	3.0	psf
Insulation	1.8	psf
(2) Layers 5/8" GWB	4.4	psf
Misc/Mech	1.3	psf
Total	**15.0**	**psf**

FLOOR SYSTEM		
Live Load:		
Residential	40.0	psf
Dead Load:		
Flooring	3.0	psf
3/4" T & G Plywood	2.5	psf
Floor Joists at 16" o.c.	2.5	psf
Insulation	0.5	psf
(1) Layers 5/8" GWB	2.2	psf
Miscellaneous	1.3	psf
Total	**12.0**	**psf**

EXTERIOR WALL SYSTEM		
2x6 at 16" o.c.	1.7	psf
Insulation	1.0	psf
1/2" Plywood Sheathing	1.5	psf
(2) layers 5/8" GWB	4.4	psf
Misc	3.4	psf
Total	**12.0**	**psf**

INTERIOR WALL SYSTEM		
2x4 at 16" o.c.	1.1	psf
Insulation	0.5	psf
(2) Layers 5/8" GWB	4.4	psf
Misc	2.0	psf
Total	**8.0**	**psf**

SEISMIC PARAMETERS:

Code Reference: ASCE 7-16
R = **6.5** Bearing Wall System, Wood Structural Panel Walls
Mapped Spectral Acceleration, Ss = **1.64**
Mapped Spectral Acceleration, S1 = **0.62**
Soil Site Class = **D**

WIND PARAMETERS:

Code Reference: ASCE 7-16
Basic Wind Speed (3 second Gust) = **100** mph
Exposure : **B**
Kzt = **1.90**

SOIL PARAMETERS:

Soil Bearing Pressure = **3,500** psf competent native soil or structural fill
1/3 increase for short-term wind or seismic loading is acceptable
Frost Depth = **18** in

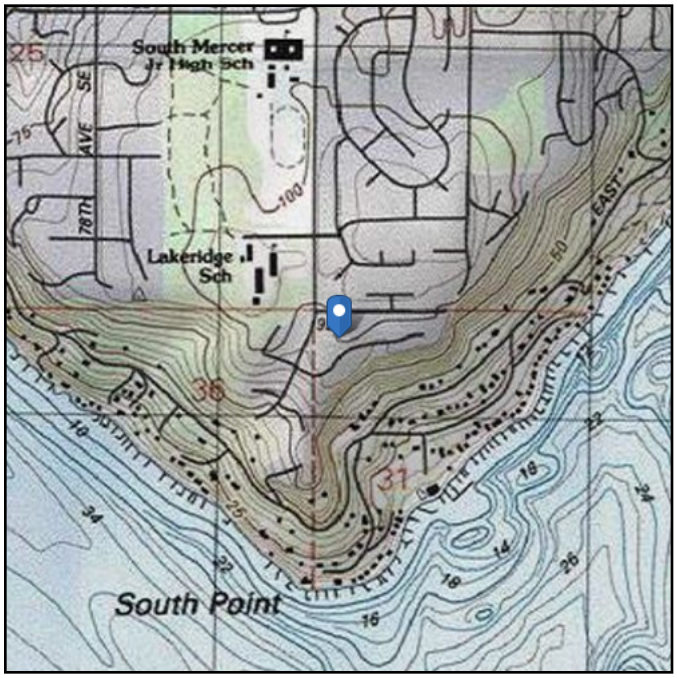
Lateral Wall Pressures:
Unrestrained Active Pressure = **35** pcf Cantilevered walls
Restrained Active Pressure = **50** pcf Plate Wall Design/Tank Walls
Passive Pressure = **300** pcf
Soil Friction Coeff. = **0.5**

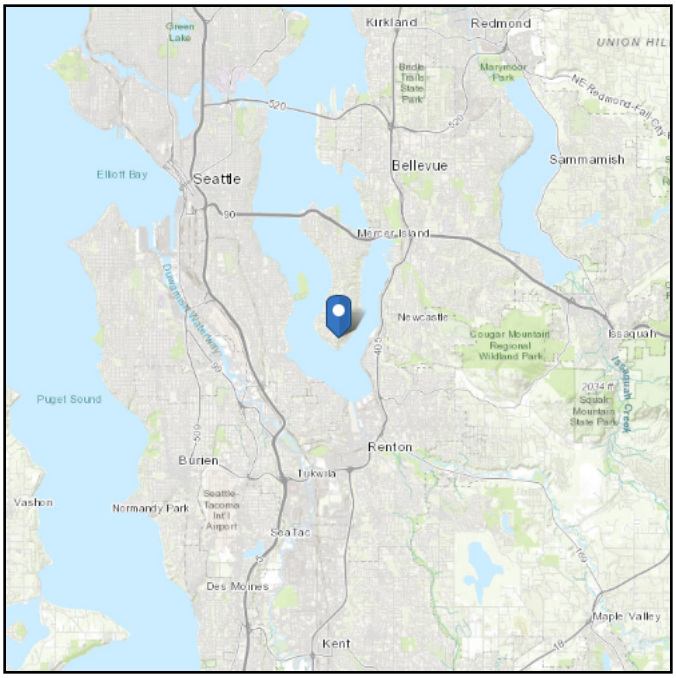
ASCE 7 Hazards Report

Address:
8440 SE 82nd St
Mercer Island, Washington
98040

Standard: ASCE/SEI 7-22
Risk Category: II
Soil Class: Default

Latitude: 47.530412
Longitude: -122.226341
Elevation: 329.5217954889228 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
300-year MRI	92 Vmph
700-year MRI	98 Vmph
1,700-year MRI	104 Vmph
3,000-year MRI	109 Vmph
10,000-year MRI	118 Vmph
100,000-year MRI	136 Vmph
1,000,000-year MRI	154 Vmph

Data Source: ASCE/SEI 7-22, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Wed Mar 15 2023

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 7-22 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years). Values for 10-year MRI, 25-year MRI, 50-year MRI and 100-year MRI are Service Level wind speeds, all other wind speeds are Ultimate wind speeds.

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-22 Section 26.2.

Seismic

Default

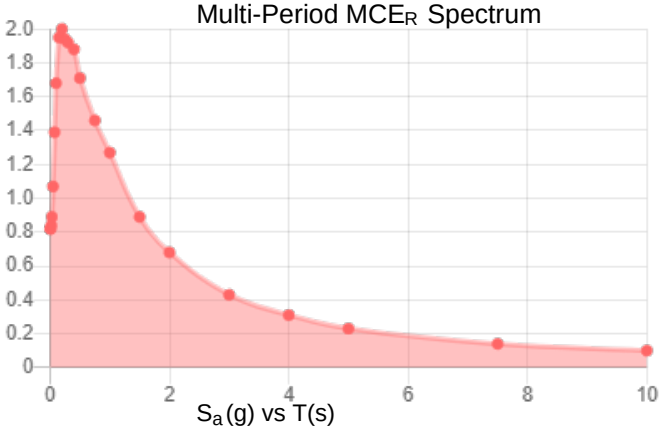
Site Soil Class:

Results:

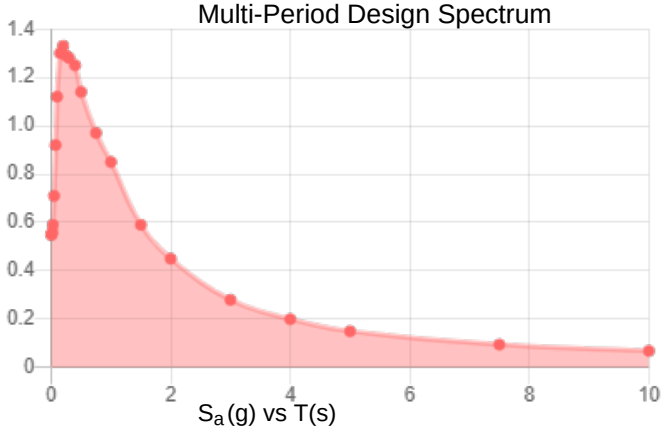
PGA_M :	0.75	T_L :	6
S_{MS} :	1.8	S_S :	1.64
S_{M1} :	1.27	S_1 :	0.62
S_{DS} :	1.2	V_{S30} :	260
S_{D1} :	0.85		

Seismic Design Category: D

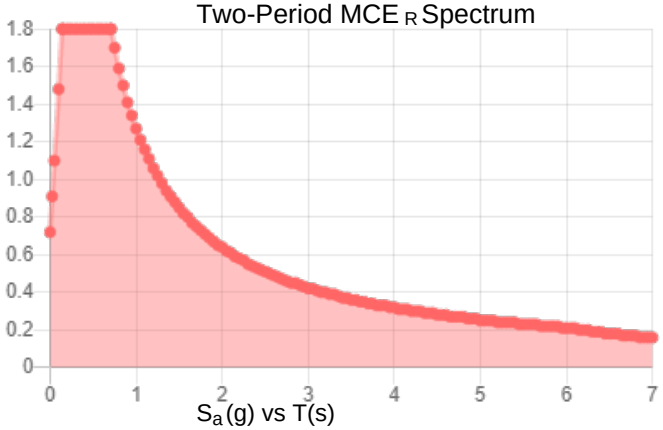
Multi-Period MCE_R Spectrum



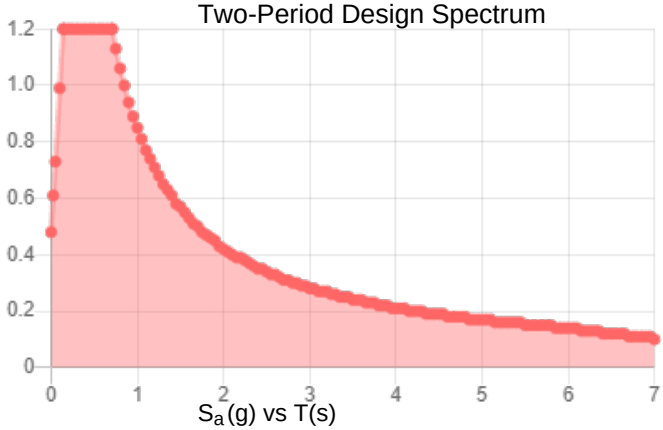
Multi-Period Design Spectrum



Two-Period MCE_R Spectrum



Two-Period Design Spectrum



MCE_R Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: **Wed Mar 15 2023**

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

LONGITUDE
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FRAMING CALCULATIONS

BEAM REFERENCE PER PLAN

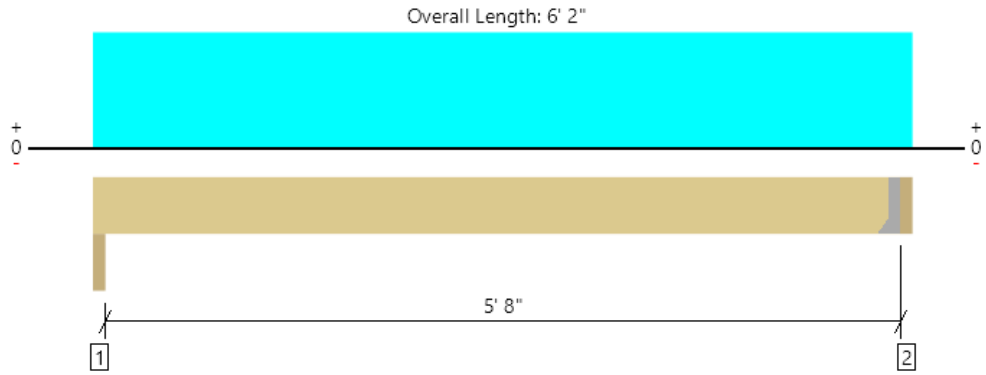
(206) 790 9502
L120Engineering.com

Roof			
Member Name	Results	Current Solution	Comments
RB-1	Passed	1 piece(s) 4 x 8 DF No.2	
GT-1 (For Reactions Only)	Passed	1 piece(s) 8 3/4" x 36" 24F-V8 DF Glulam	
GT-2 (For Reactions Only)	Passed	1 piece(s) 8 3/4" x 36" 24F-V8 DF Glulam	
2nd Floor			
Member Name	Results	Current Solution	Comments
RH-1	Passed	1 piece(s) 5 1/2" x 7 1/2" 24F-V4 DF Glulam	
RH-2	Passed	1 piece(s) 4 x 8 DF No.2	
RH-3	Passed	1 piece(s) 6 x 8 DF No.2	
RH-4	Passed	1 piece(s) 4 x 8 DF No.2	
RH-5	Passed	1 piece(s) 4 x 8 DF No.2	
2J-1	Passed	1 piece(s) 18" TJI® 360 @ 16" OC	
2B-1	Passed	1 piece(s) 3 1/2" x 18" 2.2E Parallam® PSL	
2B-2	Passed	1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL	
2B-3	Passed	1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL	
2B-4	Passed	1 piece(s) 7" x 18" 2.2E Parallam® PSL	
2B-5	Passed	1 piece(s) 7" x 18" 2.2E Parallam® PSL	
2B-6	Failed	1 piece(s) 7" x 18" 2.2E Parallam® PSL	Support 1 failed reaction check due to insufficient bearing capacity.
2B-7	Passed	1 piece(s) 3 1/2" x 18" 2.2E Parallam® PSL	
2B-8	Passed	1 piece(s) 3 1/2" x 18" 2.2E Parallam® PSL	
2B-10	Passed	1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL	
2B-11	Passed	1 piece(s) 7" x 14" 2.2E Parallam® PSL	
2B-12	Passed	1 piece(s) 3 1/2" x 14" 2.2E Parallam® PSL	
2B-13	Passed	1 piece(s) 3 1/2" x 14" 2.2E Parallam® PSL	
2B-14	Passed	1 piece(s) 4 x 10 DF No.2	
1st Floor			
Member Name	Results	Current Solution	Comments
1C-1	Passed	1 piece(s) 5 1/4" x 11 7/8" 2.2E Parallam® PSL	
1C-2	Passed	1 piece(s) 7" x 7" 1.8E Parallam® PSL	
1H-1	Passed	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
1H-2	Passed	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
1H-3	Passed	1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam	
1H-4	Passed	1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam	
1H-5	Passed	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
1H-6	Passed	1 piece(s) 4 x 8 DF No.2	
1H-7	Passed	1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam	
1B-1	Passed	1 piece(s) W14X53 (A992) ASTM Steel	
1B-2	Passed	1 piece(s) W14X53 (A992) ASTM Steel	
1B-3	Passed	1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL	
1B-4	Passed	1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL	
1B-5	Failed	1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL	Multiple Failures/Errors
1B-6 (East West Seismic Condition)	Passed	1 piece(s) W14X43 (A992) ASTM Steel	
1B-6 (North South Seismic Condition)	Failed	1 piece(s) W14X43 (A992) ASTM Steel	Multiple Failures/Errors
1B-7	Passed	1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL	

Basement			
Member Name	Results	Current Solution	Comments
BH-1	Passed	1 piece(s) 5 1/2" x 9" 24F-V4 DF Glulam	
BH-2	Passed	1 piece(s) 5 1/2" x 10 1/2" 24F-V4 DF Glulam	
BB-1	Passed	1 piece(s) 1 3/4" x 16" 2.0E Microllam® LVL	

Roof, RB-1

1 piece(s) 4 x 8 DF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1109 @ 5' 11"	3281 (1.50")	Passed (34%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	878 @ 5' 3 3/4"	3502	Passed (25%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	1606 @ 3' 1/4"	3407	Passed (47%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.036 @ 3' 1/4"	0.193	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.055 @ 3' 1/4"	0.290	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 0.9% decrease in the moment capacity has been added to account for lateral stability.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - HF	3.00"	3.00"	1.50"	402	755	1157	None
2 - Hanger on 7 1/4" DF beam	3.00"	Hanger[1]	1.50"	417	786	1203	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	LUS46	2.00"	N/A	4-16d	4-16d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 5' 11"	N/A	6.4	--	
1 - Uniform (PSF)	0 to 6' 2" (Top)	10'	12.6	25.0	Roof Load

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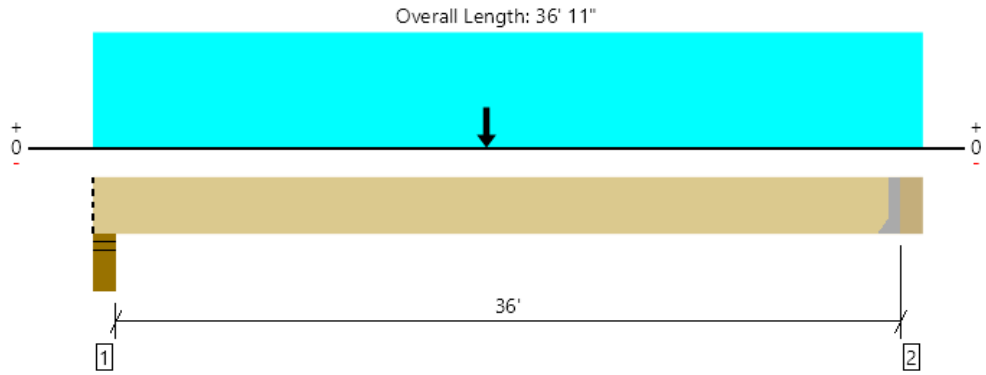
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Roof, GT-1 (For Reactions Only)

1 piece(s) 8 3/4" x 36" 24F-V8 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4236 @ 36' 5 1/2"	8531 (1.50")	Passed (50%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3810 @ 3' 5 1/2"	63998	Passed (6%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	51525 @ 18'	349693	Passed (15%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.081 @ 18' 3 13/16"	0.903	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.178 @ 18' 4 1/16"	1.806	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 0.80 that was calculated using length L = 36' 1 1/2".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	5.50"	5.50"	1.50"	2512	1840	4352	Blocking
2 - Hanger on 36" DF beam	5.50"	Hanger[1]	1.50"	2467	1806	4273	See note [1]

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	36' 6" o/c	
Bottom Edge (Lu)	36' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 36' 5 1/2"	N/A	76.6	--	
1 - Uniform (PSF)	0 to 36' 11" (Front)	2'	15.0	25.0	Roof Load
2 - Point (lb)	18' (Front)	N/A	1080	1800	DL = 15psf*18*4 SL = 25psf*18*4

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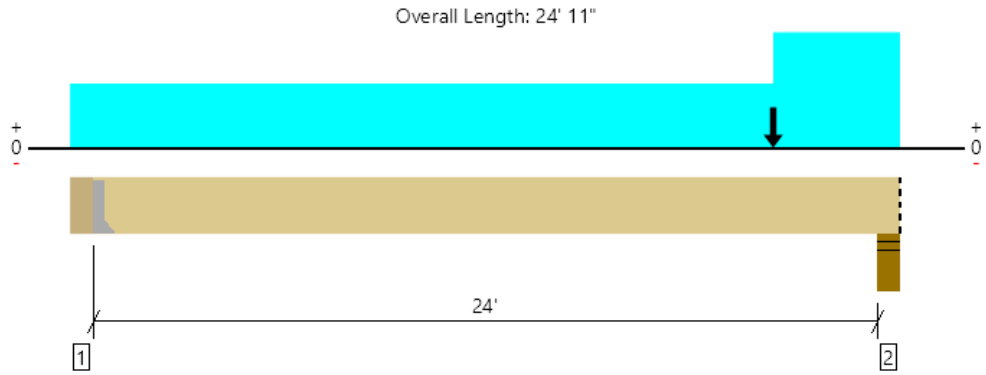
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

Roof, GT-2 (For Reactions Only)

1 piece(s) 8 3/4" x 36" 24F-V8 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	6468 @ 5 1/2"	8531 (1.50")	Passed (76%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	7959 @ 21' 5 1/2"	63998	Passed (12%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	43898 @ 14' 3/8"	364101	Passed (12%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.039 @ 12' 10 1/16"	0.603	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.077 @ 12' 10 5/8"	1.206	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 0.84 that was calculated using length L = 24' 1 1/2".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Hanger on 36" HF beam	5.50"	Hanger[1]	1.50"	3200	3452	6652	See note [1]
2 - Stud wall - HF	5.50"	5.50"	3.02"	5347	5367	10714	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	24' 6" o/c	
Bottom Edge (Lu)	24' 6" o/c	

- Maximum allowable bracing intervals based on applied load.

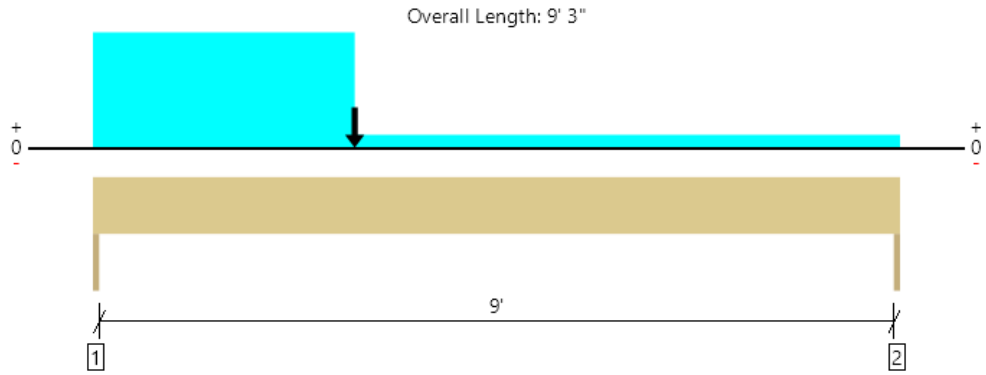
Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 24' 11"	N/A	76.6	--	
1 - Uniform (PSF)	0 to 21' (Front)	10'	15.0	25.0	Roof Load
2 - Point (lb)	21' (Front)	N/A	2467	1806	Linked from: GT-1 (For Reactions Only), Support 2
3 - Uniform (PSF)	21' to 24' 11" (Front)	18'	15.0	25.0	Roof Load

2nd Floor, RH-1

1 piece(s) 5 1/2" x 7 1/2" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4011 @ 0	5363 (1.50")	Passed (75%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3453 @ 9"	8381	Passed (41%)	1.15	1.0 D + 1.0 S (All Spans)
Pos Moment (Ft-lbs)	8682 @ 3'	11778	Passed (74%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.193 @ 4' 3"	0.308	Passed (L/575)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.316 @ 4' 3 1/16"	0.463	Passed (L/351)	--	1.0 D + 1.0 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 0.7% decrease in the moment capacity has been added to account for lateral stability.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 9' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	1558	2453	4011	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	666	1010	1676	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

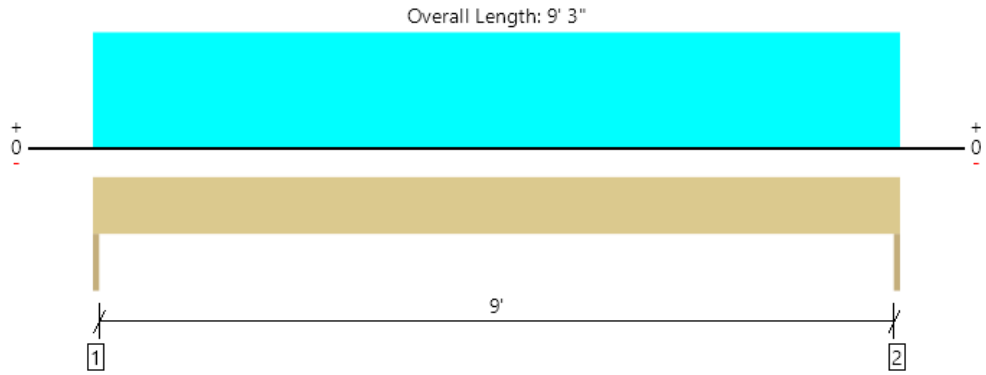
Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 9' 3"	N/A	10.0	--	
1 - Uniform (PSF)	0 to 3'	18'	15.8	25.0	Roof Load
2 - Point (lb)	3'	N/A	1080	1800	Girder Truss = DL=15psf*4*18 SL=25psf*4*18
3 - Uniform (PSF)	3' to 9' 3"	2'	15.8	25.0	Roof Load

Weyerhaeuser Notes

Weyerhaeuser warrants that the sizing of its products will be in accordance with Weyerhaeuser product design criteria and published design values. Weyerhaeuser expressly disclaims any other warranties related to the software. Use of this software is not intended to circumvent the need for a design professional as determined by the authority having jurisdiction. The designer of record, builder or framer is responsible to assure that this calculation is compatible with the overall project. Accessories (Rim Board, Blocking Panels and Squash Blocks) are not designed by this software. Products manufactured at Weyerhaeuser facilities are third-party certified to sustainable forestry standards. Weyerhaeuser Engineered Lumber Products have been evaluated by ICC-ES under evaluation reports ESR-1153 and ESR-1387 and/or tested in accordance with applicable ASTM standards. For current code evaluation reports, Weyerhaeuser product literature and installation details refer to www.weyerhaeuser.com/woodproducts/document-library.

The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

2nd Floor, RH-2
1 piece(s) 4 x 8 DF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	785 @ 0	3281 (1.50")	Passed (24%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	661 @ 8 3/4"	3502	Passed (19%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	1815 @ 4' 7 1/2"	3387	Passed (54%)	1.15	1.0 D + 1.0 S (All Spans)
Vert Live Load Defl. (in)	0.093 @ 4' 7 1/2"	0.308	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Vert Total Load Defl. (in)	0.157 @ 4' 7 1/2"	0.313	Passed (L/706)	--	1.0 D + 1.0 S (All Spans)
Lat Member Reaction (lbs)	207 @ 9' 3"	N/A	Passed (N/A)	1.60	1.0 D + 0.6 W
Lat Shear (lbs)	188 @ 5"	4872	Passed (4%)	1.60	1.0 D + 0.6 W
Lat Moment (Ft-lbs)	478 @ mid-span	2425	Passed (20%)	1.60	1.0 D + 0.6 W
Lat Deflection (in)	0.124 @ mid-span	0.925	Passed (L/892)	--	1.0 D + 0.6 W
Bi-Axial Bending	0.48	1.00	Passed (48%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 S

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (5/16").
- Lateral deflection criteria: Wind (L/120)
- A 1.5% decrease in the moment capacity has been added to account for lateral stability.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	322	462	785	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	322	462	785	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Lateral Connections						
Supports	Plate Size	Plate Material	Connector	Type/Model	Quantity	Nailing
Left	2X	Hem Fir	Nails	10d (0.128" x 3") (End)	3	
Right	2X	Hem Fir	Nails	10d (0.128" x 3") (End)	3	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 9' 3"	N/A	6.4	--	
1 - Uniform (PSF)	0 to 9' 3"	4'	15.8	25.0	Roof Load

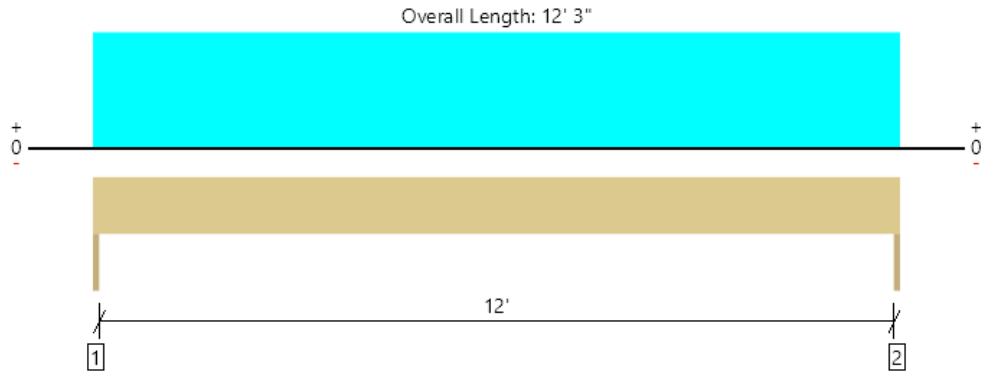
Lateral Load	Location	Tributary Width	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	3'	24.9	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, RH-3
1 piece(s) 6 x 8 DF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	554 @ 0	5156 (1.50")	Passed (11%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	486 @ 9"	5376	Passed (9%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	1697 @ 6' 1 1/2"	3706	Passed (46%)	1.15	1.0 D + 1.0 S (All Spans)
Vert Live Load Defl. (in)	0.101 @ 6' 1 1/2"	0.408	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Vert Total Load Defl. (in)	0.182 @ 6' 1 1/2"	0.613	Passed (L/806)	--	1.0 D + 1.0 S (All Spans)
Lat Member Reaction (lbs)	352 @ 12' 3"	N/A	Passed (N/A)	1.60	1.0 D + 0.6 W
Lat Shear (lbs)	319 @ 7"	7480	Passed (4%)	1.60	1.0 D + 0.6 W
Lat Moment (Ft-lbs)	1079 @ mid-span	3781	Passed (29%)	1.60	1.0 D + 0.6 W
Lat Deflection (in)	0.151 @ mid-span	1.225	Passed (L/974)	--	1.0 D + 0.6 W
Bi-Axial Bending	0.50	1.00	Passed (50%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 S

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Lateral deflection criteria: Wind (L/120)
- A 0.6% decrease in the moment capacity has been added to account for lateral stability.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	248	306	554	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	248	306	554	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Lateral Connections						
Supports	Plate Size	Plate Material	Connector	Type/Model	Quantity	Nailing
Left	2X	Hem Fir	Nails	10d (0.128" x 3") (End)	5	
Right	2X	Hem Fir	Nails	10d (0.128" x 3") (End)	5	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 12' 3"	N/A	10.4	--	
1 - Uniform (PSF)	0 to 12' 3"	2'	15.0	25.0	Roof Load

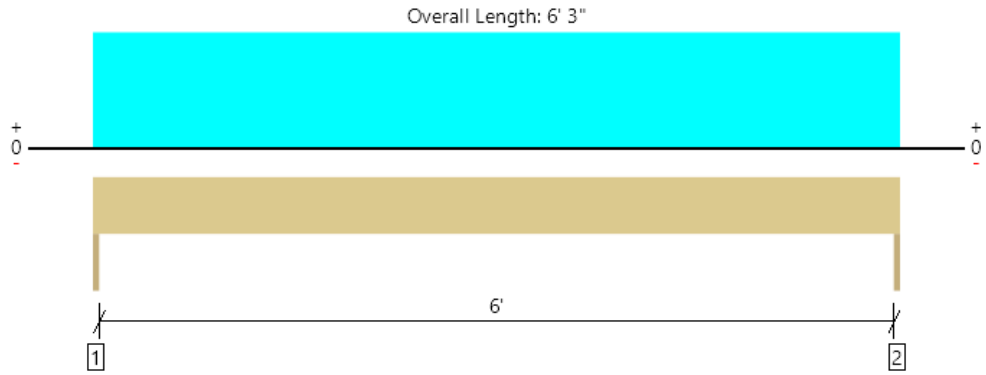
Lateral Load	Location	Tributary Width	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	4'	24.0	

• ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Effective Wind Area determined using full member span and trib. width.
• IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, RH-4
1 piece(s) 4 x 8 DF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	913 @ 0	3281 (1.50")	Passed (28%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	700 @ 8 3/4"	3502	Passed (20%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	1426 @ 3' 1 1/2"	3405	Passed (42%)	1.15	1.0 D + 1.0 S (All Spans)
Vert Live Load Defl. (in)	0.034 @ 3' 1 1/2"	0.208	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Vert Total Load Defl. (in)	0.056 @ 3' 1 1/2"	0.313	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Lat Member Reaction (lbs)	144 @ 6' 3"	N/A	Passed (N/A)	1.60	1.0 D + 0.6 W
Lat Shear (lbs)	124 @ 5"	4872	Passed (3%)	1.60	1.0 D + 0.6 W
Lat Moment (Ft-lbs)	224 @ mid-span	2425	Passed (9%)	1.60	1.0 D + 0.6 W
Lat Deflection (in)	0.027 @ mid-span	0.625	Passed (L/999+)	--	1.0 D + 0.6 W
Bi-Axial Bending	0.33	1.00	Passed (33%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 S

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Lateral deflection criteria: Wind (L/120)
- A 1% decrease in the moment capacity has been added to account for lateral stability.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	366	547	913	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	366	547	913	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Lateral Connections						
Supports	Plate Size	Plate Material	Connector	Type/Model	Quantity	Nailing
Left	2X	Hem Fir	Nails	8d (0.113" x 2 1/2") (Toe)	2	
Right	2X	Hem Fir	Nails	8d (0.113" x 2 1/2") (Toe)	2	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 6' 3"	N/A	6.4	--	
1 - Uniform (PSF)	0 to 6' 3"	7'	15.8	25.0	Snow Load

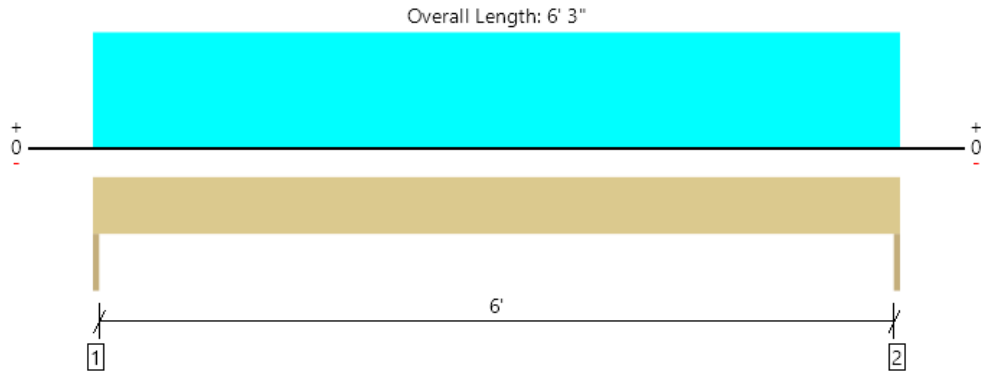
Lateral Load	Location	Tributary Width	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	3'	25.5	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, RH-5
1 piece(s) 4 x 8 DF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1678 @ 0	3281 (1.50")	Passed (51%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	1287 @ 8 3/4"	3502	Passed (37%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	2622 @ 3' 1 1/2"	3405	Passed (77%)	1.15	1.0 D + 1.0 S (All Spans)
Vert Live Load Defl. (in)	0.063 @ 3' 1 1/2"	0.208	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Vert Total Load Defl. (in)	0.104 @ 3' 1 1/2"	0.313	Passed (L/723)	--	1.0 D + 1.0 S (All Spans)
Lat Member Reaction (lbs)	144 @ 6' 3"	N/A	Passed (N/A)	1.60	1.0 D + 0.6 W
Lat Shear (lbs)	124 @ 5"	4872	Passed (3%)	1.60	1.0 D + 0.6 W
Lat Moment (Ft-lbs)	224 @ mid-span	2425	Passed (9%)	1.60	1.0 D + 0.6 W
Lat Deflection (in)	0.027 @ mid-span	0.625	Passed (L/999+)	--	1.0 D + 0.6 W
Bi-Axial Bending	0.54	1.00	Passed (54%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 S

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Lateral deflection criteria: Wind (L/120)
- A 1% decrease in the moment capacity has been added to account for lateral stability.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	662	1016	1678	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	662	1016	1678	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Lateral Connections						
Supports	Plate Size	Plate Material	Connector	Type/Model	Quantity	Nailing
Left	2X	Hem Fir	Nails	8d (0.113" x 2 1/2") (Toe)	2	
Right	2X	Hem Fir	Nails	8d (0.113" x 2 1/2") (Toe)	2	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 6' 3"	N/A	6.4	--	
1 - Uniform (PSF)	0 to 6' 3"	13'	15.8	25.0	Roof Load

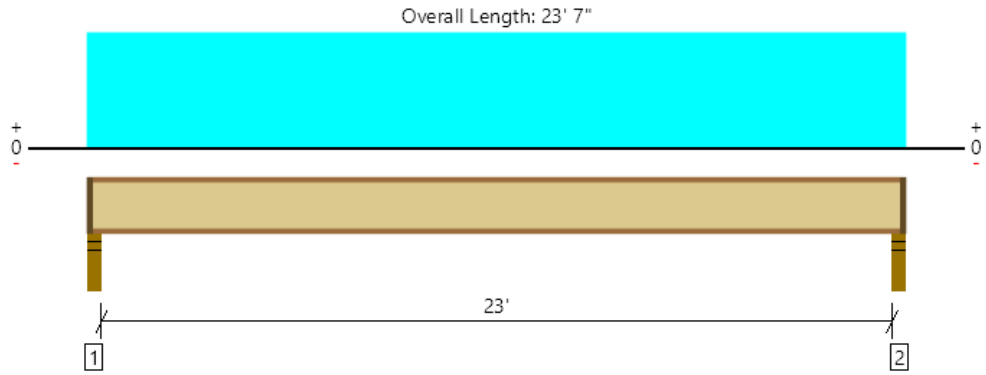
Lateral Load	Location	Tributary Width	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	3'	25.5	

- ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Effective Wind Area determined using full member span and trib. width.
- IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2J-1
1 piece(s) 18" TJI® 360 @ 16" OC



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	809 @ 2 1/2"	1141 (2.00")	Passed (71%)	1.00	1.0 D + 1.0 L (All Spans)
Shear (lbs)	797 @ 3 1/2"	2425	Passed (33%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	4651 @ 11' 9 1/2"	9465	Passed (49%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.316 @ 11' 9 1/2"	0.579	Passed (L/878)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.411 @ 11' 9 1/2"	1.158	Passed (L/676)	--	1.0 D + 1.0 L (All Spans)
TJ-Pro™ Rating	43	40	Passed	--	--

System : Floor
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- A structural analysis of the deck has not been performed.
- Deflection analysis is based on composite action with a single layer of 23/32" Weyerhaeuser Edge™ Panel (24" Span Rating) that is glued and nailed down.
- Additional considerations for the TJ-Pro™ Rating include: None.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - DF	3.50"	2.00"	1.75"	189	629	818	1 1/2" Rim Board
2 - Stud wall - DF	3.50"	2.00"	1.75"	189	629	818	1 1/2" Rim Board

• Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	5' 6" o/c	
Bottom Edge (Lu)	23' 4" o/c	

•TJI joists are only analyzed using Maximum Allowable bracing solutions.
•Maximum allowable bracing intervals based on applied load.

Vertical Load	Location	Spacing	Dead (0.90)	Floor Live (1.00)	Comments
1 - Uniform (PSF)	0 to 23' 7"	16"	12.0	40.0	Floor Load

Weyerhaeuser Notes

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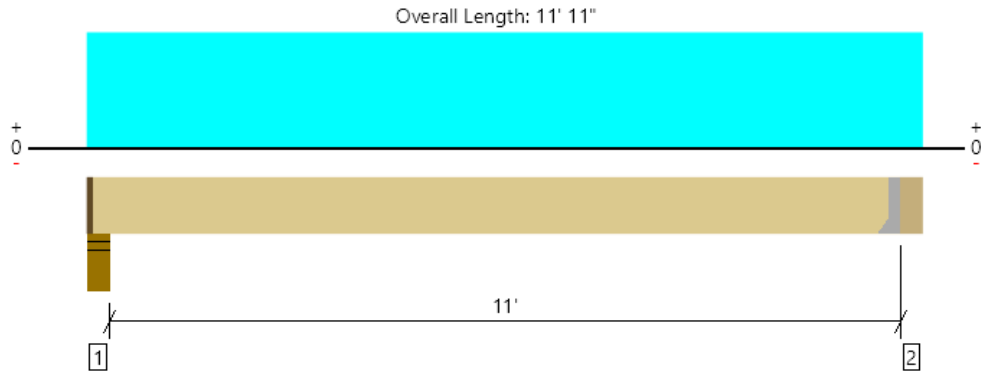
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

2nd Floor, 2B-1

1 piece(s) 3 1/2" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3533 @ 11' 5 1/2"	3533 (1.62")	Passed (100%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2580 @ 9' 11 1/2"	12180	Passed (21%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	9827 @ 5' 10 3/4"	43665	Passed (23%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.054 @ 5' 10 3/4"	0.278	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.075 @ 5' 10 3/4"	0.556	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - HF	5.50"	4.00"	2.59"	1030	2712	3742	1 1/2" Rim Board
2 - Hanger on 18" PSL beam	5.50"	Hanger[1]	1.62"	1046	2770	3815	See note [1]

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	11' 4" o/c	
Bottom Edge (Lu)	11' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	THA422	1.75"	N/A	22-16d	6-16d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	1 1/2" to 11' 5 1/2"	N/A	19.7	--	
1 - Uniform (PSF)	0 to 11' 11" (Front)	8'	12.0	40.0	Floor Load
2 - Uniform (PSF)	0 to 11' 11" (Back)	3' 6"	17.0	40.0	Master Bath Load

Weyerhaeuser Notes

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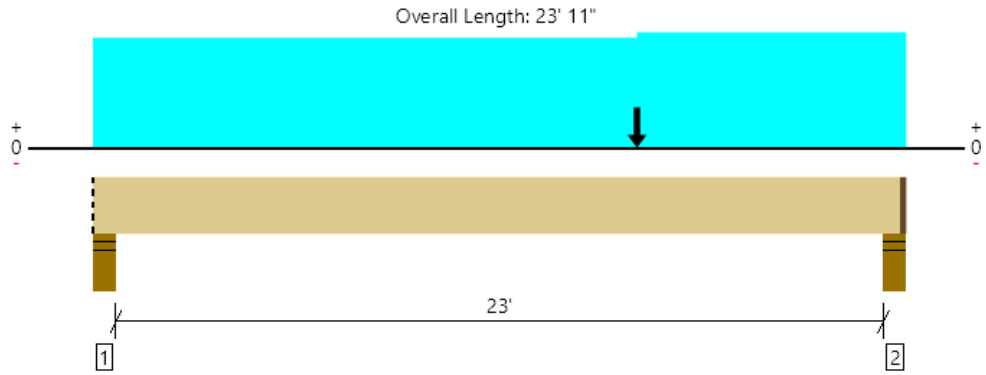
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-2

1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4184 @ 23' 7"	8505 (4.00")	Passed (49%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	3930 @ 21' 11 1/2"	18270	Passed (22%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	27528 @ 16'	65497	Passed (42%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.301 @ 12' 8 1/16"	0.581	Passed (L/927)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.445 @ 12' 7 9/16"	1.163	Passed (L/627)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - HF	5.50"	5.50"	1.50"	987	1860	2848	Blocking
2 - Stud wall - HF	5.50"	4.00"	1.97"	1375	2823	4198	1 1/2" Rim Board

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	23' 10" o/c	
Bottom Edge (Lu)	23' 10" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 23' 9 1/2"	N/A	29.5	--	
1 - Uniform (PSF)	0 to 23' 11" (Front)	1'	12.0	40.0	Floor Load
2 - Uniform (PSF)	0 to 16' (Back)	1'	12.0	40.0	Floor Load
3 - Uniform (PSF)	16' to 23' 11" (Back)	1'	17.0	40.0	Master Bath
4 - Point (lb)	16' (Back)	N/A	1046	2770	Linked from: 2B-1, Support 2

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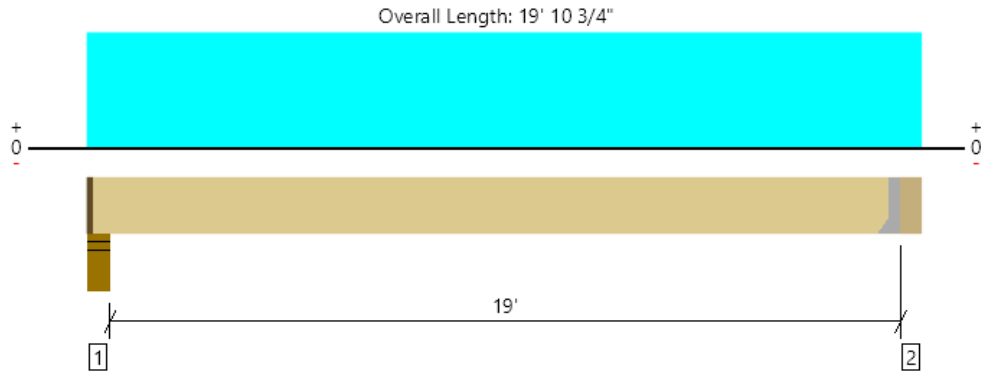
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-3

1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	8604 @ 4"	8505 (4.00")	Passed (101%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	7099 @ 17' 11 1/2"	18270	Passed (39%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	40258 @ 9' 10 3/4"	65497	Passed (61%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.340 @ 9' 10 3/4"	0.478	Passed (L/674)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.517 @ 9' 10 3/4"	0.956	Passed (L/444)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Stud wall - HF	5.50"	4.00"	4.05"	2970	5740	1732	8710	1 1/2" Rim Board
2 - Hanger on 18" PSL beam	5.25"	Hanger[1]	2.57"	2992	5800	1750	8792	See note [1]

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	19' 4" o/c	
Bottom Edge (Lu)	19' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	HGUS5.50/14	4.00"	N/A	66-10d	22-10d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	1 1/2" to 19' 5 1/2"	N/A	29.5	--	--	
1 - Uniform (PSF)	0 to 19' 10 3/4" (Back)	5' 6"	12.0	40.0	-	Floor Load
2 - Uniform (PSF)	0 to 19' 10 3/4" (Back)	6'	15.0	60.0	25.0	Deck Load
3 - Uniform (PLF)	0 to 19' 10 3/4" (Top)	N/A	100.0	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 19' 10 3/4" (Top)	1'	15.0	-	25.0	Roof Load

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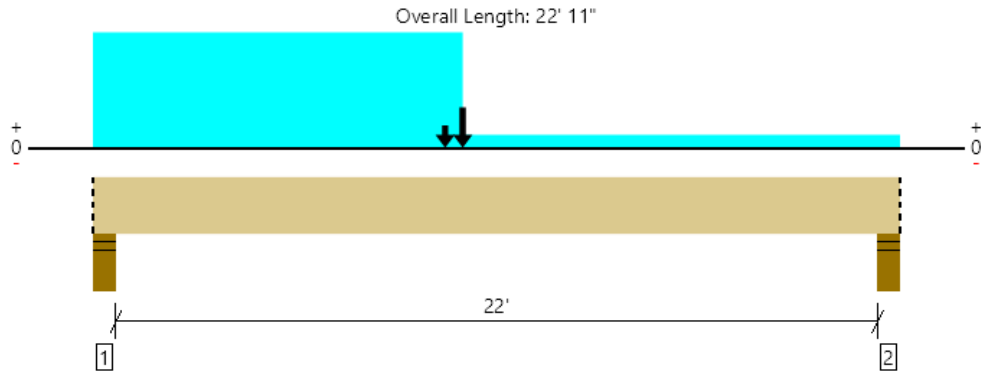
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-4

1 piece(s) 7" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	12604 @ 4"	15593 (5.50")	Passed (81%)	--	1.0 D + 0.45 W + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	10363 @ 1' 11 1/2"	28014	Passed (37%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	68144 @ 10' 6"	87330	Passed (78%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.543 @ 10' 6"	0.556	Passed (L/492)	--	1.0 D + 0.45 W + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.895 @ 10' 6"	1.112	Passed (L/298)	--	1.0 D + 0.45 W + 0.75 L + 0.75 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Member should be side-loaded from both sides of the member or braced to prevent rotation.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Wind	Factored	
1 - Stud wall - HF	5.50"	5.50"	4.45"	5496	4066	4630	1301	12604	Blocking
2 - Stud wall - HF	5.50"	5.50"	2.64"	2987	3567	1845	999	7495	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	22' 11" o/c	
Bottom Edge (Lu)	22' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Wind (1.60)	Comments
0 - Self Weight (PLF)	0 to 22' 11"	N/A	39.4	--	--	--	
1 - Uniform (PSF)	0 to 22' 11" (Front)	2'	12.0	40.0	-	-	Floor Load
2 - Point (lb)	10' 6" (Front)	N/A	2992	5800	1750	-	Linked from: 2B-3, Support 2
3 - Uniform (PLF)	0 to 10' 6" (Top)	N/A	100.0	-	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 10' 6" (Top)	18'	15.8	-	25.0	-	Roof Load
5 - Point (lb)	10' (Top)	N/A	-	-	-	2300	Wind governed shearwall reaction

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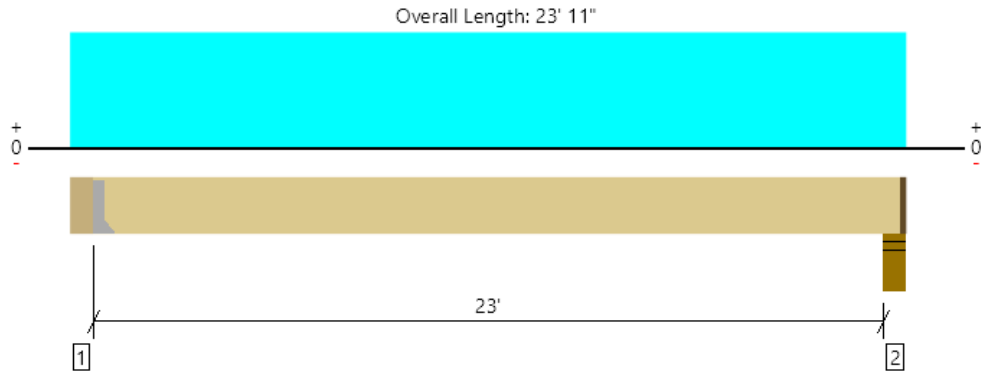
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-5

1 piece(s) 7" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	10672 @ 5 1/2"	10672 (2.44")	Passed (100%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	9287 @ 1' 11 1/2"	28014	Passed (33%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	61697 @ 12' 1/4"	100429	Passed (61%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.435 @ 12' 1/4"	0.578	Passed (L/638)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.845 @ 12' 1/4"	1.156	Passed (L/328)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Member should be side-loaded from both sides of the member or braced to prevent rotation.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Hanger on 18" PSL beam	5.50"	Hanger[1]	2.44"	5367	481	5710	11077	See note [1]
2 - Stud wall - HF	5.50"	4.00"	3.83"	5324	476	5651	10975	1 1/2" Rim Board

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	23' 4" o/c	
Bottom Edge (Lu)	23' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	HGUS7.25/14	4.00"	N/A	66-10d	22-10d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 23' 9 1/2"	N/A	39.4	--	--	
1 - Uniform (PSF)	0 to 23' 11" (Front)	1'	12.0	40.0	-	Floor Load
2 - Uniform (PSF)	0 to 23' 11" (Back)	1'	12.0	-	25.0	Low Roof Load
3 - Uniform (PLF)	0 to 23' 11" (Top)	N/A	100.0	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 23' 11" (Top)	18'	15.8	-	25.0	Roof Load

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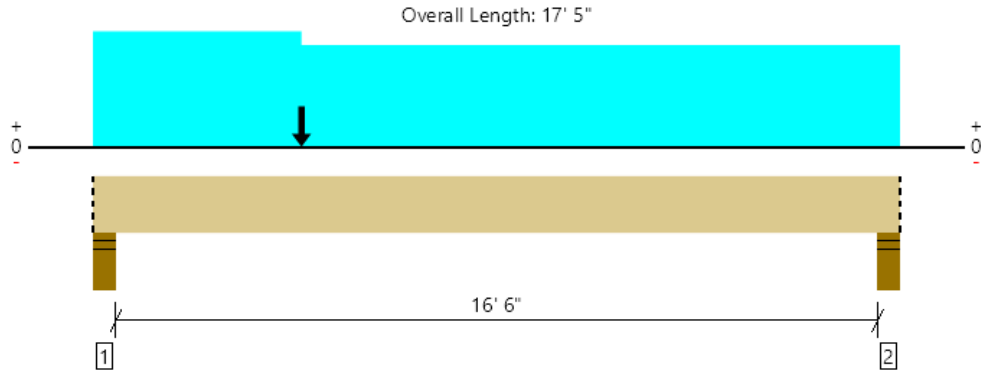
ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-6

1 piece(s) 7" x 18" 2.2E Parallam® PSL

Support 1 failed reaction check due to insufficient bearing capacity.



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	24670 @ 4"	15593 (5.50")	Failed (158%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	22799 @ 1' 11 1/2"	28014	Passed (81%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	93562 @ 4' 6"	100429	Passed (93%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.339 @ 8' 2 1/4"	0.419	Passed (L/594)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.646 @ 8' 1 3/4"	0.837	Passed (L/311)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Member should be side-loaded from both sides of the member or braced to prevent rotation.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Stud wall - HF	5.50"	5.50"	8.70"	11977	4631	12293	24670	Blocking
2 - Stud wall - HF	5.50"	5.50"	5.11"	6594	2796	7723	14483	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	17' 5" o/c	
Bottom Edge (Lu)	17' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 17' 5"	N/A	39.4	--	--	
1 - Uniform (PSF)	0 to 4' 6" (Back)	11' 6"	12.0	40.0	-	Floor Load
2 - Uniform (PSF)	4' 6" to 17' 5" (Back)	11' 6"	12.0	-	25.0	Low Roof Load
3 - Uniform (PSF)	0 to 17' 5" (Front)	7'	12.0	40.0	-	Floor Load
4 - Point (lb)	4' 6" (Back)	N/A	5367	481	5710	Linked from: 2B-5, Support 1
5 - Uniform (PSF)	0 to 17' 5" (Top)	12'	15.8	-	25.0	Roof Load
6 - Point (lb)	4' 6" (Top)	N/A	5347	-	5367	Linked from: GT-2 (For Reactions Only), Support 2

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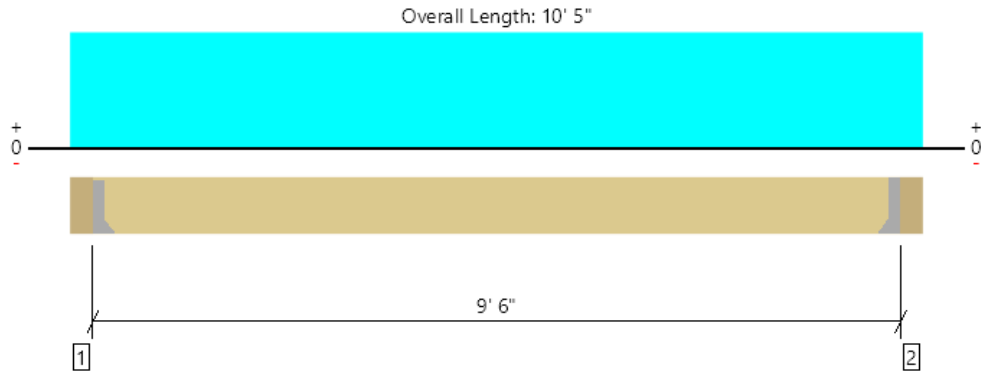
ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-7

1 piece(s) 3 1/2" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1329 @ 5 1/2"	3281 (1.50")	Passed (40%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	909 @ 1' 11 1/2"	12180	Passed (7%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	3155 @ 5' 2 1/2"	43665	Passed (7%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.014 @ 5' 2 1/2"	0.237	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.019 @ 5' 2 1/2"	0.475	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Hanger on 18" PSL beam	5.50"	Hanger[1]	1.50"	406	1042	1448	See note [1]
2 - Hanger on 18" PSL beam	5.50"	Hanger[1]	1.50"	406	1042	1448	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	9' 6" o/c	
Bottom Edge (Lu)	9' 6" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	IUS3.56/11.88	2.00"	N/A	12-10d	2-10dx1.5	
2 - Face Mount Hanger	IUS3.56/11.88	2.00"	N/A	12-10d	2-10dx1.5	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	5 1/2" to 9' 11 1/2"	N/A	19.7	--	
1 - Uniform (PSF)	0 to 10' 5" (Front)	5'	12.0	40.0	Stair Load

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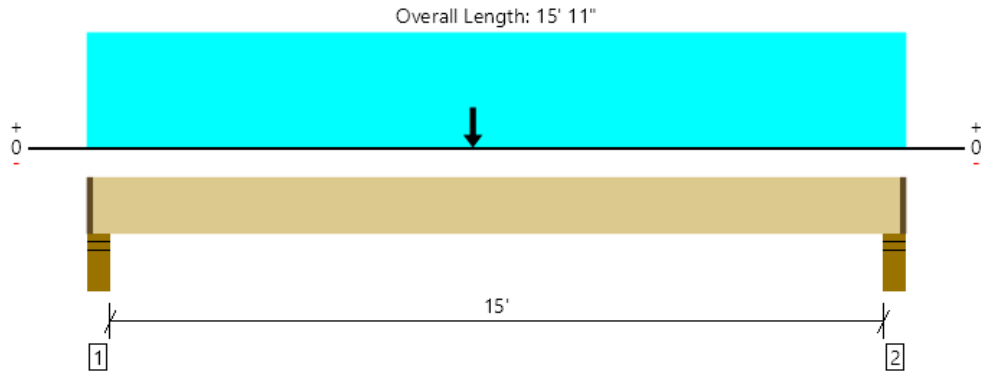
ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-8

1 piece(s) 3 1/2" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	5810 @ 4"	5670 (4.00")	Passed (102%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	4630 @ 1' 11 1/2"	12180	Passed (38%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	24145 @ 7' 6"	43665	Passed (55%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.221 @ 7' 11 1/4"	0.381	Passed (L/829)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.298 @ 7' 11 1/4"	0.762	Passed (L/614)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - HF	5.50"	4.00"	4.10"	1515	4372	5888	1 1/2" Rim Board
2 - Stud wall - HF	5.50"	4.00"	4.04"	1491	4310	5801	1 1/2" Rim Board

• Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	15' 8" o/c	
Bottom Edge (Lu)	15' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	1 1/2" to 15' 9 1/2"	N/A	19.7	--	
1 - Uniform (PSF)	0 to 15' 11" (Front)	12'	12.0	40.0	Floor Load
2 - Point (lb)	7' 6" (Front)	N/A	406	1042	Linked from: 2B-7, Support 1

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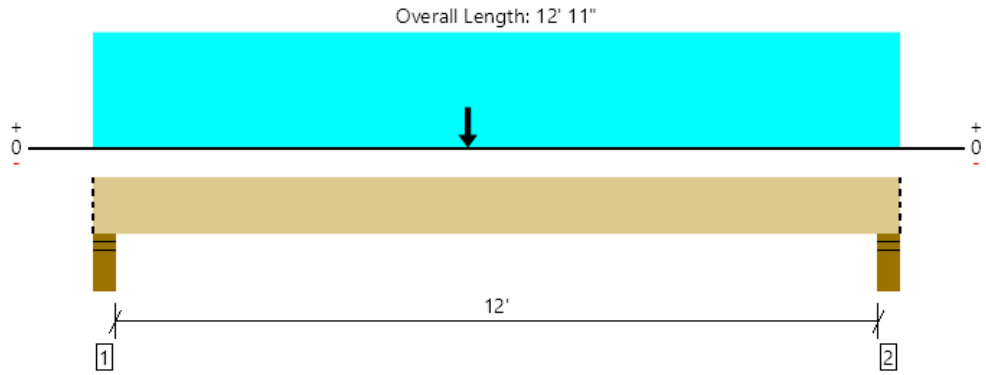
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

2nd Floor, 2B-10

1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	9823 @ 4"	11694 (5.50")	Passed (84%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	6378 @ 1' 11 1/2"	21011	Passed (30%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	26585 @ 6' 5 1/2"	75322	Passed (35%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.108 @ 6' 5 5/16"	0.306	Passed (L/999+)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.176 @ 6' 5 3/8"	0.613	Passed (L/836)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Seismic	Factored	
1 - Stud wall - HF	5.50"	5.50"	4.62"	3922	3100	3875	1276/-1276	9823	Blocking
2 - Stud wall - HF	5.50"	5.50"	4.58"	3922	3100	3875	1099/-1099	9730	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	12' 11" o/c	
Bottom Edge (Lu)	12' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	0 to 12' 11"	N/A	29.5	--	--	--	
1 - Uniform (PSF)	0 to 12' 11" (Front)	12'	12.0	40.0	-	-	Floor Load
2 - Uniform (PSF)	0 to 12' 11" (Back)	12'	12.0	-	25.0	-	Low Roof Load
3 - Uniform (PLF)	0 to 12' 11" (Top)	N/A	100.0	-	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 12' 11" (Top)	12'	15.8	-	25.0	-	Roof Load
5 - Point (lb)	6' (Top)	N/A	-	-	-	2375	EQ = 950lb*2.5

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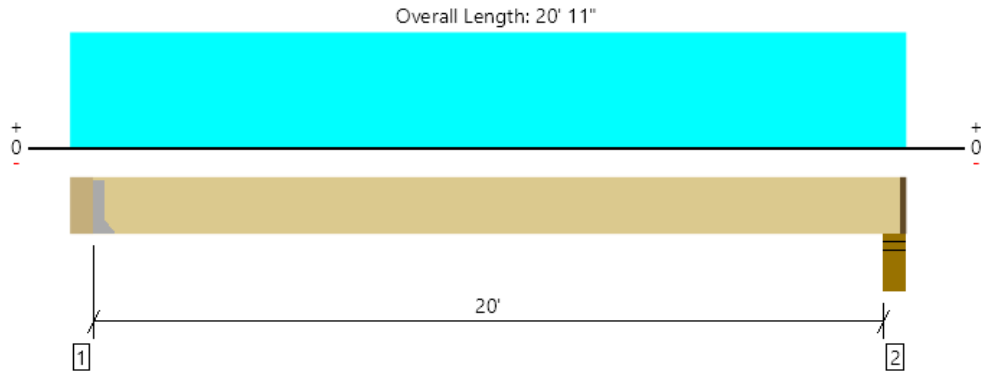
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-11

1 piece(s) 7" x 14" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2507 @ 5 1/2"	6563 (1.50")	Passed (38%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	2105 @ 1' 7 1/2"	17052	Passed (12%)	0.90	1.0 D (All Spans)
Moment (Ft-lbs)	11980 @ 10' 6 1/4"	48891	Passed (25%)	0.90	1.0 D (All Spans)
Live Load Defl. (in)	0.014 @ 10' 6 1/4"	0.503	Passed (L/999+)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.275 @ 10' 6 1/4"	1.006	Passed (L/880)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Member should be side-loaded from both sides of the member or braced to prevent rotation.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Hanger on 14" HF beam	5.50"	Hanger[1]	1.50"	2475	132	2607	See note [1]
2 - Stud wall - HF	5.50"	4.00"	1.50"	2456	130	2586	1 1/2" Rim Board

- Rim Board is assumed to carry all loads applied directly above it, bypassing the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	20' 4" o/c	
Bottom Edge (Lu)	20' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	HU412-2	2.50"	N/A	22-16d	8-16d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 20' 9 1/2"	N/A	30.6	--	
1 - Uniform (PSF)	0 to 20' 11" (Front)	6"	12.0	25.0	Low Roof Load
2 - Uniform (PLF)	0 to 20' 11" (Top)	N/A	200.0	-	Operable Window Load

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ForteWEB Software Operator	Job Notes
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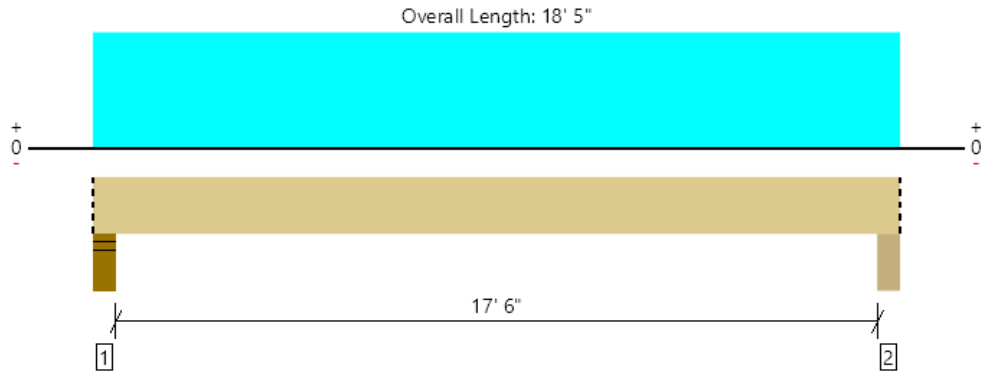
2nd Floor, 2B-12

1 piece(s) 3 1/2" x 14" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3718 @ 4"	7796 (5.50")	Passed (48%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3062 @ 1' 7 1/2"	10894	Passed (28%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	15903 @ 9' 2 1/2"	31236	Passed (51%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.355 @ 9' 2 1/2"	0.444	Passed (L/600)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.546 @ 9' 2 1/2"	0.887	Passed (L/390)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	5.50"	5.50"	2.62"	1301	2417	3718	Blocking
2 - Column - HF	5.50"	5.50"	1.70"	1301	2417	3718	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	18' 5" o/c	
Bottom Edge (Lu)	18' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 18' 5"	N/A	15.3	--	
1 - Uniform (PSF)	0 to 18' 5" (Front)	10' 6"	12.0	25.0	Low Roof Load

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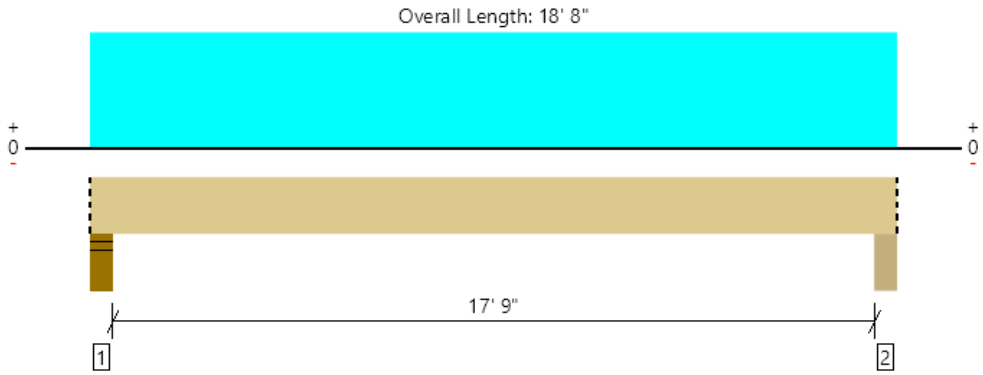
2nd Floor, 2B-13

1 piece(s) 3 1/2" x 14" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4114 @ 4"	7796 (5.50")	Passed (53%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	3398 @ 1' 7 1/2"	10894	Passed (31%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	17853 @ 9' 4"	31236	Passed (57%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.411 @ 9' 4"	0.450	Passed (L/526)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.629 @ 9' 4"	0.900	Passed (L/343)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Stud wall - HF	5.50"	5.50"	2.90"	1431	2683	4114	Blocking
2 - Column - HF	5.50"	5.50"	1.88"	1431	2683	4114	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	18' 8" o/c	
Bottom Edge (Lu)	18' 8" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 18' 8"	N/A	15.3	--	
1 - Uniform (PSF)	0 to 18' 8" (Front)	11' 6"	12.0	25.0	Low Roof Load

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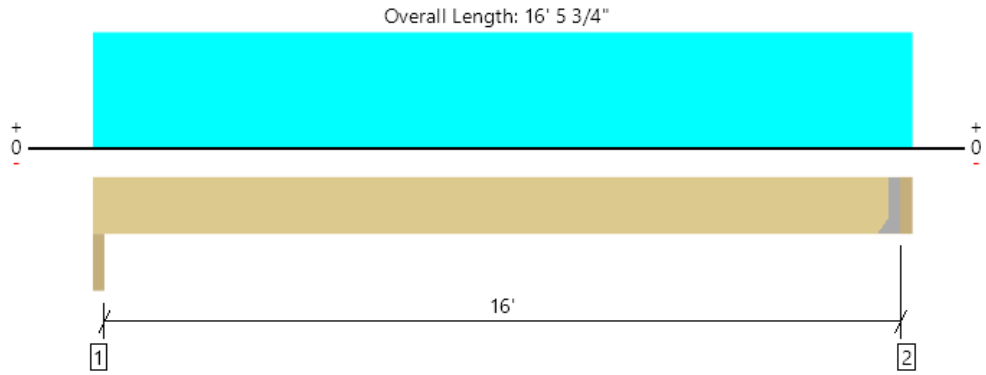
ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

2nd Floor, 2B-14
1 piece(s) 4 x 10 DF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	901 @ 16' 2 3/4"	3281 (1.50")	Passed (27%)	--	1.0 D + 1.0 S (All Spans)
Shear (lbs)	815 @ 15' 5 1/2"	4468	Passed (18%)	1.15	1.0 D + 1.0 S (All Spans)
Moment (Ft-lbs)	3632 @ 8' 2"	4955	Passed (73%)	1.15	1.0 D + 1.0 S (All Spans)
Live Load Defl. (in)	0.283 @ 8' 2"	0.538	Passed (L/683)	--	1.0 D + 1.0 S (All Spans)
Total Load Defl. (in)	0.460 @ 8' 2"	0.806	Passed (L/420)	--	1.0 D + 1.0 S (All Spans)

System : Floor
Member Type : Drop Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 4.1% decrease in the moment capacity has been added to account for lateral stability.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Snow	Factored	
1 - Column - HF	2.75"	2.75"	1.50"	351	561	913	None
2 - Hanger on 9 1/4" HF beam	3.00"	Hanger[1]	1.50"	355	571	927	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	LUS48	2.00"	N/A	6-10dx1.5	4-10d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 16' 2 3/4"	N/A	8.2	--	
1 - Uniform (PSF)	0 to 16' 5 3/4" (Front)	2' 9"	12.6	25.0	Low Roof Load

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ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1C-1

1 piece(s) 5 1/4" x 11 7/8" 2.2E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	23	50	Passed (46%)	--	--
Compression (lbs)	24670	100327	Passed (25%)	1.15	1.0 D + 0.75 L + 0.75 S
Base Bearing (lbs)	24670	1851609	Passed (1%)	--	1.0 D + 0.75 L + 0.75 S
Bending/Compression	0.24	1	Passed (24%)	1.15	1.0 D + 0.75 L + 0.75 S

- Input axial load eccentricity for this design is 16.67% of applicable member side dimension.
- Applicable calculations are based on NDS.
- Initial eccentricity applied as per ESR-1387.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
1 - Point (lb)	11977	4631	12293	Linked from: 2B-6, Support 1

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

1st Floor, 1C-2

1 piece(s) 7" x 7" 1.8E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	17	50	Passed (34%)	--	--
Compression (lbs)	14483	100441	Passed (14%)	1.15	1.0 D + 0.75 L + 0.75 S
Base Bearing (lbs)	14483	1455300	Passed (1%)	--	1.0 D + 0.75 L + 0.75 S
Bending/Compression	0.14	1	Passed (14%)	1.15	1.0 D + 0.75 L + 0.75 S

- Input axial load eccentricity for this design is 16.67% of applicable member side dimension.
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
1 - Point (lb)	6594	2796	7723	Linked from: 2B-6, Support 2

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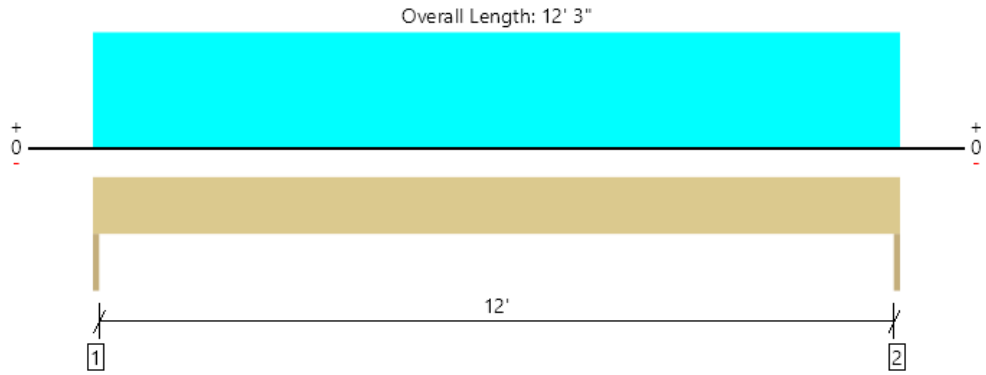
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

1st Floor, 1H-1

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1715 @ 0	3413 (1.50")	Passed (50%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	1470 @ 10 1/2"	6400	Passed (23%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Pos Moment (Ft-lbs)	5251 @ 6' 1 1/2"	10421	Passed (50%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.139 @ 6' 1 1/2"	0.408	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.371 @ 6' 1 1/2"	0.613	Passed (L/397)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 4.1% decrease in the moment capacity has been added to account for lateral stability.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 12' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	1072	245	613	1715	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	1072	245	613	1715	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 12' 3"	N/A	7.7	--	--	
1 - Uniform (PSF)	0 to 12' 3"	1'	12.0	40.0	-	Floor Load
2 - Uniform (PSF)	0 to 12' 3"	2'	12.6	-	25.0	Low Roof Load
3 - Uniform (PLF)	0 to 12' 3"	N/A	100.0	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 12' 3"	2'	15.0	-	25.0	Roof Load

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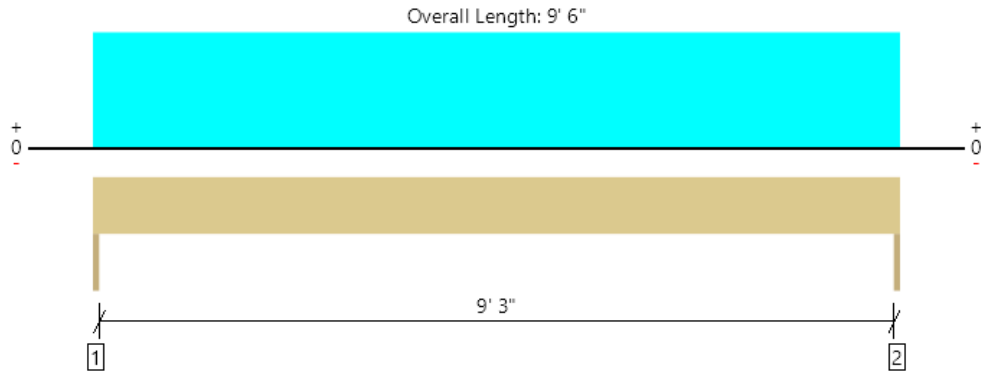
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1H-2

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3000 @ 0	3413 (1.50")	Passed (88%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2448 @ 10 1/2"	5565	Passed (44%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	7126 @ 4' 9"	9231	Passed (77%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.230 @ 4' 9"	0.317	Passed (L/496)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.302 @ 4' 9"	0.475	Passed (L/377)	--	1.0 D + 1.0 L (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 2.3% decrease in the moment capacity has been added to account for lateral stability.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 9' 6".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	720	2280	3000	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	720	2280	3000	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 9' 6"	N/A	7.7	--	
1 - Uniform (PSF)	0 to 9' 6"	12'	12.0	40.0	Floor Load

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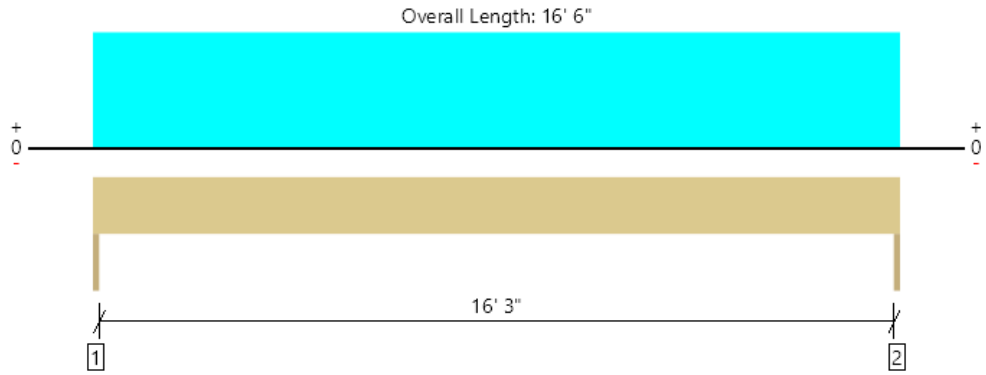
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1H-3

1 piece(s) 5 1/2" x 13 1/2" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	5346 @ 0	5363 (1.50")	Passed (100%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	4326 @ 1' 3"	13118	Passed (33%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	21033 @ 8' 3"	32595	Passed (65%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.419 @ 8' 3"	0.550	Passed (L/473)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.532 @ 8' 3"	0.825	Passed (L/372)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 2.4% decrease in the moment capacity has been added to account for lateral stability.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 16' 6".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	1139	3960	1650	5346	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	1139	3960	1650	5346	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 16' 6"	N/A	18.0	--	--	
1 - Uniform (PSF)	0 to 16' 6"	8'	15.0	60.0	25.0	Deck Load

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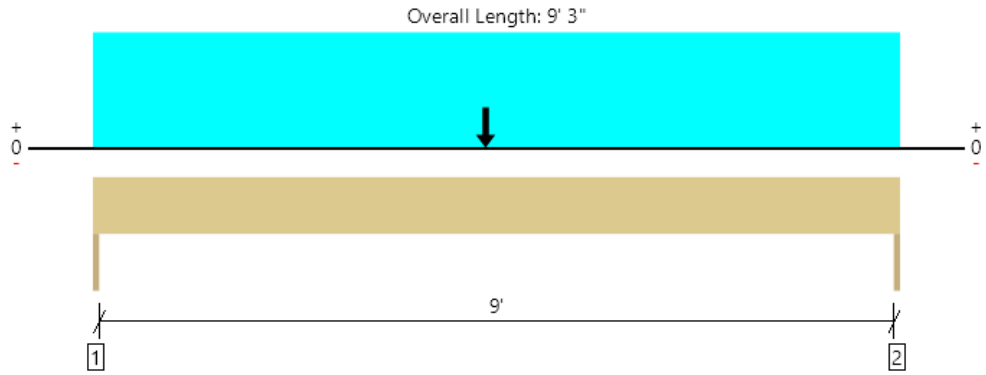
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1H-4
1 piece(s) 5 1/2" x 12" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	5028 @ 0	5363 (1.50")	Passed (94%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	4893 @ 1' 1 1/2"	11660	Passed (42%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	21410 @ 4' 6"	26115	Passed (82%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.124 @ 4' 7 1/4"	0.308	Passed (L/896)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.188 @ 4' 7 1/4"	0.463	Passed (L/591)	--	1.0 D + 1.0 L (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 1.1% decrease in the moment capacity has been added to account for lateral stability.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 9' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	1710	3318	889	5028	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	1630	3162	843	4792	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 9' 3"	N/A	16.0	--	--	
1 - Uniform (PSF)	0 to 9' 3"	2'	12.0	40.0	-	Floor Load
2 - Point (lb)	4' 6"	N/A	2970	5740	1732	Linked from: 2B-3, Support 1

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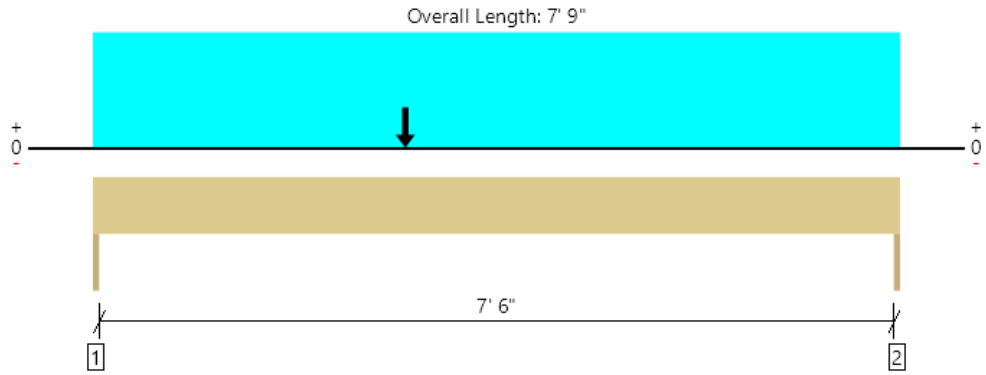
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

1st Floor, 1H-5

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2726 @ 0	3413 (1.50")	Passed (80%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2628 @ 10 1/2"	5565	Passed (47%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	7676 @ 3'	9277	Passed (83%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.128 @ 3' 8 11/16"	0.258	Passed (L/728)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.177 @ 3' 8 11/16"	0.387	Passed (L/527)	--	1.0 D + 1.0 L (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 1.8% decrease in the moment capacity has been added to account for lateral stability.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 7' 9".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	754	1972	2726	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	521	1360	1881	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 7' 9"	N/A	7.7	--	
1 - Uniform (PSF)	0 to 7' 9"	2'	12.0	40.0	Floor Load
2 - Point (lb)	3'	N/A	1030	2712	Linked from: 2B-1, Support 1

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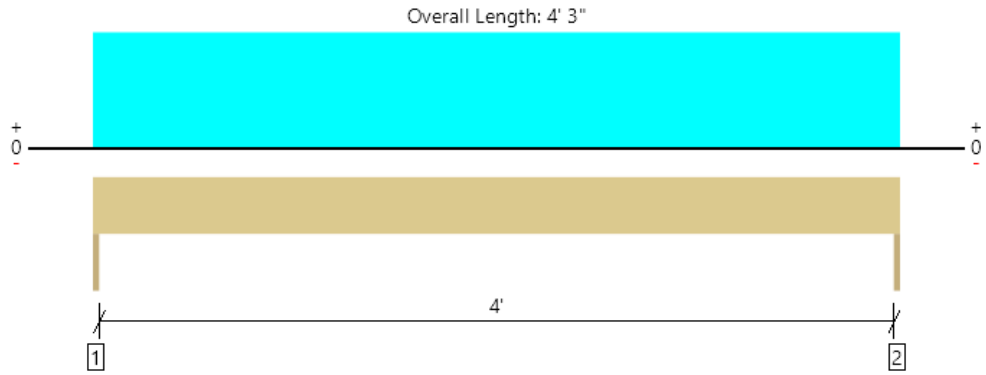
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1H-6
1 piece(s) 4 x 8 DF No.2



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	1284 @ 0	3281 (1.50")	Passed (39%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	844 @ 8 3/4"	3045	Passed (28%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	1365 @ 2' 1 1/2"	2972	Passed (46%)	1.00	1.0 D + 1.0 L (All Spans)
Vert Live Load Defl. (in)	0.019 @ 2' 1 1/2"	0.142	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Vert Total Load Defl. (in)	0.025 @ 2' 1 1/2"	0.213	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Lat Member Reaction (lbs)	100 @ 4' 3"	N/A	Passed (N/A)	1.60	1.0 D + 0.6 W
Lat Shear (lbs)	80 @ 5"	4872	Passed (2%)	1.60	1.0 D + 0.6 W
Lat Moment (Ft-lbs)	106 @ mid-span	2425	Passed (4%)	1.60	1.0 D + 0.6 W
Lat Deflection (in)	0.006 @ mid-span	0.425	Passed (L/999+)	--	1.0 D + 0.6 W
Bi-Axial Bending	0.27	1.00	Passed (27%)	1.60	1.0 D + 0.45 W + 0.75 L + 0.75 Lr

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- Lateral deflection criteria: Wind (L/120)
- A 0.6% decrease in the moment capacity has been added to account for lateral stability.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	307	978	1284	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	307	978	1284	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Lateral Connections						
Supports	Plate Size	Plate Material	Connector	Type/Model	Quantity	Nailing
Left	2X	Hem Fir	Nails	8d (0.113" x 2 1/2") (Toe)	2	
Right	2X	Hem Fir	Nails	8d (0.113" x 2 1/2") (Toe)	2	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 4' 3"	N/A	6.4	--	
1 - Uniform (PSF)	0 to 4' 3"	11' 6"	12.0	40.0	Floor Load

Lateral Load	Location	Tributary Width	Wind (1.60)	Comments
1 - Uniform (PSF)	Full Length	3'	26.1	

• ASCE/SEI 7 Sec. 30.4: Exposure Category (B), Mean Roof Height (33'), Topographic Factor (1.0), Wind Directionality Factor (0.85), Basic Wind Speed (115), Risk Category(II), Effective Wind Area determined using full member span and trib. width.
• IBC Table 1604.3, footnote f: Deflection checks are performed using 42% of this lateral wind load.

ForteWEB Software Operator	Job Notes
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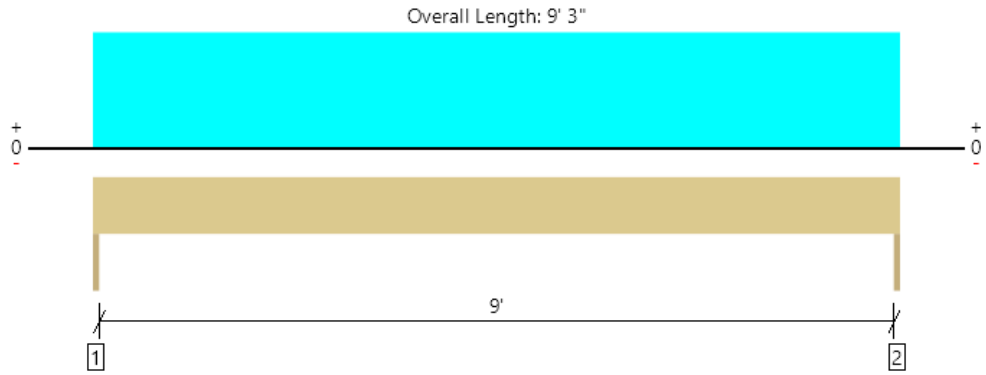
Weyerhaeuser

1st Floor, 1H-7

1 piece(s) 3 1/2" x 9" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	2801 @ 0	3413 (1.50")	Passed (82%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2271 @ 10 1/2"	5565	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	6478 @ 4' 7 1/2"	9238	Passed (70%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.198 @ 4' 7 1/2"	0.308	Passed (L/561)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.261 @ 4' 7 1/2"	0.463	Passed (L/426)	--	1.0 D + 1.0 L (All Spans)

System : Wall
Member Type : Header
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/360) and TL (L/240).
- A 2.2% decrease in the moment capacity has been added to account for lateral stability.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 9' 3".
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Trimmer - HF	1.50"	1.50"	1.50"	674	2128	2801	None
2 - Trimmer - HF	1.50"	1.50"	1.50"	674	2128	2801	None

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 9' 3"	N/A	7.7	--	
1 - Uniform (PSF)	0 to 9' 3"	11' 6"	12.0	40.0	Floor Load

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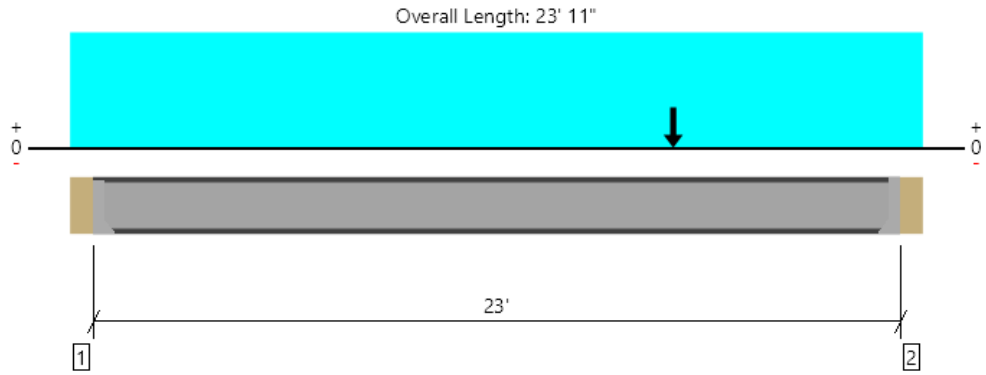
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1B-1

1 piece(s) W14X53 (A992) ASTM Steel



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	20569 @ 23' 5 1/2"	50018 (1.50")	Passed (41%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	20203 @ 23' 5 1/2"	102860	Passed (20%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	112759 @ 16' 8 7/8"	130148	Passed (87%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.396 @ 12' 5 5/8"	0.575	Passed (L/697)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.648 @ 12' 6 3/8"	1.150	Passed (L/426)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Bearing reinforcement may be required for support located at 0".
- Bearing reinforcement may be required for support located at 23'.
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Hanger on 13 7/8" PSL beam	5.50"	Hanger[1]	1.50" / - [2]	5188	9873	2169	15061	See note [1]
2 - Hanger on 13 7/8" PSL beam	5.50"	Hanger[1]	1.50" / - [2]	8078	11099	5554	20569	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	
2 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 23' 5 1/2"	N/A	53.0	--	--	
1 - Uniform (PSF)	0 to 23' 11"	19'	12.0	40.0	-	Floor Load
2 - Point (lb)	17'	N/A	6594	2796	7723	Linked from: 2B-6, Support 2

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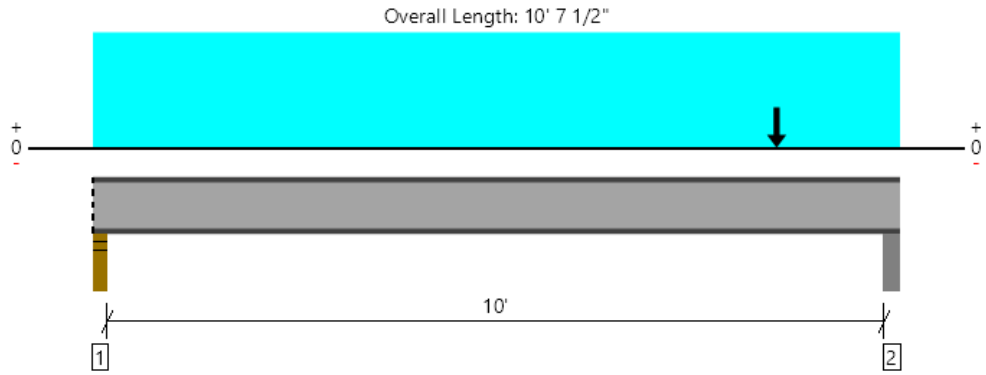
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1B-2
1 piece(s) W14X53 (A992) ASTM Steel



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	18232 @ 10' 5"	29500 (4.00")	Passed (62%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	18200 @ 10' 3 1/2"	102860	Passed (18%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	25705 @ 9'	199082	Passed (13%)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.013 @ 5' 11 3/8"	0.256	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.022 @ 5' 11 1/8"	0.512	Passed (L/999+)	--	1.0 D + 0.75 L + 0.75 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (C_b) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Stud wall - HF	3.50"	3.50"	3.50"	1460	1746	768	3345	Blocking
2 - Pocket - concrete	4.00"	4.00"	4.00"	7308	9778	4786	18232	None

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	0 to 10' 7 1/2"	N/A	53.0	--	--	
1 - Uniform (PSF)	0 to 10' 7 1/2"	1'	12.0	40.0	-	Floor Load
2 - Point (lb)	9'	N/A	8078	11099	5554	Linked from: 1B-1, Support 2

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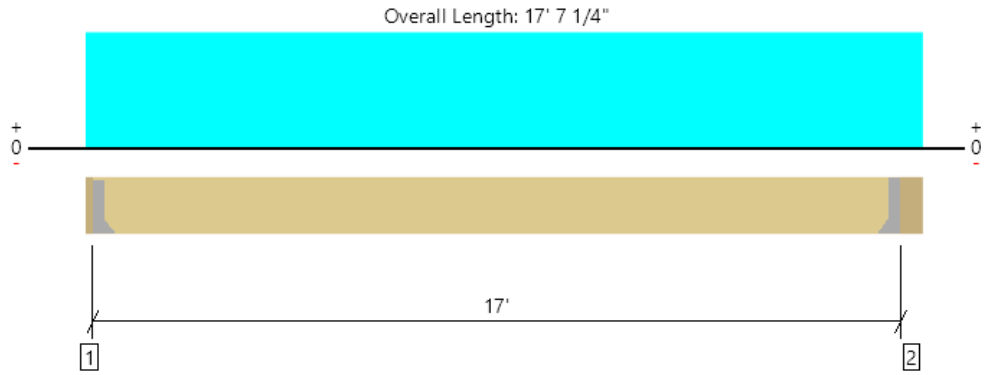
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1B-3

1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	6898 @ 1 3/4"	6898 (2.10")	Passed (100%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	5681 @ 1' 7 3/4"	18270	Passed (31%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	29317 @ 8' 7 3/4"	65497	Passed (45%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.135 @ 8' 7 3/4"	0.425	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.304 @ 8' 7 3/4"	0.850	Passed (L/671)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Hanger on 18" LVL Ledger	1.75"	Hanger[1]	2.10"	3900	3113	432	7012	See note [1]
2 - Hanger on 18" PSL beam	5.50"	Hanger[1]	2.10"	4031	3225	448	7256	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	17' o/c	
Bottom Edge (Lu)	17' o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	
2 - Face Mount Hanger	HGUS5.50/14	4.00"	N/A	66-10d	22-10d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	1 3/4" to 17' 1 3/4"	N/A	29.5	--	--	
1 - Uniform (PSF)	0 to 17' 7 1/4" (Back)	6'	12.0	40.0	-	Floor Load
2 - Uniform (PSF)	0 to 17' 7 1/4" (Front)	3'	40.0	40.0	-	Exterior Patio Load
3 - Uniform (PLF)	0 to 17' 7 1/4" (Top)	N/A	200.0	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 17' 7 1/4" (Top)	2'	15.0	-	25.0	Roof Load Above

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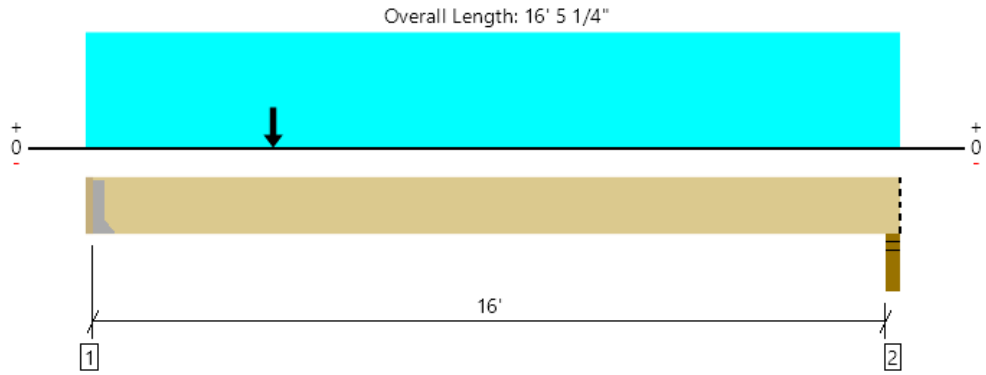
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

1st Floor, 1B-4

1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	7936 @ 1 3/4"	7936 (2.42")	Passed (100%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	7508 @ 1' 7 3/4"	18270	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	26749 @ 3' 9"	65497	Passed (41%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.087 @ 7' 6"	0.403	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.227 @ 7' 7 5/16"	0.806	Passed (L/854)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Hanger on 18" LVL Ledger	1.75"	Hanger[1]	2.42"	4813	3161	758	7974	See note [1]
2 - Stud wall - PSL	3.50"	3.50"	1.50"	2592	1379	512	4010	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	16' 4" o/c	
Bottom Edge (Lu)	16' 4" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

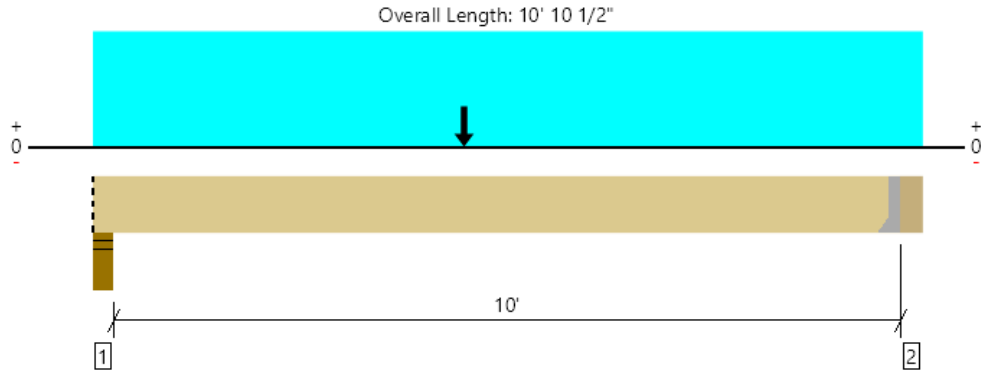
Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	1 3/4" to 16' 5 1/4"	N/A	29.5	--	--	
1 - Uniform (PSF)	0 to 16' 5 1/4" (Back)	1'	12.0	40.0	-	Floor Load
2 - Uniform (PSF)	0 to 16' 5 1/4" (Front)	1'	40.0	40.0	-	Exterior Patio Load
3 - Uniform (PLF)	0 to 16' 5 1/4" (Top)	N/A	100.0	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 16' 5 1/4" (Top)	2'	12.0	-	25.0	Low Roof Load Above
5 - Point (lb)	3' 9" (Back)	N/A	4031	3225	448	Linked from: 1B-3, Support 2

1st Floor, 1B-5

1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL

An excessive uplift of -2644 lbs at support located at 3 1/2" failed this product.

An excessive uplift of -2057 lbs at support located at 10' 5" failed this product.



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	8687 @ 10' 5"	8687 (2.65")	Passed (100%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	4843 @ 8' 11"	18270	Passed (27%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	29787 @ 5'	104796	Passed (28%)	1.60	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.094 @ 5'	0.253	Passed (L/999+)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.121 @ 5'	0.506	Passed (L/999+)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Seismic	Factored	
1 - Stud wall - HF	5.00"	5.00"	4.44"	2567	4712	268	5978/-5978	9441/-2644	Blocking
2 - Hanger on 18" PSL beam	5.50"	Hanger[1]	2.65"	2634	4858	276	5197/-5197	9213/-2057	See note [1]

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' 5" o/c	
Bottom Edge (Lu)	10' 5" o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
2 - Face Mount Hanger	HGUS5.50/14	4.00"	N/A	66-10d	22-10d	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	0 to 10' 5"	N/A	29.5	--	--	--	
1 - Uniform (PSF)	0 to 10' 10 1/2" (Back)	8'	12.0	40.0	-	-	Floor Load
2 - Uniform (PSF)	0 to 10' 10 1/2" (Front)	2'	40.0	40.0	-	-	Exterior Patio Load
3 - Uniform (PLF)	0 to 10' 10 1/2" (Top)	N/A	100.0	-	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 10' 10 1/2" (Top)	2'	15.0	-	25.0	-	Roof Load Above
5 - Uniform (PSF)	0 to 10' 10 1/2" (Top)	12'	12.0	40.0	-	-	2nd Floor Load
6 - Point (lb)	5' (Top)	N/A	-	-	-	11175	max EQ load that can be transmitted through holdown

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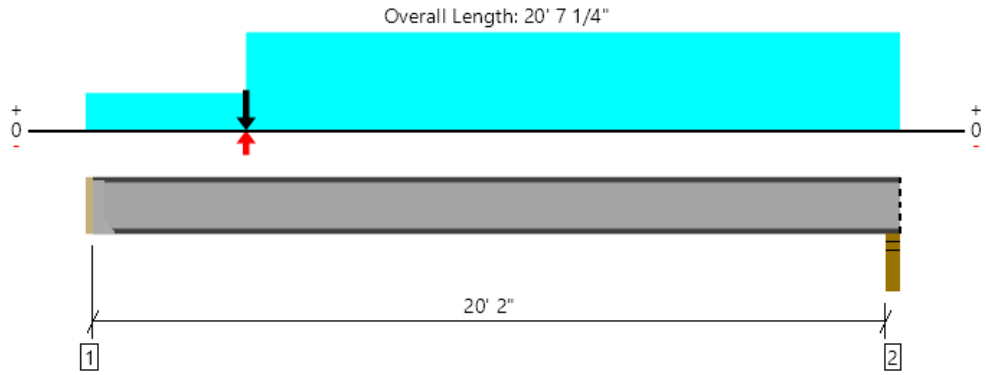
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

1st Floor, 1B-6 (East West Seismic Condition)
1 piece(s) W14X43 (A992) ASTM Steel



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern) [Group]
Member Reaction (lbs)	7061 @ 20' 5 1/4"	17780 (3.50")	Passed (40%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans) [1]
Shear (lbs)	11720 @ 1 3/4"	83570	Passed (14%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans) [1]
Moment (Ft-lbs)	46223 @ 7' 2 3/16"	107172	Passed (43%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans) [1]
Live Load Defl. (in)	0.136 @ 9' 5 7/16"	0.507	Passed (L/999+)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans) [1]
Total Load Defl. (in)	0.276 @ 9' 9 1/16"	1.015	Passed (L/883)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans) [1]

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Bearing reinforcement may be required for support located at 0".
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Seismic	Factored	
1 - Hanger on 13 11/16" LVL Ledger	1.75"	Hanger[1]	1.50" / - [2]	4963	5025	1071	4210/-4210	11745	See note [1]
2 - Stud wall - PSL	3.50"	3.50"	3.50"	4135	2146	1065	987/-987	7061	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	1 3/4" to 20' 7 1/4"	N/A	43.0	--	--	--	
1 - Uniform (PSF)	0 to 20' 7 1/4"	1'	12.0	40.0	-	-	Floor Load
2 - Uniform (PSF)	0 to 20' 7 1/4"	1'	40.0	40.0	-	-	Exterior Patio Load
3 - Uniform (PLF)	4' to 20' 7 1/4"	N/A	200.0	-	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 20' 7 1/4"	2'	12.0	-	25.0	-	Low Roof Load Above
5 - Uniform (PSF)	4' to 20' 7 1/4"	1'	12.0	40.0	-	-	2nd Floor Load
6 - Uniform (PSF)	4' to 20' 7 1/4"	2'	15.0	-	25.0	-	Roof Load
7 - Point (lb)	4'	N/A	2634	4858	276	5197/-5197	Linked from: 1B-5, Support 2

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

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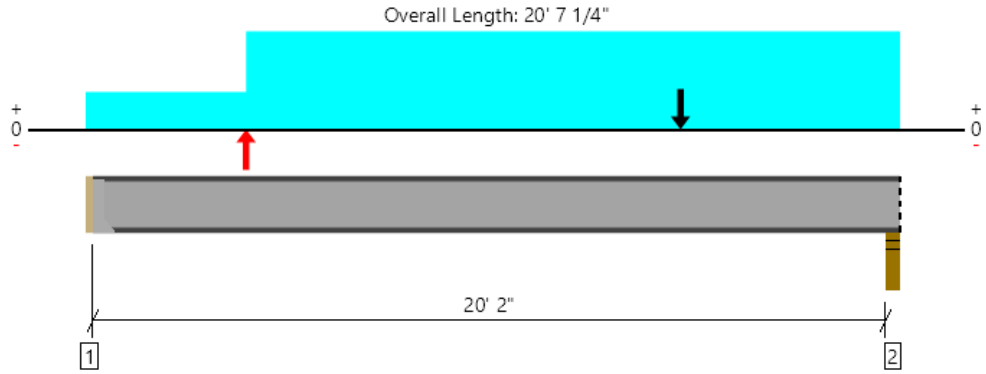
1st Floor, 1B-6 (North South Seismic Condition)
1 piece(s) W14X43 (A992) ASTM Steel

An excessive uplift of -2856 lbs at support located at 1 3/4" failed this product.

An excessive uplift of -2373 lbs at support located at 20' 5 1/4" failed this product.



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	8726 @ 20' 5 1/4"	17780 (3.50")	Passed (49%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Shear (lbs)	8573 @ 20' 3 3/4"	83570	Passed (10%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Moment (Ft-lbs)	39197 @ 15'	107172	Passed (37%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Live Load Defl. (in)	0.084 @ 12' 7"	0.507	Passed (L/999+)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)
Total Load Defl. (in)	0.185 @ 11' 6 1/8"	1.015	Passed (L/999+)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Bearing reinforcement may be required for support located at 0".
- Applicable calculations are based on ANSI/AISC 360-16.
- A lateral-torsional buckling factor (Cb) of 1.0 has been assumed.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Seismic	Factored	
1 - Hanger on 13 11/16" LVL Ledger	1.75"	Hanger[1]	1.50" / - [2]	2830	1090	847	6505/-6505	7698/-2856	See note [1]
2 - Stud wall - PSL	3.50"	3.50"	3.50"	3634	1223	1013	6505/-6505	8726/-2373	Blocking

- Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.
- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.
- [2] Required Bearing Length / Required Bearing Length with Web Stiffeners

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	End Bearing Points	
Bottom Edge (Lu)	End Bearing Points	

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	1 3/4" to 20' 7 1/4"	N/A	43.0	--	--	--	
1 - Uniform (PSF)	0 to 20' 7 1/4"	1'	12.0	40.0	-	-	Floor Load
2 - Uniform (PSF)	0 to 20' 7 1/4"	1'	40.0	40.0	-	-	Exterior Patio Load
3 - Uniform (PLF)	4' to 20' 7 1/4"	N/A	200.0	-	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 20' 7 1/4"	2'	12.0	-	25.0	-	Low Roof Load Above
5 - Uniform (PSF)	4' to 20' 7 1/4"	1'	12.0	40.0	-	-	2nd Floor Load
6 - Uniform (PSF)	4' to 20' 7 1/4"	2'	15.0	-	25.0	-	Roof Load
7 - Point (lb)	15'	N/A	-	-	-	12000	EQ = sw reaction * overstrength
8 - Point (lb)	4'	N/A	-	-	-	-12000	EQ = sw reaction * overstrength

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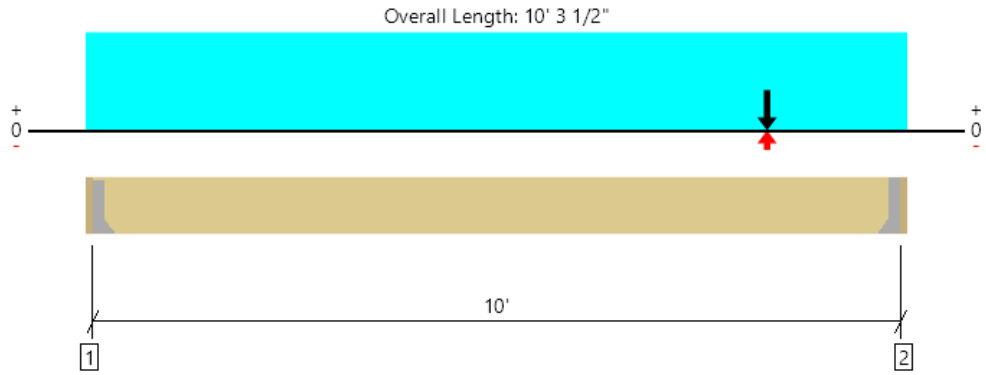
The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

1st Floor, 1B-7

1 piece(s) 5 1/4" x 18" 2.2E Parallam® PSL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern) [Group]
Member Reaction (lbs)	10481 @ 10' 1 3/4"	10481 (3.19")	Passed (100%)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans) [1]
Shear (lbs)	9294 @ 8' 7 3/4"	21011	Passed (44%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans) [1]
Moment (Ft-lbs)	15826 @ 8' 4 3/16"	75322	Passed (21%)	1.15	1.0 D + 0.75 L + 0.75 S (All Spans) [1]
Live Load Defl. (in)	0.031 @ 5' 7 11/16"	0.250	Passed (L/999+)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans) [1]
Total Load Defl. (in)	0.065 @ 5' 6 1/2"	0.500	Passed (L/999+)	--	1.0 D + 0.525 E + 0.75 L + 0.75 S (All Spans) [1]

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)					Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Seismic	Factored	
1 - Hanger on 18" LVL Ledger	1.75"	Hanger[1]	1.50"	2368	922	1152	181/-181	4018	See note [1]
2 - Hanger on 18" LVL Ledger	1.75"	Hanger[1]	3.19"	4999	3001	3752	918/-918	10546	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' o/c	
Bottom Edge (Lu)	10' o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	
2 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Seismic (1.60)	Comments
0 - Self Weight (PLF)	1 3/4" to 10' 1 3/4"	N/A	29.5	--	--	--	
1 - Uniform (PSF)	0 to 10' 3 1/2" (Back)	1'	12.0	40.0	-	-	Floor Load
2 - Uniform (PSF)	0 to 10' 3 1/2" (Front)	1'	40.0	40.0	-	-	Exterior Patio Load
3 - Uniform (PLF)	0 to 10' 3 1/2" (Top)	N/A	200.0	-	-	-	Wall Load Above
4 - Uniform (PSF)	0 to 10' 3 1/2" (Top)	2'	12.0	-	25.0	-	Low Roof Load Above
5 - Point (lb)	8' 6" (Top)	N/A	3922	3100	3875	1099/-1099	Linked from: 2B-10, Support 2
6 - Uniform (PSF)	0 to 10' 3 1/2" (Front)	2'	15.0	-	25.0	-	Roof Load

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

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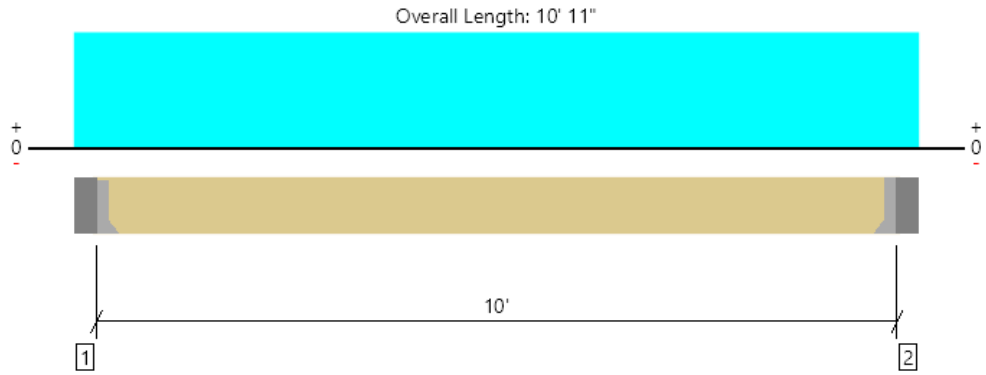
Basement, BH-1

1 piece(s) 5 1/2" x 9" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	4287 @ 5 1/2"	5363 (1.50")	Passed (80%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	3644 @ 1' 2 1/2"	8745	Passed (42%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	10718 @ 5' 5 1/2"	14850	Passed (72%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.172 @ 5' 5 1/2"	0.250	Passed (L/697)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.321 @ 5' 5 1/2"	0.500	Passed (L/374)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 10'.
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Hanger on concrete	5.50"	Hanger[1]	1.50"	2164	2511	409	4675	See note [1]
2 - Hanger on concrete	5.50"	Hanger[1]	1.50"	2164	2511	409	4675	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' o/c	
Bottom Edge (Lu)	10' o/c	

•Maximum allowable bracing intervals based on applied load.

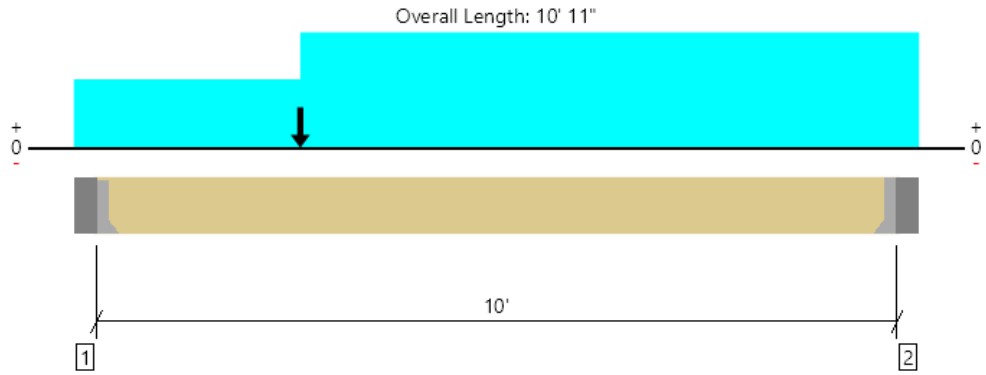
Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	
2 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 10' 5 1/2"	N/A	12.0	--	--	
1 - Uniform (PSF)	0 to 10' 11" (Top)	11' 6"	12.0	40.0	-	2nd Floor Load
2 - Uniform (PLF)	0 to 10' 11" (Top)	N/A	200.0	-	-	Wall Load Above
3 - Uniform (PSF)	0 to 10' 11" (Top)	3'	15.8	-	25.0	Roof Load

Basement, BH-2

1 piece(s) 5 1/2" x 10 1/2" 24F-V4 DF Glulam



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	6601 @ 5 1/2"	6601 (1.85")	Passed (100%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	6175 @ 1' 4"	10203	Passed (61%)	1.00	1.0 D + 1.0 L (All Spans)
Pos Moment (Ft-lbs)	15997 @ 4' 4 5/16"	20213	Passed (79%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.172 @ 5' 3 3/16"	0.250	Passed (L/698)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.300 @ 5' 3 7/16"	0.500	Passed (L/400)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.
- Critical positive moment adjusted by a volume factor of 1.00 that was calculated using length L = 10'.
- The effects of positive or negative camber have not been accounted for when calculating deflection.
- The specified glulam is assumed to have its strong laminations at the bottom of the beam. Install with proper side up as indicated by the manufacturer.
- Applicable calculations are based on NDS.

Supports	Bearing Length			Loads to Supports (lbs)				Accessories
	Total	Available	Required	Dead	Floor Live	Snow	Factored	
1 - Hanger on concrete	5.50"	Hanger[1]	1.85"	3031	3786	409	6817	See note [1]
2 - Hanger on concrete	5.50"	Hanger[1]	1.50"	2503	3128	409	5631	See note [1]

- At hanger supports, the Total Bearing dimension is equal to the width of the material that is supporting the hanger
- [1] See Connector grid below for additional information and/or requirements.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	10' o/c	
Bottom Edge (Lu)	10' o/c	

•Maximum allowable bracing intervals based on applied load.

Connector: Simpson Strong-Tie						
Support	Model	Seat Length	Top Fasteners	Face Fasteners	Member Fasteners	Accessories
1 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	
2 - Face Mount Hanger	Connector not found	N/A	N/A	N/A	N/A	

- Refer to manufacturer notes and instructions for proper installation and use of all connectors.

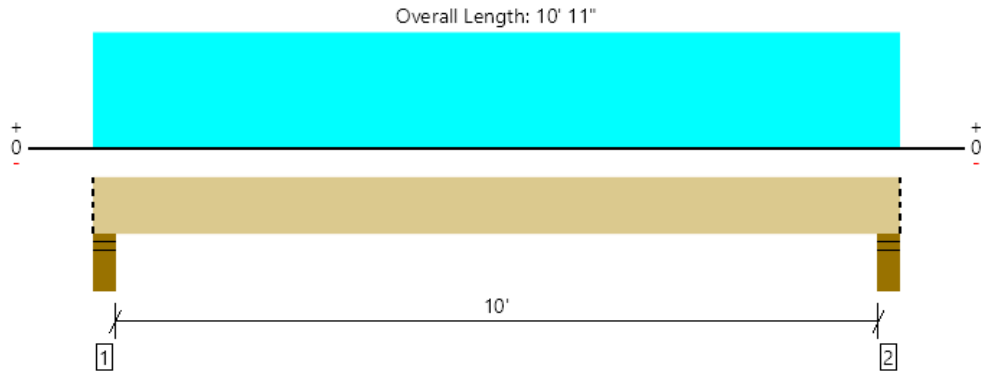
Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Snow (1.15)	Comments
0 - Self Weight (PLF)	5 1/2" to 10' 5 1/2"	N/A	14.0	--	--	
1 - Uniform (PSF)	3' to 10' 11" (Top)	11' 6"	12.0	40.0	-	2nd Floor Load
2 - Uniform (PLF)	0 to 10' 11" (Top)	N/A	200.0	-	-	Wall Load Above
3 - Uniform (PSF)	0 to 10' 11" (Top)	3'	15.8	-	25.0	Roof Load
4 - Point (lb)	3' (Top)	N/A	1375	2823	-	Linked from: 2B-2, Support 2
5 - Uniform (PSF)	0 to 3' (Top)	3' 9"	20.0	40.0	-	Master Bath Load

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

Basement, BB-1

1 piece(s) 1 3/4" x 16" 2.0E Microllam® LVL



All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

Design Results	Actual @ Location	Allowed	Result	LDF	Load: Combination (Pattern)
Member Reaction (lbs)	3309 @ 4"	3898 (5.50")	Passed (85%)	--	1.0 D + 1.0 L (All Spans)
Shear (lbs)	2223 @ 1' 9 1/2"	5320	Passed (42%)	1.00	1.0 D + 1.0 L (All Spans)
Moment (Ft-lbs)	7961 @ 5' 5 1/2"	15557	Passed (51%)	1.00	1.0 D + 1.0 L (All Spans)
Live Load Defl. (in)	0.120 @ 5' 5 1/2"	0.256	Passed (L/999+)	--	1.0 D + 1.0 L (All Spans)
Total Load Defl. (in)	0.159 @ 5' 5 1/2"	0.512	Passed (L/775)	--	1.0 D + 1.0 L (All Spans)

System : Floor
Member Type : Flush Beam
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD

- Deflection criteria: LL (L/480) and TL (L/240).
- Allowed moment does not reflect the adjustment for the beam stability factor.

Supports	Bearing Length			Loads to Supports (lbs)			Accessories
	Total	Available	Required	Dead	Floor Live	Factored	
1 - Stud wall - HF	5.50"	5.50"	4.67"	798	2511	3309	Blocking
2 - Stud wall - HF	5.50"	5.50"	4.67"	798	2511	3309	Blocking

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

Lateral Bracing	Bracing Intervals	Comments
Top Edge (Lu)	6' 9" o/c	
Bottom Edge (Lu)	10' 11" o/c	

•Maximum allowable bracing intervals based on applied load.

Vertical Loads	Location (Side)	Tributary Width	Dead (0.90)	Floor Live (1.00)	Comments
0 - Self Weight (PLF)	0 to 10' 11"	N/A	8.2	--	
1 - Uniform (PSF)	0 to 10' 11" (Front)	11' 6"	12.0	40.0	Floor Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

ForteWEB Software Operator	Job Notes
Harrison Kliegl L120 Engineering (425) 636-3313 hkliegl@l120engineering.com	

Weyerhaeuser

LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

LATERAL CALCULATIONS

SHEAR-WALL REFERENCE PER PLAN

L120 ENGINEERING & DESIGN, LLC
(206) 790 9502
L120Engineering.com

Project Number:	Plan Name:	Sheet Number:
S230110-1	Granbois	DC
Engineer:	Specifics:	Date:
HK	Design Criteria	4/6/2023

Gravity Criteria: Code: IBC 2018

ROOF SYSTEM		
Live Load:		
Snow	25.0	psf
Dead Load:		
Composite Roofing	2.0	psf
19/32" Plywood Sheathing	2.5	psf
Trusses at 24" o.c.	3.0	psf
Insulation	1.8	psf
(2) Layers 5/8" GWB	4.4	psf
Misc/Mech	1.3	psf
Total	**15.0**	**psf**

FLOOR SYSTEM		
Live Load:		
Residential	40.0	psf
Dead Load:		
Flooring	3.0	psf
3/4" T & G Plywood	2.5	psf
Floor Joists at 16" o.c.	2.5	psf
Insulation	0.5	psf
(1) Layers 5/8" GWB	2.2	psf
Miscellaneous	1.3	psf
Total	**12.0**	**psf**

EXTERIOR WALL SYSTEM		
2x6 at 16" o.c.	1.7	psf
Insulation	1.0	psf
1/2" Plywood Sheathing	1.5	psf
(2) layers 5/8" GWB	4.4	psf
Misc	3.4	psf
Total	**12.0**	**psf**

INTERIOR WALL SYSTEM		
2x4 at 16" o.c.	1.1	psf
Insulation	0.5	psf
(2) Layers 5/8" GWB	4.4	psf
Misc	2.0	psf
Total	**8.0**	**psf**

SEISMIC PARAMETERS:

Code Reference: ASCE 7-16
R = **6.5** Bearing Wall System, Wood Structural Panel Walls
Mapped Spectral Acceleration, Ss = **1.64**
Mapped Spectral Acceleration, S1 = **0.62**
Soil Site Class = **D**

WIND PARAMETERS:

Code Reference: ASCE 7-16
Basic Wind Speed (3 second Gust) = **100** mph
Exposure : **B**
Kzt = **1.90**

SOIL PARAMETERS:

Soil Bearing Pressure = **3,500** psf competent native soil or structural fill
1/3 increase for short-term wind or seismic loading is acceptable
Frost Depth = **18** in

Lateral Wall Pressures:
Unrestrained Active Pressure = **35** pcf Cantilevered walls
Restrained Active Pressure = **50** pcf Plate Wall Design/Tank Walls
Passive Pressure = **300** pcf
Soil Friction Coeff. = **0.5**

Project Number:	Plan:	Sheet Number:
S230110-1	**Granbois**	**L1**
Engineer:	**Specifics:**	**Date**
HK	**WIND FORCES**	**4/6/2023**

IBC 2018 Section 1609 → ASCE 7-16 Section 28.5 - Simplified Procedure → Main Wind-Force Resisting System

LOAD CRITERIA:

Basic Wind Speed, V_s =	100 mph	(ASCE 7-16, Section 26.5)
Exposure =	B	(ASCE 7-16, Section 26.7)

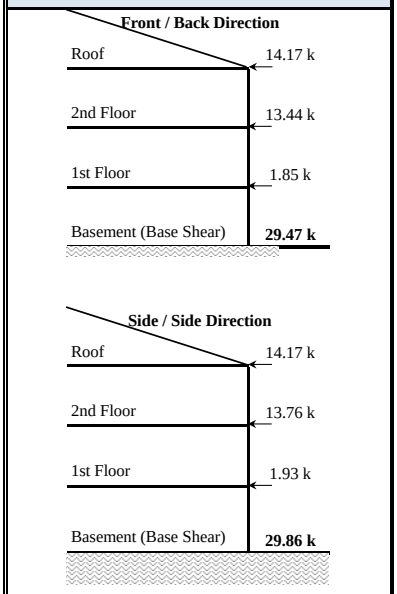
BUILDING GEOMETRY:

Roof Slope =	7.00 :12	=	30.26	degrees
Loads From Front/Back - Width (ft)=	64.00 ft		Roof:	Hip
Loads From Side - Width (ft) =	64.00 ft		Roof:	Hip
Average Eave Height =	21.00 ft			
Mean Roof Ht. , h =	29.00 ft	(ASCE 7-16, Figure 27.5-2)		
Edge Strip Width, a =	6.4 ft	(ASCE 7-16, Figure 28.5-1)		
End Zone Width, 2a =	12.80 ft	(ASCE 7-16, Figure 28.5-1)		

DESIGN:

Topographic Factor , Kzt =	1.90	(ASCE 7-16, Section 26.8)
Adjustment Factor, λ =	1.00	(ASCE 7-16, Figure 28.5-1)

WIND LOAD SUMMARY:

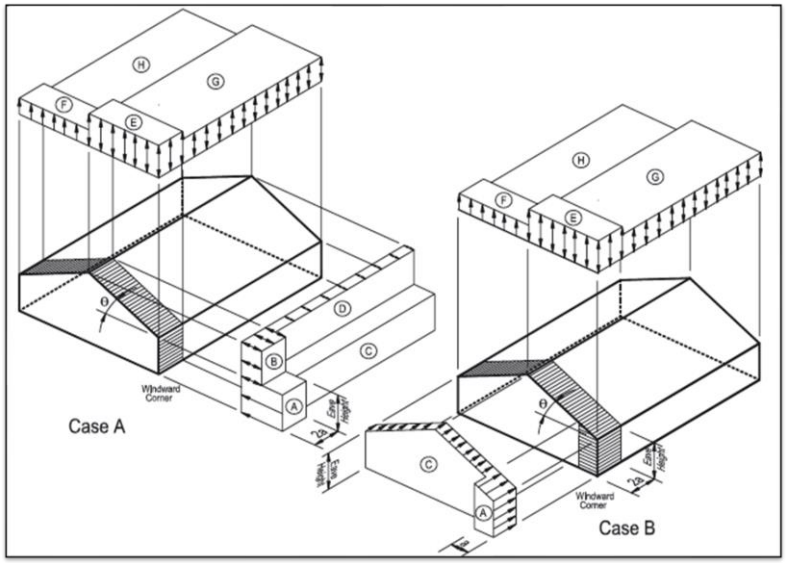


SIMPLIFIED DESIGN WIND PRESSURE, P_{S30} (psf)

(Exposure B at h = 30ft.)

Basic Wind Speed, Vs (mph)	Roof Angle (Degrees)	Load Case	ZONES*									
			Horizontal Pressure				Vertical Presssure				Overhang	
			A	B	C	D	E	F	G	H	E_{OH}	G_{OH}
100	30.26	A	17.80	12.20	14.20	9.80	1.40	-10.80	0.50	-9.30	-6.30	-7.20

** Values Interpolated from Figure 28.5-1 ASCE 7 - 16*



Project Number:	Plan:	Sheet Number:
S230110-1	**Granbois**	**L1**
Engineer:	**Specifics:**	**Date**
HK	**WIND FORCES**	**4/6/2023**

IBC 2018 Section 1609 → ASCE 7-16 Section 28.5 - Simplified Procedure → Main Wind-Force Resisting System

HORIZONTAL LOADS (psf) $p_s = \lambda * Kzt * Ps30$				**MIN. LOADS (psf)** *Per ASCE 7-16, 28.6.3*	
End zone		Interior zone		Roof	Wall
A (Wall)	B (Roof)	C (Wall)	D (Roof)		
33.82	23.18	26.98	18.62	8.0	16.0

Full Impact at Basement? NO (No = 1/4 Impact)

ASD WIND FORCES: FRONT / BACK LOADING DIRECTION

	Location	Width (ft)	Height (ft)	Plane	End Zone Length (ft)	End Zone Pressure (W) (psf)	Interior zone Length (ft)	Interior zone Pressure (W) (psf)	Force 0.6 ω*W (kips)	Min Force 0.6 ω*W (kips)
ROOF	'Height" of Roof to Plate (see note)	64.0	8.00	(roof)	12.8	23.18	51.2	18.62	7.80	3.19
	Plate to Mid 2nd LVL	64.0	4.50	(wall)	12.8	33.82	51.2	26.98	6.37	3.59
								Σ =	14.17	6.79
2nd FLOOR	Mid 2nd LVL to Floor	64.0	4.50	(wall)	12.8	33.82	51.2	26.98	6.37	3.59
	eight" Low-Roof to Plate (see note)	0.0	0.00	(roof)	12.8	23.18	-12.8	18.62	0.00	0.00
	Floor to Mid 1st LVL	64.0	5.00	(wall)	12.8	33.82	51.2	26.98	7.08	3.99
								Σ =	13.44	7.59
1st FLOOR	Mid 1st LVL to Floor	64.0	5.00	(wall)	12.8	33.82	51.2	26.98	7.08	3.99
	eight" Low-Roof to Plate (see note)	0.0	0.00	(roof)	12.8	23.18	-12.8	18.62	0.00	0.00
	Floor to Mid Basement LVL	0.0	5.00	(wall)	12.8	33.82	-12.8	26.98	0.34	0.00
								Σ =	1.85	1.00
								Total Wind Base Shear (kips)	29.47	15.38

Full Impact at Basement? NO (No = 1/4 Impact)

ASD WIND FORCES: SIDE / SIDE LOADING DIRECTION

	Location	Width (ft)	Height (ft)	Plane	End Zone Length (ft)	End Zone Pressure (W) (psf)	Interior zone Length (ft)	Interior zone Pressure (W) (psf)	Force 0.6 ω*W kips	Min Force 0.6 ω*W kips
ROOF	'Height" of Roof to Plate (see note)	64.0	8.00	(roof)	12.8	23.18	51.2	18.62	7.80	3.19
	Plate to Mid 2nd LVL	64.0	4.50	(wall)	12.8	33.82	51.2	26.98	6.37	3.59
								Σ =	14.17	6.79
2nd FLOOR	Mid 2nd LVL to Floor	64.0	4.50	(wall)	12.8	33.82	51.2	26.98	6.37	3.59
	eight" Low-Roof to Plate (see note)	0.0	0.00	(roof)	12.8	23.18	-12.8	18.62	0.00	0.00
	Floor to Mid 1st LVL	67.0	5.00	(wall)	12.8	33.82	54.2	26.98	7.39	4.18
								Σ =	13.76	7.78
1st FLOOR	Mid 1st LVL to Floor	67.0	5.00	(wall)	12.8	33.82	54.2	26.98	7.39	4.18
	eight" Low-Roof to Plate (see note)	0.0	0.00	(roof)	12.8	23.18	-12.8	18.62	0.00	0.00
	Floor to Mid Basement LVL	0.0	5.00	(wall)	12.8	33.82	-12.8	26.98	0.34	0.00
								Σ =	1.93	1.05
								Total Wind Base Shear (kips)	29.86	15.61

Project Number:	Plan Name:	Sheet Number:
S230110-1	**Granbois**	**L2**
Engineer:	Specifics:	Date:
HK	**SEISMIC WEIGHTS**	**4/6/2023**

Unit Weights (psf)

Roof:	15	psf	Seismic Weights include: (REF §12.7)
Floor:	12	psf	25% of storage Live loads
Exterior Wall:	12	psf	Actual partition weight or 10 psf min if applicable
Interior Wall:	8	psf	Operating weight of permenant equipment
			20% of uniform design snow loads for areas where Pf > 30 psf

LEVEL	ITEM	AREA / LENGTH	HEIGHT (ft)	WEIGHT (psf)		Total Weight. (lbs)	Sub-Total (kips)	Average Pressure (psf)
ROOF:								
	Roof	3,100	1.12	15	=	52,195		
	Ext. Wall Below	300	4.00	12	=	14,400		
	Corridor Wall Below	150	4.00	8	=	4,800		
							71	**23**
2nd FLOOR:								
	Floor	2,650	1.00	12	=	31,800		
	Low Roof	0	1.12	15	=	0		
	Ext. Wall Above	300	4.00	12	=	14,400		
	Corridor Wall Above	150	4.00	8	=	4,800		
	Ext. Wall Below	200	4.50	12	=	10,800		
	Corridor Wall Below	110	4.50	8	=	3,960		
							66	**25**
1st FLOOR:								
	Floor	3,900	1.00	12	=	46,800		
	Low Roof	0	1.12	15	=	0		
	Ext. Wall Above	200	4.50	12	=	10,800		
	Corridor Wall Above	110	4.50	8	=	3,960		
	Ext. Wall Below	200	4.50	12	=	10,800		
	Corridor Wall Below	100	4.50	8	=	3,600		
							76	**19**
BASEMENT:								
	Ext. Wall Above	200	4.50	12	=	10,800		
	Corridor Wall Above	100	4.50	8	=	3,600		
							14	

STRUCTURE WEIGHT FOR SEISMIC BASE SHEAR: 213 kips

TOTAL WEIGHT OF STRUCTURE: 228 kips

(Includes Basement Dead Load)

Project Number:	Plan Name:	Sheet Number:
S230110-1	**Granbois**	**L3**
Engineer:	Specifics:	Date:
HK	**SEISMIC FORCES**	**4/6/2023**

Equivelant Lateral Force Analysis per IBC 2018 1613.1 →ASCE 7-16 Table 12.6-1 →Sec 12.8

Data generated by: Seismic Design Values for Buildings **"Java Ground Motion Parameter Calculation"**

S_1 =	0.62		Maps
S_{DS} =	1.2		(ASCE 7 EQ 11.4.-3)
S_{D1} =	0.85		(ASCE 7 EQ 11.4.-4)
Seismic Importance Factor =	1.00		(ASCE 7 Table 11.5-1)
Seismic Design Category =	D		(ASCE 7 Table 11.6-1 & 11.6.2)
Response Modification Factor, R =	6.5		(ASCE 7 Table 12.2-1)
Seismic Force-Resisting System Description =	A.13 - light framed walls		

Building Height, h_n =	30.0	ft	
Building Period Coefficient, C_T =	0.020		(ASCE 7 Table 12.8.-2)
Approx. Fundamental Period, T_a =	0.256	$(C_T*(h_n^{0.75})$	(ASCE 7 EQ 12.8.-7)
Approx. Fundamental Period, T_L =	6.0	sec	(ASCE 7 11.4.6)

Seismic Response Coefficient

$C_s = S_{DS}/(R/I)$	C_s =	0.185		(ASCE 7 EQ 12.8.-2)

Seismic Response Coefficient, Maximum

$C_{s,\,MAX} = S_{D1}/(T*R/I)$	$C_{s,\,MAX}$ =	0.510	$T \le T_L$	(ASCE 7 EQ 12.8.-3)
$C_{s,\,MAX} = S_{D1}\,T_L/(T^2*R/I)$	$C_{s,\,MAX}$ =	NA	$T > T_L$	(ASCE 7 EQ 12.8.-4)

Seismic Response Coefficient, Minimum

$C_{s,\,MIN} = 0.01$	$C_{s,\,MIN}$ =	0.010		(ASCE 7 EQ 12.8.-5)
$C_{s,\,MIN} = 0.5\,S_1/(R/I)$	$C_{s,\,MIN}$ =	0.048	if S1 > 0.6	(ASCE 7 EQ 12.8.-6)

C_s =	**0.185**		
Dead Load W =	213	kips	
V = Cs W =	39.3	kips	(ASCE 7 EQ 12.8.-1)
$Q_E = V$ =	39.3	kips	(ASCE 7 EQ 12.4-3)
ρ =	1.0		(ASCE 7 12.3.4.2)
$E_H = \rho\,Q_E$	39.3	kips	(ASCE 7 EQ 12.4-3)
Ev = .2 S_{DS} D =	0.24	x D kips	

Factor for Alternate Basic Load conbinations - 2018 IBC

$E_H/1.4$ =	**28.1**	**kips**	IBC 2018 1605.3.2
k =	1		(ASCE 7 12.8.3)

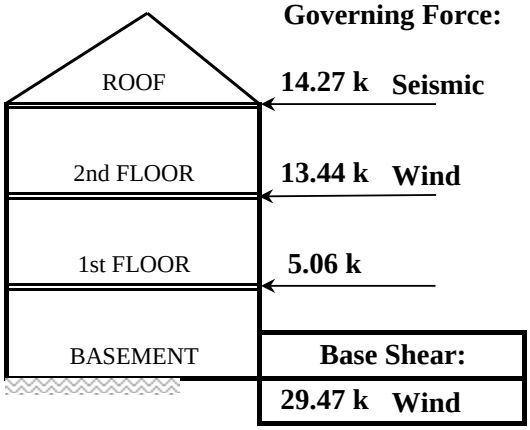
VERTICAL DISTRIBUTION (Per ASCE 7 - 12.8.3)

Floor	Area (ft²)	Story Height H (ft)	Total Height h_x (ft)	Story Weight w_x (kips)	$w_x h_x^k$ (k-ft)	Vert Dist Factor Cvx	Story Force Fx (kips)	Factored Story Force (ASD) Fx ρ/1.4 = E_H/1.4 (kips)
Roof	3,100	10.00	30.00	71	2,142	0.51	20.0	**14.3**
2nd	2,650	10.00	20.00	66	1,315	0.31	12.3	**8.8**
1st	3,900	10.00	10.00	76	760	0.18	7.1	**5.1**
				Sum =	4,217	1.000	39.3	**28.1**

Project Number:	Plan Name:	Sheet Number:
S230110-1	**Granbois**	**L4**
Engineer:	**Specifics:**	**Date:**
HK	**DESIGN LOADS**	**4/6/2023**

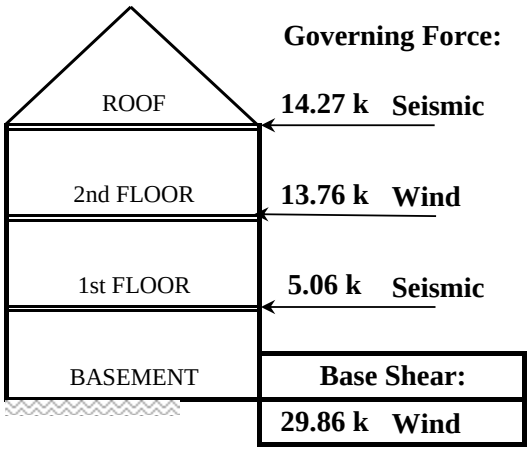
FRONT / BACK DIRECTION

Wind Force $0.6\,\omega * W_{F/B}$ (kips)		Seismic Force $E/1.4$ (kips)	
Per Level	Sum	Per Level	Sum
14.17		14.27	
13.44	14.17	8.77	14.27
1.85	27.61	5.06	23.04
	29.47		28.10



SIDE / SIDE DIRECTION

Wind Force $0.6\,\omega * W_{S}$ (kips)		Seismic Force $E/1.4$ (kips)	
Per Level	Sum	Per Level	Sum
14.17		14.27	
13.76	14.17	8.77	14.27
1.93	27.93	5.06	23.04
	29.86		28.10



Project Number:	Plan Name:	Sheet Number:
S230110-1	**Granbois**	**L5**
Engineer:	Specifics:	Date:
HK	**Shear walls (front/back)**	**4/6/2023**

Notes:

* All walls designed with Force-Transfer should meet a minimum height to width ratio of 2:1 at Pier (SDPWS 2018, Table 4.3.4)
* Maximum allowed height to width ratio 3.5:1 for walls w/o openings (increased shear design values per SDPWS 2018, Table 4.3.4)
* Shear panel height is height to underside or roof or floor framing.

RED = Update Formula as required - Important
BLUE = Review and update as required - Typical Input

2nd Story Walls (Front - Back Direction)

Stud Species: HF

2nd Story Walls (Front - Back Direction)
Hold downs and window straps

Story shear(kips) = 14.27
Story height (ft) = 10.00
Shear Panel height (ft) = 9.00
Total Diaphragm Width (ft) = 64.00

100% story shear YES

Governing Force (F/B Direction) = Wind
Dead load factor (F/B Direction) = 0.67 IBC 2018 Equation 16-18
Shear panel capacity (Wind or Seismic) = Seismic
load balance check = ill loads do not match story shear

Story	Wall Mark	Wall L(ft)	Opening Width (ft)	Opening Height (ft)	Opening (max) to Edge (ft)	Plate to Opening (ft)	Effective Length (ft)	Trib. Width (ft)	Percent Sharing (%)	Effective Trib. Width	Story V(kips)	Sum V(kips)	Panel Shear (plf)	Height/Width Reduction (%) R = 2*L/H	Design Panel Shear (plf)	Wall Type	Roof DL Trib(ft)	Sum DL(klf)	Sum DL(klf)	OTM (k-ft)	RM (k-ft)	Resultant HD(kips)	HD TYPE	HD/Strap to DF or HF?	HD location Edge/Interior?	Resultant HD	Force at Window (Kips)	Window Strap
2	1.0	23.00	3.00	5.00	4.00	0.67	20.00	9.50	1.00	9.50	2.12	2.12	106	1.00	106	SW6	15.00	0.33	0.33	21.2	59.0	-1.68	flr-flr	HF	Edge	No HD	2.01	CS14
2	2.0	12.75					12.75	16.50	1.00	16.50	3.68	3.68	289	1.00	289	SW4	15.00	0.33	0.33	36.8	18.1	1.52	flr-beam	HF	Edge	MSTC48B3	0.00	No strap
2	3.0	15.50					15.50	21.50	1.00	21.50	4.80	4.80	309	1.00	309	SW4	10.00	0.26	0.26	48.0	20.8	1.81	flr-flr	HF	Edge	MST37	0.00	No strap
2	5.0	21.00	3.00	5.00	4.00	0.67	18.00	16.00	1.00	16.00	3.57	3.57	198	1.00	198	SW6	3.00	0.15	0.15	35.7	22.6	0.64	flr-flr	HF	Edge	MST37	3.75	CMSTC16
S =	72.25					Total OSB wall length = (feet)	48.25			S =	63.50	14.16	**14.16**	Warning-Wall	Total OSB Capacity (kips)	14.27											

1st Story Walls (Front - Back Direction)

1st Story Walls (Front - Back Direction)
Hold downs and window straps

Story shear(kips) = 13.44
Story height (ft) = 10.08
Shear Panel height (ft) = 9.08
Total Diaphragm width (ft) = 64.00

Shear panel capacity (Wind or Seismic) = Wind
Accumulated Shear = 27.72
load balance check = OK

Story	Wall Mark	Wall L(ft)	Opening Width (ft)	Opening Height (ft)	Opening (max) to Edge (ft)	Plate to Opening (ft)	Effective Length (ft)	Trib. Width (ft)	Percent Sharing (%)	Effective Trib. Width	Story V(kips)	Sum V(kips)	Panel Shear (plf)	Height/Width Reduction (%) R = 2*L/H	Design Panel Shear (plf)	Wall Type	Floor DL Trib(ft)	Story DL(klf)	Walls/DL Stacks?	Sum DL(klf)	OTM (k-ft)	RM (k-ft)	Resultant HD(kips)	HD TYPE	HD/Strap to DF or HF?	HD location Edge/Interior?	Resultant HD	Force at Window (Kips)	Window Strap
1	1.1	15.50	5.50	5.00	3.00	0.67	10.00	15.00	0.63	9.38	1.97	4.44	444	1.00	444	SW3	2.00	0.14	YES	0.47	44.8	11.1	2.25	flr-conc	HF	Edge	HDU5	6.31	CMST14
1	1.2	6.00					6.00	15.00	0.38	5.63	1.18	3.46	577	1.00	577	SW2	4.00	0.17	NO	0.17	34.9	2.0	5.97	flr-conc	HF	Edge	HDU8	0.00	No strap
1	3.0	23.50					23.50	23.00	1.00	23.00	4.83	11.47	488	1.00	488	SW2	2.00	0.14	YES	0.47	115.6	25.5	3.92	flr-conc	HF	Edge	HDU5	0.00	No strap
1	4.0	12.00					12.00	13.00	1.00	13.00	2.73	2.73	228	1.00	228	SW6	3.00	0.15	NO	0.15	27.5	7.4	1.75	flr-beam	HF	Edge	MSTC48B3	0.00	No strap
1	5.0	11.25					11.25	11.00	1.00	11.00	2.31	5.88	523	1.00	523	SW2	4.00	0.17	YES	0.32	59.3	7.1	4.85	flr-beam	HF	Edge	HDU8	0.00	No strap
1	6.0	8.00					8.00	5.00	1.00	5.00	1.05	4.62	577	1.00	577	SW2	2.00	0.14	NO	0.14	46.6	3.0	5.81	flr-conc	HF	Edge	HDU8	0.00	No strap
S =	76.25					Total OSB wall length = (feet)	51.50			S =	67.00	13.02	**32.60**	OK	Total OSB Capacity (kips)	13.44											

Basement Walls (Front - Back Direction)

Basement Walls (Front - Back Direction)
Hold downs and window straps

Story shear(kips) = 5.06
Story height (ft) = 10.08
Shear Panel height (ft) = 9.08
Total Diaphragm width (ft) = 64.00

Accumulated Shear = 5.06 The rest of the story shear from above has been transferred into foundation
load balance check = Warning-Wall loads do not match story shear

Story	Wall Mark	Wall L(ft)	Opening Width (ft)	Opening Height (ft)	Opening (max) to Edge (ft)	Plate to Opening (ft)	Effective Length (ft)	Trib. Width (ft)	Percent Sharing (%)	Effective Trib. Width	Story V(kips)	Sum V(kips)	Panel Shear (plf)	Height/Width Reduction (%) R = 2*L/H	Design Panel Shear (plf)	Wall Type	Story DL(klf)	Sum DL(klf)	OTM (k-ft)	RM (k-ft)	Resultant HD(kips)	HD TYPE	Resultant HD	Force at Window (Kips)	Window Strap
B	N/A																								
	CONCRETE FOUNDATION							CONCRETE FOUNDATION										CONCRETE FOUNDATION				CONCRETE FOUNDATION			
B																									
S =	0.00									S =	0.00	0.00	**0.00**	Warning-Wall loads do not match story shear											

Project Number:	Plan Name:	Sheet Number:
S230110-1	**Granbois**	**L6**
Engineer:	Specifics:	Date:
HK	**Shear walls (side/side)**	**4/6/2023**

Notes:

* All walls designed with Force-Transfer should meet a minimum height to width ratio of 2:1 at Pier (SDPWS 2018, Table 4.3.4)
* Maximum allowed height to width ratio 3.5:1 for walls w/o openings (increased shear design values per SDPWS 2018, Table 4.3.4)
* Shear panel height is height to underside or roof or floor framing.

RED = Update Formula as required - Important
BLUE = Review and update as required - Typical Input

2nd Story Walls (Side / Side Direction)
Hold downs and window straps

2nd Story Walls (Side / Side Direction)

Stud Species: HF

Story shear(kips) = 14.27 | **Governing Force (F/B Direction) =** Wind
Story height (ft) = 9.08 | **Dead load factor (F/B Direction) =** 0.67 | IBC 2018 Equation 16-18
Shear Panel height (ft) = 8.08 | **100% story shear** YES | **Shear panel capacity (Wind or Seismic) =** Seismic
Total Diaphragm width (ft) = 64.00 | load balance check = Warning-Wall loads do not match story shear

Story	Wall Mark	Wall L(ft)	Opening Width (ft)	Opening Height (ft)	Opening (max) to Edge (ft)	Plate to Opening (ft)	Effective Length (ft)	Trib. Width (ft)	Percent Sharing (%)	Effective Trib. Width	Story V(kips)	Sum V(kips)	Panel Shear (plf)	Height/Width Reduction (%) R = 2*L/H	Design Panel Shear (plf)	Wall Type	Roof DL Trib(ft)	Story DL(klf)	Sum DL(klf)	OTM (k-ft)	RM (k-ft)	Resultant HD(kips)	HD TYPE	HD/Strap to DF or HF?	HD location Edge/Interior?	Resultant HD	Force at Window (Kips)	Window Strap
2	A1	33.00	17.00	5.00	3.00	0.67	16.00	15.00	1.00	15.00	3.35	3.35	209	1.00	209	SW6	4.00	0.16	0.16	30.4	57.3	-0.83	flr-flr	HF	Edge	No HD	2.97	CMSTC16
2	B1	21.00	6.00	5.00	4.00	0.67	15.00	20.00	1.00	20.00	4.46	4.46	297	1.00	297	SW4	9.00	0.23	0.23	40.5	34.3	0.30	flr-beam	HF	Edge	No HD	5.63	CMST14
2	C1	13.00	7.00	5.00	3.00	0.67	6.00	25.00	0.50	12.50	2.79	2.79	465	1.00	465	SW2	2.00	0.13	0.13	25.3	7.2	1.45	flr-flr	HF	Edge	MST37	6.60	CMST12
2	C2	13.00	7.00	5.00	3.00	0.67	6.00	25.00	0.50	12.50	2.79	2.79	465	1.00	465	SW2	2.00	0.13	0.13	25.3	7.2	1.45	flr-beam	HF	Edge	MSTC48B3	6.60	CMST12

S = 80.00 | Total OSB wall length = (feet) 43.00 | S = 60.00 | 13.38 | **13.38** | Warning-Wa | Total OSB Capacity (kips) **14.27**

1st Story Walls (Side / Side Direction)
Hold downs and window straps

1st Story Walls (Side / Side Direction)

Shear panel capacity (Wind or Seismic) = Wind

Story shear(kips) = 13.76 | **Accumulated Shear =** 28.03
Story height (ft) = 10.08 | load balance check = Warning-Wall loads do not match story shear
Shear Panel height (ft) = 9.08
Total Diaphragm width (ft) = 60.00

Story	Wall Mark	Wall L(ft)	Opening Width (ft)	Opening Height (ft)	Opening (max) to Edge (ft)	Plate to Opening (ft)	Effective Length (ft)	Trib. Width (ft)	Percent Sharing (%)	Effective Trib. Width	Story V(kips)	Sum V(kips)	Panel Shear (plf)	Height/Width Reduction (%) R = 2*L/H	Design Panel Shear (plf)	Wall Type	Floor DL Trib(ft)	Story DL(klf)	Walls/DL Stacks?	Sum DL(klf)	OTM (k-ft)	RM (k-ft)	Resultant HD(kips)	HD TYPE	HD/Strap to DF or HF?	HD location Edge/Interior?	Resultant HD	Force at Window (Kips)	Window Strap
1	A1	37.00	16.00	5.00	3.50	1.08	21.00	12.50	1.00	12.50	2.87	6.21	296	1.00	296	SW4	2.00	0.19	YES	0.35	62.6	158.7	-2.63	flr-conc	HF	Edge	No HD	3.43	CMSTC16
1	B1	19.00					19.00	22.00	0.73	16.08	3.69	6.95	366	1.00	366	SW3	3.00	0.20	YES	0.43	70.0	52.4	0.95	flr-conc	HF	Edge	STHD14	0.00	No strap
1	B2	7.00					7.00	22.00	0.27	5.92	1.36	2.56	366	1.00	366	SW3	4.00	0.21	YES	0.34	25.8	5.6	3.11	flr-conc	HF	Edge	STHD14	0.00	No strap
1	C1	1.50					1.50	25.00	0.12	3.06	0.70	2.10	1397		WSWH18x8												WSWH18x8		
1	C2	1.50					1.50	25.00	0.12	3.06	0.70	2.10	1397																
1	C3	9.25					9.25	25.00	0.76	18.88	4.33	7.12	769	1.00	769	2W3	12.00	0.31	NO	0.31	71.7	8.9	7.19	flr-conc	HF	Edge	HDU14	0.00	No strap

S = 75.25 | Total OSB wall length = (feet) 50.00 | S = 59.50 | 9.32 | **27.03** | Warning-Wa | Total OSB Capacity (kips) **13.76**

Basement Walls (Side / Side Direction)
Hold downs and window straps

Basement Walls (Side / Side Direction)

Shear panel capacity (Wind or Seismic) = Seismic

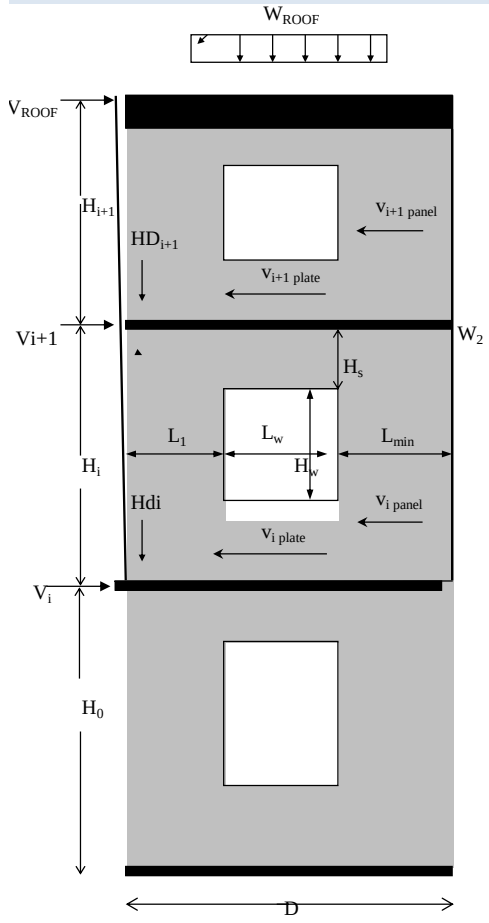
Story shear(kips) = 5.06 | **Accumulated Shear =** 5.06 | The rest of the story shear from above has been transferred into foundation
Story height (ft) = 10.08 | load balance check = Warning-Wall loads do not match story shear
Shear Panel height (ft) = 9.08
Total Diaphragm width (ft) = 42.00

Story	Wall Mark	Wall L(ft)	Opening Width (ft)	Opening Height (ft)	Opening (max) to Edge (ft)	Plate to Opening (ft)	Effective Length (ft)	Trib. Width (ft)	Percent Sharing (%)	Effective Trib. Width	Story V(kips)	Sum V(kips)	Panel Shear (plf)	Height/Width Reduction (%) R = 2*L/H	Design Panel Shear (plf)	Wall Type	Floor DL Trib(ft)	Story DL(klf)	Walls/DL Stacks?	Sum DL(klf)	OTM (k-ft)	RM (k-ft)	Resultant HD(kips)	HD TYPE	HD/Strap to DF or HF?	HD location Edge/Interior?	Resultant HD	Force at Window (Kips)	Window Strap
B	N/A																												
		CONCRETE FOUNDATION						CONCRETE FOUNDATION												CONCRETE FOUNDATION						CONCRETE FOUNDATION			

S = 0.00 | Total OSB wall length = (feet) 0.00 | S = 0.00 | 0.00 | **0.00** | Warning-Wa | Total OSB Capacity (kips) **5.06**

Project	Sheet number:
Granbois	**L7**
Subject	Date
SHEAR WALL EQUATION DIAGRAM	**4/6/2023**

SHEAR WALL WITH WINDOW BASED ON SHEAR TRANSFER:



Where:

V_i = Story Shear
W_i = Story Dead Load
HD_i = Story Holdown
M_{OTi} = Story Over Turning Moment
M_{Ri} = Story Resisting Moment

$M_{OT\ ROOF} = V_{ROOF} \times H_{1+1}$

$M_{OTi} = [(V_{i+1} + V_{ROOF}) \times H_i] + M_{OT\ ROO}$

$M_{R\ ROOF} = 0.6 \times W_{ROOF} \times D'/2$

$M_{Ri} = 0.6 \times (W_{i+1} + W_{ROOF}) \times D'/2$

$HD_{i+1} = (M_{OT\ ROOF} - M_{R\ ROOF})/(D - 6")$

$HD_i = (M_{OTi} - M_{R1i})/(D - 6")$

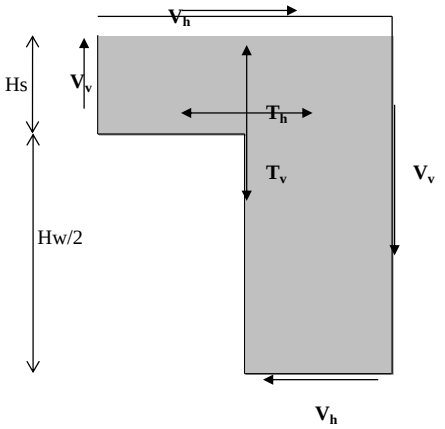
$V_{i+1\ panel} = V_{ROOF} / (L_1 + L_{max})$

$V_{i\ panel} = (V_{ROOF} + V_{i+1}) / (L_1 + L_{max})$

$V_{i+1\ plate} = V_{ROOF} / D$

$V_{i\ plate} = (V_{ROOF} + V_{i+1}) / D$

FORCE TRANSFER AROUND WINDOW CALCULATION (CANTILEVER PIER METHOD)



$V_h = v_{i\ panel} \times L_{max}$

$V_v = HD_i$

$T_h = V_h\ (H_w / 2 + H_s) / H_s$

T_v = Is resisted by the continuous stud adjacent to the window.

Garage Portal Systems on Concrete Foundations

The Strong-Wall® high-strength wood shearwall garage portal system provides higher allowable shear load with reduced concrete anchorage requirements. Portal walls may be used in single- or double-portal applications and shall be installed with a minimum 3" x 11¼" single- or multi-ply header depending upon loading and span requirements.

Codes: ICC-ES ESR-2652, City of LA Building Code Supplement and State of Florida FL5113

For product data and naming scheme information, see pp. 12–13.

Garage Header Rough Opening Height

Model No.	Trimmed Panel Height (in.)	H Curb (in.)	Rough Opening Height (in.)
WSWH12x7 WSWH18x7 WSWH24x7	78	5½	6'-11½"[1]
		6	7'-0"[1]
WSWH12x8 WSWH18x8 WSWH24x8	85½	0	7'-1½"
	93¼	5½	8'-2¾"[2]
		6	8'-3¼"[2]

1. If required rough opening height exceeds table value, specify next taller panel and trim as necessary. The Strong-Wall high-strength wood shearwalls may be trimmed to a minimum height of 74½".
2. Furring down garage header may be required for correct rough opening height.

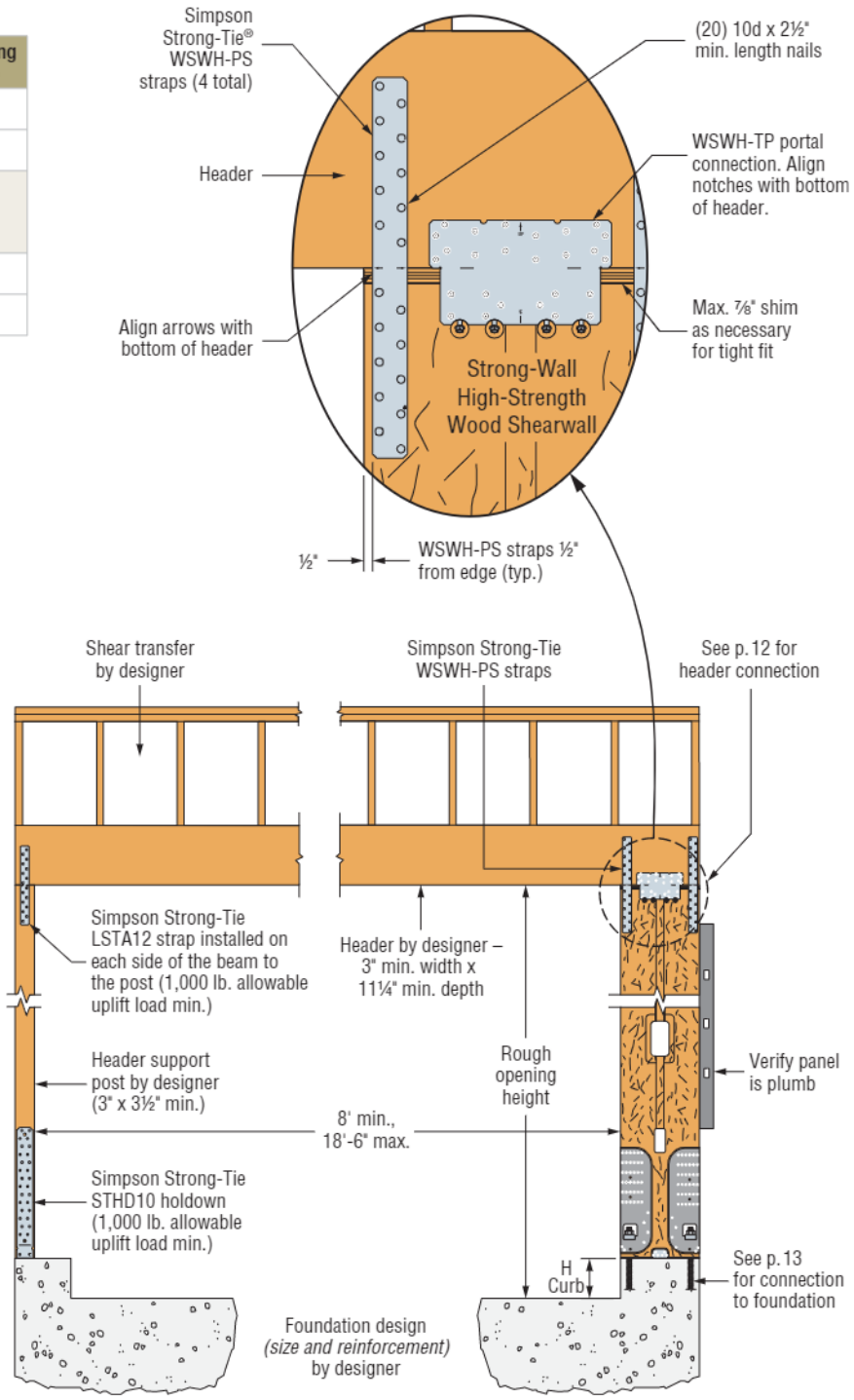
Installation

- Portal-frame connection kit is required for portal-frame applications.
- All panels may be trimmed to a minimum of 74½". Trim height from top of panel only, do not trim from sides or bottom. Drilling holes in the Strong-Wall high-strength wood shearwalls is not allowed except as shown on p. 36.
- Anchor bolt nuts should be finger tight plus ½ turn.
- Maximum shim thickness between Strong-Wall high-strength wood shearwalls and the top plates or header is ⅞".
- Top connection installs with a combination of ¼" x 6" SDS Heavy-Duty Connector screws and SWS16150 Strong-Wall screws.
- Walls may also be used in 2x6 wall framing. Install the panel flush to the outside face of the framing and add furring to the opposite side.
- Walls may be installed with solid or multi-ply headers, see details 3, 4, 5, 6/WSWH4 for fastening and furring requirements on pp. 38–39.

Portal Frame Connection Kit

Model No.	Contents
WSWH-PK	4 (10-gauge) WSWH-PS straps

1. Portal-frame connection kit comes with panels that are 100" or less in height. The kit must be ordered separately for panels over 100" tall.



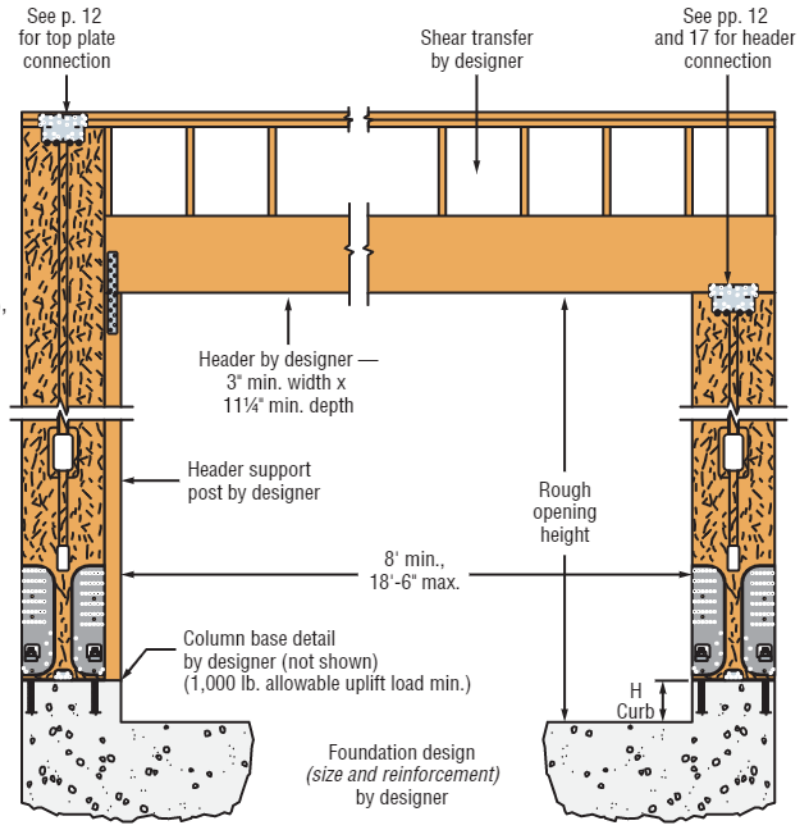
Single Portal Installation
US Patent 10,711,477

Garage Portal Systems on Concrete Foundations

Portal Design Information

A portal frame under lateral loads causes the portal header to experience internal stresses in addition to those created by the primary loads (live, dead and snow). These additional stresses are called induced forces and must be considered when designing portal headers. To account for the induced forces from lateral loads, a concentrated end moment equal to the top-of-panel moment must be placed at the end of the header that is connected to the WSWH panel. For the WSWH12, WSWH18 and WSWH24, the moment induced into the portal header must be taken as 20%, 10% and 0%, respectively, of the total lateral moment at the base. The total lateral moment is calculated as the design shear times the panel height. For headers with typical residential uniform loads, the induced moment and shear forces from a portal-frame system do not control the design. This is due to the 1.60 load duration factor (C_D) used in design when wind and seismic loads are included.

The lateral and vertical loads shown on p. 19 for portal frames assume that the header size falls within the portal-frame parameters listed in the table below.



US Patent 10,711,477

Strong-Wall® High-Strength Wood Shearwall Portal Header Design Parameters

Header Design Parameter	Allowable Range
Width	3" – 5½"
Depth	11¼" – 18"
Clear Span	8' – 18' 6"
K	90 lb./in. – 4,000 lb./in.

1. Single- or multi-ply header members may be used.
2. Maximum clear span for multi-ply 2x DF/SP header shall be limited to 16'-4".
3. Secondary moment, shear and axial forces shall be considered in header design.
4. Header design shall be by designer and assume gravity loads only induce simple span moments in beam.
5. Header stiffness (K) for use in WSWH portal system may be determined using the following equation:
   $K = (E \times b \times d^3) / 12L^3$ where:
   E = Header modulus of elasticity (psi)
   b = Header width (in.)
   d = Header depth (in.)
   L = Header clear span (in.)

Alternative Garage Front Options

These alternative garage-front options may be used for applications when the Strong-Wall® high-strength wood shearwall is installed at the full height (option 1) or without the additional Portal-Frame Kit (option 2), when higher allowable load or reduced concrete anchorage is not needed. Refer to the Standard Application on Concrete Foundations on pp. 12–16 for product data and allowable load values.

For Garage Wall Option 2, the designer shall design for:

1. Shear transfer
2. Out-of-plane loading effect
3. Increased overturning and drift due to additional height

Garage Portal Systems on Concrete Foundations

Single-Wall Garage Portal System on Concrete Foundation

Strong-Wall High-Strength Wood Shearwall Model No.	Panel Evaluation Height, H_E (in.)[7]	Allowable Vertical Load, P (lb.)[5]	2,500 psi Concrete						3,000 psi Concrete					
			Seismic[3]			Wind			Seismic[3]			Wind		
			Allowable ASD Shear Load, V (lb.)	Drift at Allowable Shear, Δ (in.)[8]	Anchor Tension at Allowable Shear, T (lb.)[11]	Allowable ASD Shear Load, V (lb.)	Drift at Allowable Shear, Δ (in.)[8]	Anchor Tension at Allowable Shear, T (lb.)[11]	Allowable ASD Shear Load, V (lb.)	Drift at Allowable Shear, Δ (in.)[8]	Anchor Tension at Allowable Shear, T (lb.)[11]	Allowable ASD Shear Load, V (lb.)	Drift at Allowable Shear, Δ (in.)[8]	Anchor Tension at Allowable Shear, T (lb.)[11]
WSWH12x7	78	1,000	1,780	0.39	14,550	2,285	0.53	18,715	1,780	0.39	14,550	2,285	0.53	18,715
		4,000	1,780	0.39	14,550	2,285	0.53	18,715	1,780	0.39	14,550	2,285	0.53	18,715
		7,500	1,780	0.39	14,550	2,285	0.53	18,715	1,780	0.39	14,550	2,285	0.53	18,715
WSWH18x7	78	1,000	3,980	0.38	22,345	4,580	0.47	25,715	3,980	0.38	22,345	4,580	0.47	25,715
		4,000	3,980	0.38	22,345	4,580	0.47	25,715	3,980	0.38	22,345	4,580	0.47	25,715
		7,500	3,980	0.38	22,345	4,505	0.46	25,285	3,980	0.38	22,345	4,580	0.47	25,715
WSWH24x7	78	1,000	7,450	0.30	33,210	7,950	0.35	35,430	7,450	0.30	33,210	8,260	0.36	36,815
		4,000	7,450	0.30	33,210	7,565	0.33	33,715	7,450	0.30	33,210	8,260	0.36	36,815
		7,500	7,115	0.28	31,715	7,115	0.31	31,715	7,450	0.30	33,210	8,260	0.36	36,815
WSWH12x8	85.5	1,000	1,590	0.42	14,280	2,065	0.57	18,520	1,590	0.42	14,280	2,065	0.57	18,520
		4,000	1,590	0.42	14,280	2,065	0.57	18,520	1,590	0.42	14,280	2,065	0.57	18,520
		7,500	1,590	0.42	14,280	2,065	0.57	18,520	1,590	0.42	14,280	2,065	0.57	18,520
WSWH18x8	85.5	1,000	3,550	0.41	21,845	4,580	0.56	28,185	3,550	0.41	21,845	4,580	0.56	28,185
		4,000	3,550	0.41	21,845	4,425	0.54	27,245	3,550	0.41	21,845	4,580	0.56	28,185
		7,500	3,550	0.41	21,845	4,110	0.50	25,285	3,550	0.41	21,845	4,580	0.56	28,185
WSWH24x8	85.5	1,000	6,425	0.33	31,385	7,250	0.41	35,430	6,425	0.33	31,385	7,535	0.43	36,815
		4,000	6,425	0.33	31,385	6,900	0.39	33,715	6,425	0.33	31,385	7,535	0.43	36,815
		7,500	6,425	0.33	31,385	6,490	0.37	31,715	6,425	0.33	31,385	7,535	0.43	36,815
WSWH12x8	93.25	1,000	1,435	0.45	14,050	1,860	0.60	18,190	1,435	0.45	14,050	1,860	0.60	18,190
		4,000	1,435	0.45	14,050	1,860	0.60	18,190	1,435	0.45	14,050	1,860	0.60	18,190
		7,500	1,435	0.45	14,050	1,860	0.60	18,190	1,435	0.45	14,050	1,860	0.60	18,190
WSWH18x8	93.25	1,000	3,170	0.44	21,290	4,130	0.60	27,735	3,170	0.44	21,290	4,130	0.60	27,735
		4,000	3,170	0.44	21,290	4,060	0.59	27,245	3,170	0.44	21,290	4,130	0.60	27,735
		7,500	3,170	0.44	21,290	3,765	0.55	25,285	3,170	0.44	21,290	4,130	0.60	27,735
WSWH24x8	93.25	1,000	6,240	0.37	33,240	6,650	0.43	35,430	6,240	0.37	33,240	6,910	0.45	36,815
		4,000	6,240	0.37	33,240	6,330	0.41	33,715	6,240	0.37	33,240	6,910	0.45	36,815
		7,500	5,950	0.35	31,715	5,950	0.38	31,715	6,240	0.37	33,240	6,910	0.45	36,815

1. Allowable shear loads are applicable to installations on concrete with specified compressive strengths as listed using the ASD basic (IBC Section 1605.3.1) or the alternative basic (IBC Section 1605.3.2) load combinations.
2. Load values include evaluation of bearing stresses on concrete foundations and do not require further evaluation by the designer. For installations on masonry foundations, bearing capacity shall be evaluated by the designer.
3. Seismic design based on 2018 IBC using R = 6.5. For other codes, use the seismic coefficients corresponding to light-frame bearing walls with wood structural panels or sheet-steel panels.
4. Allowable values shown apply to single-wall garage portal systems. The allowable shear load for a double-wall garage portal system, which consists of two walls with a header continuous across both panels, may be taken as twice the table value.
5. Allowable vertical load denotes the total maximum concentric vertical load permitted on the panel acting in combination with the allowable shear loads.
6. Allowable shear, drift and anchor tension values may be interpolated for intermediate height or vertical loads. For panels 74½"–78" tall, use the values for a 78"-tall panel.
7. To achieve required WSWH panel evaluation height, trim next tallest full-height panel defined in table on p. 13.
8. Drifts at lower design shear may be linearly reduced.
9. See p. 16 for allowable out-of-plane and axial capacities.
10. High-strength anchor bolts are required for anchor tension forces exceeding the allowable load for standard-strength bolts tabulated on pp. 22–23. See pp. 21–29 for WSWH-AB anchor bolt information and anchorage solutions.
11. Tabulated anchor tension values assume no resisting vertical load. Anchor tension loads at design shear values and including the effect of vertical load may be determined using the following equation:
    $T = [(k \times V \times H) / B] - P/2$, where:
    T = Anchor tension load (lb.)
    V = Design shear load (lb.)
    P = Applied vertical load (lb.)
    H = Panel height (in.)
    B = Moment arm (in.); 7.625" for WSWH12, 12.50" for WSWH18 and 17.50" for WSWH24
    k = Portal factor; 0.80 for WSWH12 panels 93¼" or less in height,
    0.90 for WSWH18 panels 93¼" or less in height,
    1.00 for all other panels.

LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

FOUNDATION CALCULATIONS

FOOTING REFERENCE PER PLAN

L120 ENGINEERING & DESIGN, LLC
(206) 790 9502
L120Engineering.com

Project Title:
Engineer:
Project ID:
Project Descr:

Wall Footing

DESCRIPTION: 1'-4" (16") Footing and Stem-wall (non retaining) - Max Loading (1500psf)

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, 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	=	40.0 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
AutoCalc Footing Weight as DL :		Yes

Soil Design Values

Allowable Soil Bearing	=	1.50 ksf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	300.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing Depth

Reference Depth below Surface	=	ft
Allow. Pressure Increase per foot of depth	=	ksf
when base footing is below	=	ft

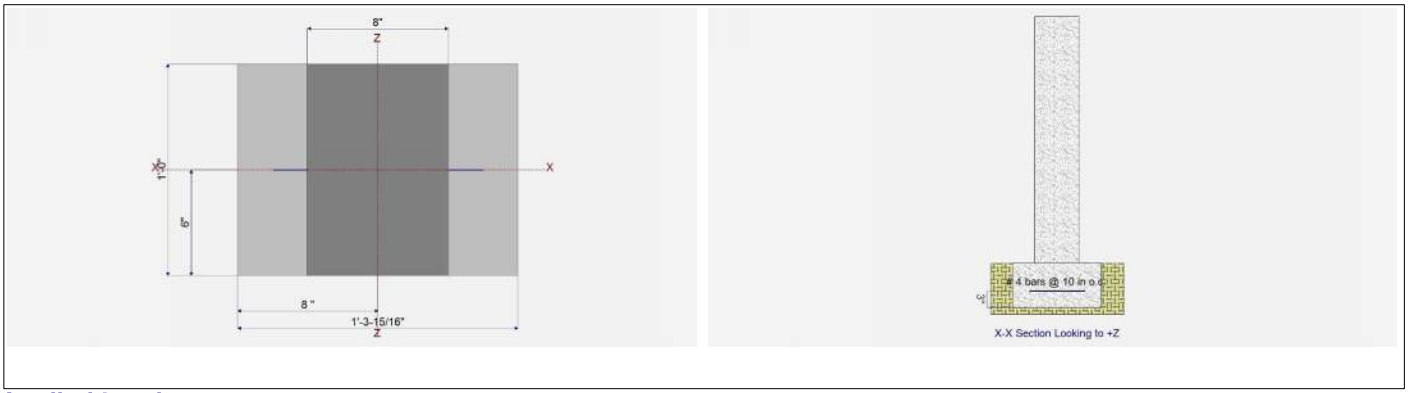
Increases based on footing Width

Allow. Pressure Increase per foot of width	=	ksf
when footing is wider than	=	ft
Adjusted Allowable Bearing Pressure	=	1.50 ksf

Dimensions

Footing Width	=	1.330 ft	Footing Thickness	=	8.0 in	Bars along X-X Axis	
Wall Thickness	=	8.0 in	Rebar Centerline to Edge of Concrete...			Bar spacing	= 10.00
Wall center offset from center of footing	=	0 in	at Bottom of footing	=	3.0 in	Reinforcing Bar Size	= # 4

Reinforcing



Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	1.0		0.750	0.40				k
OB : Overburden	=								ksf
V-x	=								k
M-zz	=								k-ft
Vx applied	=	in above top of footing							

Project Title:
Engineer:
Project ID:
Project Descr:

Wall Footing

DESCRIPTION: 1'-4" (16") Footing and Stem-wall (non retaining) - Max Loading (1500psf)

DESIGN SUMMARY

Design OK

	Factor of Safety	Item	Applied	Capacity	Governing Load Combination
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift

	Utilization Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9980	Soil Bearing	1.497 ksf	1.50 ksf	+D+0.750L+0.750S
PASS	0.03287	Z Flexure (+X)	0.1139 k-ft	3.464 k-ft	+1.20D+1.60L+0.50S
PASS	0.02607	Z Flexure (-X)	0.09031 k-ft	3.464 k-ft	+1.20D+L+0.20S
PASS	n/a	1-way Shear (+X)	0.0 psi	75.0 psi	n/a
PASS	0.0	1-way Shear (-X)	0.0 psi	0.0 psi	n/a

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc	Actual Soil Bearing Stress -X	Actual Soil Bearing Stress +X	Actual / Allowable Ratio
, D Only	1.50 ksf	0.0 in	0.8485 ksf	0.8485 ksf	0.566
, +D+L	1.50 ksf	0.0 in	1.412 ksf	1.412 ksf	0.942
, +D+S	1.50 ksf	0.0 in	1.149 ksf	1.149 ksf	0.766
, +D+0.750L	1.50 ksf	0.0 in	1.271 ksf	1.271 ksf	0.848
, +D+0.750L+0.750S	1.50 ksf	0.0 in	1.497 ksf	1.497 ksf	0.998
, +0.60D	1.50 ksf	0.0 in	0.5091 ksf	0.5091 ksf	0.339

Overturning Stability

Units : k-ft

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

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot. or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
, +1.40D	0.06532	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.40D	0.06532	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+1.60L	0.1056	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+1.60L	0.1056	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+1.60L+0.50S	0.1139	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+1.60L+0.50S	0.1139	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+L	0.087	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+L	0.087	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D	0.05599	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D	0.05599	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+L+1.60S	0.1135	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+L+1.60S	0.1135	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+1.60S	0.08245	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+1.60S	0.08245	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+L+0.50S	0.09527	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+L+0.50S	0.09527	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +0.90D	0.04199	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +0.90D	0.04199	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+L+0.20S	0.09031	-X	Bottom	0.1728	Min Temp %	0.24	3.464	OK
, +1.20D+L+0.20S	0.09031	+X	Bottom	0.1728	Min Temp %	0.24	3.464	OK

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

DESCRIPTION: 16" (non retaining) stemwall footing - max point load (1500psf)

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	=	2.5	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	=	1.0	ft
Allow press. increase per foot of depth	=		ksf
when footing base is below	=		ft

Increases based on footing plan dimension

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

Dimensions

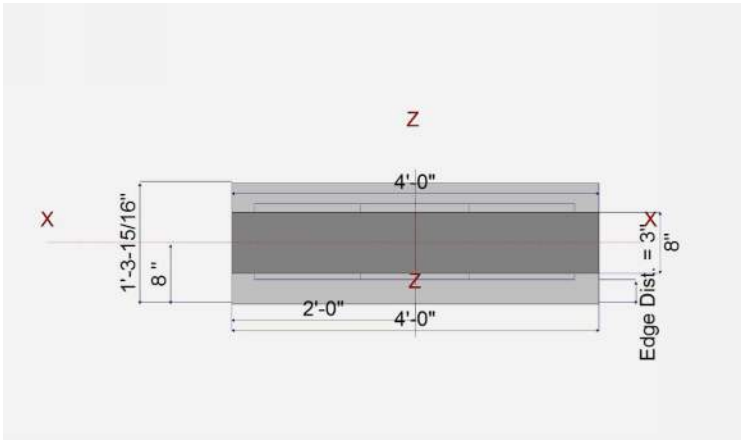
Width parallel to X-X Axis	=	4.0 ft
Length parallel to Z-Z Axis	=	1.330 ft
Footing Thickness	=	8.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	48.0 in
pz : parallel to Z-Z Axis	=	8.0 in
Height	=	18.0 in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0 in



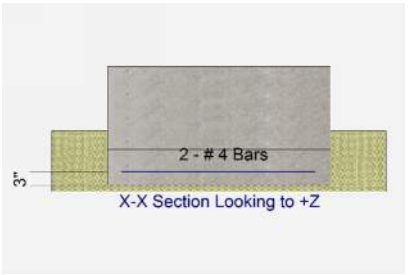
Reinforcing

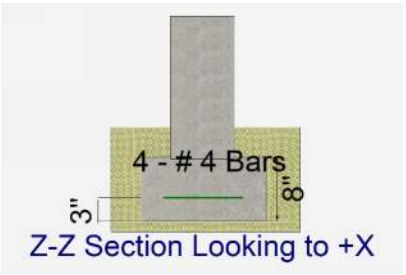
Bars parallel to X-X Axis			
Number of Bars	=		2.0
Reinforcing Bar Size	=	#	4
Bars parallel to Z-Z Axis			
Number of Bars	=		4.0
Reinforcing Bar Size	=	#	4

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation: Bars along Z-Z Axis

# Bars required within zone	49.9 %
# Bars required on each side of zone	50.1 %





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	3.0		4.30					k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=								k
V-z	=								k

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

LIC# : KW-06011993, Build:20.22.1.5 L120 Engineering and Design

DESCRIPTION: 16" (non retaining) stemwall footing - max point load (1500psf)

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9913	Soil Bearing	1.487 ksf	1.50 ksf	+D+L about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
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	0.0	Z Flexure (+X)	0.0 k-ft/ft	0.0 k-ft/ft	No Moment
PASS	0.0	Z Flexure (-X)	0.0 k-ft/ft	0.0 k-ft/ft	No Moment
PASS	0.02530	X Flexure (+Z)	0.1071 k-ft/ft	4.235 k-ft/ft	+1.20D+1.60L
PASS	0.02530	X Flexure (-Z)	0.1071 k-ft/ft	4.235 k-ft/ft	+1.20D+1.60L
PASS	n/a	1-way Shear (+X)	0.0 psi	67.082 psi	n/a
PASS	n/a	1-way Shear (-X)	0.0 psi	67.082 psi	n/a
PASS	n/a	1-way Shear (+Z)	0.0 psi	67.082 psi	n/a
PASS	n/a	1-way Shear (-Z)	0.0 psi	67.082 psi	n/a
PASS	n/a	2-way Punching	0.0 psi	67.082 psi	n/a

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, D Only	1.50	n/a	0.0	0.6789	0.6789	n/a	n/a	0.453
X-X, +D+L	1.50	n/a	0.0	1.487	1.487	n/a	n/a	0.991
X-X, +D+0.750L	1.50	n/a	0.0	1.285	1.285	n/a	n/a	0.857
X-X, +0.60D	1.50	n/a	0.0	0.4073	0.4073	n/a	n/a	0.272
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.6789	0.6789	0.453
Z-Z, +D+L	1.50	0.0	n/a	n/a	n/a	1.487	1.487	0.991
Z-Z, +D+0.750L	1.50	0.0	n/a	n/a	n/a	1.285	1.285	0.857
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.4073	0.4073	0.272

Overturning Stability

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

Sliding Stability

All units k

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	0.04201	+Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +1.40D	0.04201	-Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +1.20D+1.60L	0.1071	+Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +1.20D+1.60L	0.1071	-Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +1.20D+0.50L	0.05823	+Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +1.20D+0.50L	0.05823	-Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +1.20D	0.03601	+Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +1.20D	0.03601	-Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +0.90D	0.0270	+Z	Bottom	0.1728	AsMin	0.20	4.235	OK
X-X, +0.90D	0.0270	-Z	Bottom	0.1728	AsMin	0.20	4.235	OK
Z-Z, +1.40D	0.0	-X	Top	0.1728	AsMin	0.3008	6.168	OK
Z-Z, +1.40D	0.0	+X	Top	0.1728	AsMin	0.3008	6.168	OK
Z-Z, +1.20D+1.60L	0.0	-X	Top	0.1728	AsMin	0.3008	6.168	OK
Z-Z, +1.20D+1.60L	0.0	+X	Top	0.1728	AsMin	0.3008	6.168	OK
Z-Z, +1.20D+0.50L	0.0	-X	Top	0.1728	AsMin	0.3008	6.168	OK
Z-Z, +1.20D+0.50L	0.0	+X	Top	0.1728	AsMin	0.3008	6.168	OK
Z-Z, +1.20D	0.0	-X	Top	0.1728	AsMin	0.3008	6.168	OK

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

DESCRIPTION: 16" (non retaining) stemwall footing - max point load (1500psf)

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
Z-Z, +1.20D	0.0	+X	Top	0.1728	AsMin	0.3008	6.168	OK
Z-Z, +0.90D	0.0	-X	Top	0.1728	AsMin	0.3008	6.168	OK
Z-Z, +0.90D	0.0	+X	Top	0.1728	AsMin	0.3008	6.168	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	67.08 psi	0.00	OK
+1.20D+1.60L	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	67.08 psi	0.00	OK
+1.20D+0.50L	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	67.08 psi	0.00	OK
+1.20D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	67.08 psi	0.00	OK
+0.90D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	67.08 psi	0.00	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	0.00 psi	89.44 psi	0	OK
+1.20D+1.60L	0.00 psi	89.44 psi	0	OK
+1.20D+0.50L	0.00 psi	89.44 psi	0	OK
+1.20D	0.00 psi	89.44 psi	0	OK
+0.90D	0.00 psi	89.44 psi	0	OK

Client:		**Date:**	Jul 29, 2022
Author:	Harrison Kliegl	**Job #:**	
Project:	3500 PSF Retaining Walls	**Subject:**	**13'-0" Max Retaining Wall** PASS
References:	IBC 2018, ASCE 7-16		

Stability Summary

	Total Sliding Forces	$F_{sliding} = 3.49$ kip/ft	
	Total Resistance to Sliding	$F_{resist} = 2.6$ kip/ft	IBC 2018, Cl 1806.3
	Lateral Force Transmitted to Footing Restraint	$F_{restraint} = 0.891$ kip/ft	
	Total Overturning Moment	$M_{overturn} = 16.4$ kip · ft/ft	
	Total Restoring Moment	$M_{restore} = 34.3$ kip · ft/ft	
72%	Overturning Factor of Safety	$FS_{overturn} = 2.09$	
	Maximum Bearing Pressure	$q_{max} = 1210$ psf	
35%	Soil Allowable Bearing Capacity	$q_a = 3500$ psf	

Stem Summary

	Moment Demand of Wall Stem	$M_{u,stem} = 20.3$ kip · ft/ft	
76%	Moment Capacity of Wall Stem	$\phi M_{n,stem} = 26.8$ kip · ft/ft	ACI 318-14, Cl 22.3
	Shear Demand of Wall Stem	$V_{u,stem} = 4.7$ kip/ft	ACI 318-14, Cl 9.4.3
64%	Shear Capacity of Wall Stem	$\phi V_{n,stem} = 7.37$ kip/ft	ACI 318-14, Cl 22.5

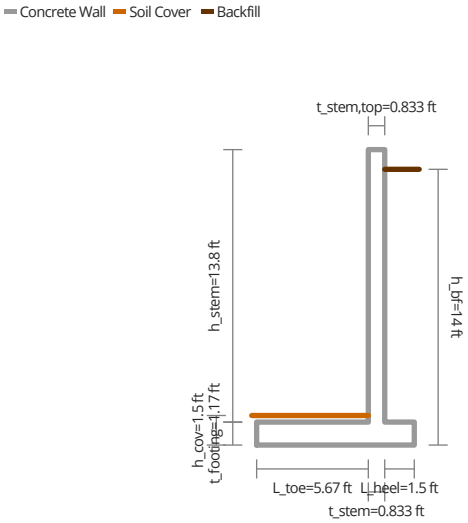
Heel Summary

	Moment Demand of Heel	$M_{u,heel} = 2.43$ kip · ft/ft	ACI 318-14, Cl 13.2.7.1
10%	Moment Capacity of Heel	$\phi M_{n,heel} = 24.3$ kip · ft/ft	ACI 318-14, Cl 22.3
	Shear Demand of Heel	$V_{u,heel} = 3.24$ kip/ft	ACI 318-14, Cl 9.4.3
33%	Shear Capacity of Wall Base	$\phi V_{n,heel} = 9.68$ kip/ft	ACI 318-14, Cl 22.5

Toe Summary

	Moment Demand of Toe	$M_{u,toe} = 22.7$ kip · ft/ft	ACI 318-14, Cl 13.2.7.1
93%	Moment Capacity of Toe	$\phi M_{n,toe} = 24.3$ kip · ft/ft	ACI 318-14, Cl 22.3
	Shear Demand of Toe	$V_{u,toe} = 6.28$ kip/ft	ACI 318-14, Cl 9.4.3
65%	Shear Capacity of Toe	$\phi V_{n,toe} = 9.68$ kip/ft	ACI 318-14, Cl 22.5

Key Dimensions



Wall Height	$H = 15$ ft	
Thickness of Wall Stem at Base	$t_{stem} = 10$ in	
Thickness of Wall Stem at Top	$t_{stem,top} = 10$ in	
Length of Toe	$L_{toe} = 5.67$ ft	
Length of Heel	$L_{heel} = 1.5$ ft	
Thickness of Footing	$t_{footing} = 14$ in	

Surcharge

Dead Load Surchage	$q_D = 0$ psf	
Dead Load Surcharge is Directly Above Heel?	No	
Live Load Surchage	$q_L = 15$ psf	

Soil Properties

Height of Backfill	$h_{bf} = 14$ ft	
Depth of Soil Cover to Bottom of Footing	$h_{cov} = 1.5$ ft	
Lateral Pressure Method	Equivalent Fluid Pressure - Custom Values	IBC 2018
Soil Unit Weight	$\gamma_{input} = 125$ pcf	
Active Soil Pressure	$p_{a,input} = 35$ psf/ft	
Allowable Passive / Lateral Bearing Pressure	$p_{p,input} = 300$ psf/ft	

Base Soil Properties

Source of Soil Properties	Same as Backfill	
Allowable Bearing Capacity of Base Soil	$q_{a,input} = 3500$ psf	
Soil-Footing Friction Coefficient	$\mu_{input} = 0.45$	
Base Soil Cohesion	$c_{base,input} = 0$ psf	
Maximum Allowable Cohesion as Proportion of Dead Load	$c_{max} = 0.5$	
Soil-Footing Friction Coefficient	$\mu = 0.45$	If presumptive values are used: IBC 2018 Table 1806.2
Base Soil Cohesion	$c_{base} = 0$ psf	If presumptive values are used: IBC 2018 Table 1806.2

Water Table

Height of Water Table	$h_{water} = 0$ ft	
Unit Weight of Water	$\gamma_{water} = 62.4$ pcf	

Concrete Properties

Concrete Strength	$f'_c = 2500$ psi	ACI 318-14 Table 19.2.1.1
Concrete Weight Classification	Normalweight	ACI 318-14, Cl 19.2.4.2
Reinforcement Yield Strength	$f_y = 60\,000$ psi	ACI 318-14 Table 20.2.2.4a

Stem Reinforcement

Stem Concrete Cover	$c_{stem} = 1.5$ in	ACI 318-14 Table 20.6.1.3.1
Main Reinforcement Size	#5	
Main Reinforcement Spacing	$s_{stem} = 4.5$ in	ACI 318-14, Cl 25.2.1 (minimum spacing) and Cl 7.7.2.3 (maximum spacing)

Heel Reinforcement (Top Bars)

Heel Concrete Cover	$c_{heel} = 3$ in	ACI 318-14 Table 20.6.1.3.1
Heel Reinforcement Size	#4	
Heel Reinforcement Spacing	$s_{heel} = 4.5$ in	ACI 318-14, Cl 25.2.1 (minimum spacing) and Cl 7.7.2.3 (maximum spacing)

Toe Reinforcement (Bottom Bars)

Include Toe Reinforcement?	Yes	
Toe Concrete Cover	$c_{toe} = 3$ in	ACI 318-14 Table 20.6.1.3.1
Toe Reinforcement Size	#4	
Toe Reinforcement Spacing	$s_{toe} = 4.5$ in	ACI 318-14, Cl 25.2.1 (minimum spacing) and Cl 7.7.2.3 (maximum spacing)

Shrinkage / Temperature Reinforcement

Shrinkage/Temperature Reinforcement Size	#4	
Stem Shrinkage/Temperature Bar Spacing	$s_{\ell,stem} = 10$ in	ACI 318-14, Cl 7.7.2.3
Footing Shrinkage/Temperature Bar Spacing	$s_{\ell,footing} = 6$ in	ACI 318-14, Cl 7.7.2.3

Stem Reinforcement Depth & Spacing

Depth to Stem Reinforcement	$d_{stem} = 8.19$ in	
Area of Vertical Tension Reinforcement	$A_{s,stem} = 0.827$ in²/ft	

Heel Reinforcement Depth & Spacing

Heel Depth to Reinforcement	$d_{heel} = 10.7$ in	ACI 318-14, Cl 13.3.1.2
Area of Heel Reinforcement	$A_{s,heel} = 0.533$ in²/ft	

Toe Reinforcement Depth & Spacing

Toe Depth to Reinforcement	$d_{toe} = 10.7$ in	ACI 318-14, Cl 13.3.1.2
Area of Toe Reinforcement	$A_{s,toe} = 0.533$ in²/ft	

Design Criteria

Design Code for Load Combinations	$code =$ International Building Code (IBC) 2018	
Retaining Wall Movement Condition	Active Case (Ka)	
Footing Restrained Against Sliding?	Yes	
Consider Resisting Soil Pressures for Stability Checks?	No	

Consider Soil Above Toe for Stability Checks?	No	
Consider Resisting Pressure from Soil Above Toe for Strength Design?	No	
Sliding Minimum Factor of Safety	$FS_{\min,sliding} = 1.5$	IBC 2018, Cl 1807.2.3
Overturning Minimum Factor of Safety	$FS_{\min,ovt} = 1.5$	IBC 2018, Cl 1807.2.3

Unfactored Vertical and Horizontal Loads for Stability Design

Backfill Soil Width	$w_s = 1 \text{ ft}, 6 \text{ in}$	
Weight of Wall Stem	$W_{stem} = 1.73 \text{ kip/ft}$	
Weight of Heel	$W_{heel} = 0.263 \text{ kip/ft}$	
Weight of Toe	$W_{toe} = 0.992 \text{ kip/ft}$	
Weight of Backfill Soil	$W_{bf} = 2.41 \text{ kip/ft}$	
Lateral Force Due to Dead Load Surcharge	$P_D = 0 \text{ kip/ft}$	
Lateral Force Due to Live Load Surcharge	$P_L = 0.0588 \text{ kip/ft}$	
Lateral Force Due to Backfill	$P_{bf} = 3.43 \text{ kip/ft}$	
Passive Force of Soil on Footing	$P_{p,footing} = 0.321 \text{ kip/ft}$	IBC 2018, Cl 1806.3.3
Passive Force of Soil Above Toe on Stem	$P_{p,stem} = 0.0167 \text{ kip/ft}$	
Active Force of Soil on Footing	$P_{a,footing} = 0.0374 \text{ kip/ft}$	IBC 2018, Cl 1806.3.3
Active Force of Soil Above Toe on Stem	$P_{a,stem} = 0.00194 \text{ kip/ft}$	

Tabulated Soil Loads

Vertical Loads (Resisting) $\mathbf{W} =$

Element	Unfactored Forces $W_{unfactored}$ (kip/ft)	Load Factor ξ	Weight W (kip/ft)	Moment Arm y (ft)	Restoring Moment $M_{restore}$ (kip · ft/ft)
Dead Load Surcharge	0	1	0	7.25	0
Wall Stem	1.73	1	1.73	6.09	10.5
Wall Footing	1.4	1	1.4	4	5.6
Soil Cover Above Toe	0.236	1	0.236	2.84	0.67
Backfill Above Water Table	2.41	1	2.41	7.25	17.5

Live Load Surcharge Vertical Loads (Soil Bearing) $\mathbf{W}_L =$

Element	Unfactored Forces $W_{unfactored}$ (kip/ft)	Load Factor ξ	Weight W (kip/ft)	Moment Arm y (ft)	Restoring Moment $M_{restore}$ (kip · ft/ft)
Live Load Surcharge	0.0225	1	0.0225	7.25	0.163

Lateral Loads $\mathbf{H} =$ IBC 2018, Cl 1605.2

Element	Unfactored Forces $H_{unfactored}$ (kip/ft)	Load Factor ξ	Lateral Load H (kip/ft)	Moment Arm y (ft)	Overturning Moment $M_{overturn}$ (kip · ft/ft)
Dead Load Surcharge	0	1	0	7	0
Live Load Surcharge	0.0588	1	0.0588	7	0.412
Backfill	3.43	1	3.43	4.67	16

Passive Soil Loads (Resisting Sliding) $\mathbf{Fp} =$

Element	Unfactored Passive Forces $F_{p,unfactored}$ (kip/ft)	Load Factor ξ	Passive Lateral Resisting Load F_p (kip/ft)
Soil Against Toe Face	0.321	0.6	0.193

Active Soil Loads (Resisting Overturning) $\mathbf{Fa} =$

Element	Unfactored Active Forces $F_{a,unfactored}$ (kip/ft)	Load Factor ξ	Active Lateral Resisting Load F_a (kip/ft)	Moment Arm y (ft)	Active Resisting Moment M_a (kip · ft/ft)
Soil Against Toe Face	0.0374	0.6	0.0225	0.46	0.0103

Stability Analysis - Sliding Loads

Total Horizontal Loads (Sliding) $H_{total} = 3.49 \text{ kip/ft}$

Total Vertical Loads (Resisting) $W_{total} = 5.77 \text{ kip/ft}$

Total Passive Loads (Resisting) $F_{p,total} = 0.193 \text{ kip/ft}$

Stability Analysis - Overturning Loads

Total Overturning Moment $M_{over} = 16.4 \text{ kip} \cdot \text{ft/ft}$

Total Restoring Moment from Gravity $M_{res,grav} = 34.3 \text{ kip} \cdot \text{ft/ft}$

Stability Analysis - Soil Bearing Check

Eccentricity (Live Load Not Over Heel) $e = 0 \text{ ft}, 10.9 \text{ in}$

Eccentricity (Live Load Over Heel) $e_L = 0 \text{ ft}, 10.7 \text{ in}$

Bearing Pressures $\mathbf{BP} =$ IBC 2018, Cl 1605.2

Location	Live Load Not Over Heel q (psf)	Live Load Over Heel q_L (psf)
Toe	1210	1210
At d from stem face	626	630
Stem face	516	521
Heel	228	238

Unfactored Vertical Loads for Structural Strength Design

Lateral Force on Stem Due to Dead Load Surcharge $P_{D,stem} = 0 \text{ kip/ft}$

Lateral Force on Stem Due to Live Load Surcharge $P_{L,stem} = 0.0539 \text{ kip/ft}$

Lateral Force on Stem Due to Backfill $P_{bf,stem} = 2.88 \text{ kip/ft}$

Structural Strength Design Loads

Lateral Stem Loads $\mathbf{SL} =$ IBC 2018, Cl 1605.2

Element	Unfactored Forces H (kip/ft)	Load Factor ξ	Factored Horizontal Loads H_u (kip/ft)	Moment Arm y (ft)	Stem Moment $M_{u,stem}$ (kip · ft/ft)
Dead Load Surcharge	0	1.6	0	6.42	0
Live Load Surcharge	0.0539	1.6	0.0862	6.42	0.553
Backfill	2.88	1.6	4.61	4.28	19.7

Heel Loads $\mathbf{HL} =$

Element	Unfactored Forces W (kip/ft)	Load Factor ξ	Factored Weight W_u (kip/ft)	Moment Arm y (ft)	Heel Moment $M_{u,heel}$ (kip · ft/ft)
Dead Load Surcharge	0	1.2	0	0.75	0
Live Load Surcharge	0.0225	1.6	0.036	0.75	0.027
Heel Weight	0.263	1.2	0.315	0.75	0.236
Backfill Above Water Table	2.41	1.2	2.89	0.75	2.17

Toe Loads (Shear) $\mathbf{TL}_V =$

Element	Unfactored Shear Load at d V_d (kip/ft)	Load Factor ξ	Factored Shear Load V_u (kip/ft)
Upwards Soil Pressure	4.39	1.6	7.03
Toe Weight	-0.835	0.9	-0.752

Toe Loads (Moment) $\mathbf{TL}_M =$

Element	Unfactored Toe Loads P (kip/ft)	Load Factor ξ	Moment Arm y (ft)	Toe Moment M_u (kip · ft/ft)
Upwards Soil Pressure	4.9	1.6	3.21	25.2
Toe Weight	-0.992	0.9	2.84	-2.53

Stem Flexural Analysis (ACI 318-14, Cl 22.2)

Tension Reinforcement Strain $\varepsilon_t = 0.00773$ ACI 318-14, Cl 22.2.2.4.1 and Cl 7.3.3.1 for strain limit

Resistance Factor in Bending	$\phi_b = 0.9$	ACI 318-14. Table 21.2.2
Factored Moment Capacity	$\phi M_n = 26\,800\ \text{lb} \cdot \text{ft/ft}$	ACI 318-14, 8.5.1.1a

Heel Flexural Analysis (ACI 318-14, Cl 22.2)

Tension Reinforcement Strain	$\varepsilon_t = 0.0188$	ACI 318-14, Cl 22.2.2.4.1 and Cl 7.3.3.1 for strain limit
Resistance Factor in Bending	$\phi_b = 0.9$	ACI 318-14. Table 21.2.2
Factored Moment Capacity	$\phi M_{n,heel} = 24\,300\ \text{lb} \cdot \text{ft/ft}$	ACI 318-14, 8.5.1.1a

Toe Flexural Analysis (ACI 318-14, Cl 22.2)

Tension Reinforcement Strain	$\varepsilon_t = 0.0188$	ACI 318-14, Cl 22.2.2.4.1 and Cl 7.3.3.1 for strain limit
Resistance Factor in Bending	$\phi_b = 0.9$	ACI 318-14. Table 21.2.1
Factored Moment Capacity	$\phi M_{n,toe} = 24\,300\ \text{lb} \cdot \text{ft/ft}$	ACI 318-14, 8.5.1.1a

Shear in Stem (ACI 318-14, Cl 22.5)

Resistance Factor in Shear	$\phi_v = 0.75$	ACI 318-14 Table 21.2.1
Factored Stem Shear Capacity	$\phi V_{n,stem} = 7370\ \text{plf}$	ACI 318-14, Cl 22.5.5

Shear in Heel (ACI 318-14, Cl 22.5)

Factored Base Shear Capacity	$\phi V_{n,base} = 9670\ \text{plf}$	ACI 318-14, Cl 22.5.5

Shear in Toe (ACI 318-14, Cl 22.5)

Resistance Factor in Shear (Toe)	$\phi_{v,toe} = 0.75$	ACI 318-14 Table 21.2.1
Factored Toe Shear Capacity	$\phi V_{n,toe} = 9670\ \text{plf}$	ACI 318-14, Cl 22.5.5

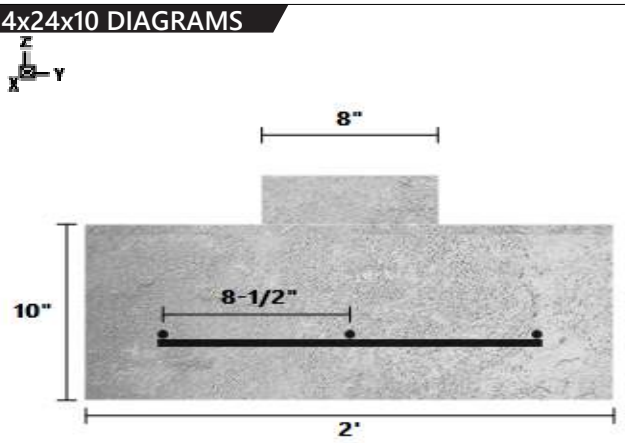
Comments

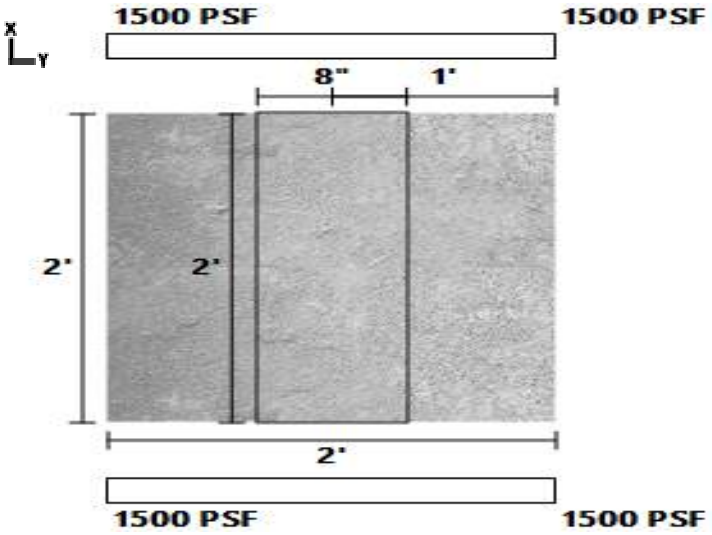
PASS

DATE:	2/11/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJ. ADDRESS:	--	PROJECT NAME:	Foundation 1500psf
	--		
LEVEL:	Roof	LOADING:	
MEMBER NAME:	24x24x10	CODE:	2018 International Building Code
MEMBER TYPE:	ISOLATED FOOTING	ACI:	ACI 318-14
MATERIAL:	Concrete		

2 (ft) X 2 (ft) X 10 (in)	Soil Depth TOF: 0 (ft)	(3) #4 Long, (3) #4 Short

24x24x10 DIAGRAMS





MATERIAL PROPERTIES

FOOTING

fc' (psi)	Ec (psi)	Density (lbf/ft³)	Width (ft)	Length (ft)	Depth (in)	Volume (ft³)
2500	2880952	145	2	2	10	3.33

CALCULATION VARIABLES

Bo (in)	Φ-X	Φ-Y
0	0	0

COLUMN

Width (in)	Length (in)	Material	Offset (in)
8	24	Concrete	0

SOIL

Bearing Strength (lbf/ft²)	Density (lbf/ft³)	Cohesion	Friction Angle	Depth (ft)	Rankine Coefficient (Kp)
1500	140	0	30	0	3

REBAR

Bar Size #	# Bars Long	# Bars Short	fy (psi)	Es (psi)
4	3	3	40000	2.9E+07

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOAD COMBO
Soil Bearing Pressure (lbf/ft²)	PASS (0.0%)	1500.0	1500.0	D+L
One-Way Shear Y (lbf)	PASS (95.5%)	525.0	11700.0	1.2D+1.6L+0.5Lr
Moment Y (lbf-ft)	PASS (70.8%)	933.3	3200.0	1.2D+1.6L+0.5Lr
Crushing (psi)	PASS (96.8%)	43.8	1381.3	1.2D+1.6L+0.5Lr

LOAD LIST

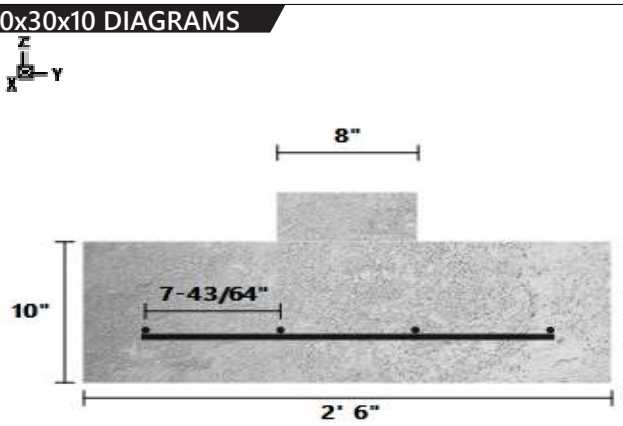
Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	3000	-	0	-	Live	Z
Point (lbf)	3000	-	0	-	Dead	Z

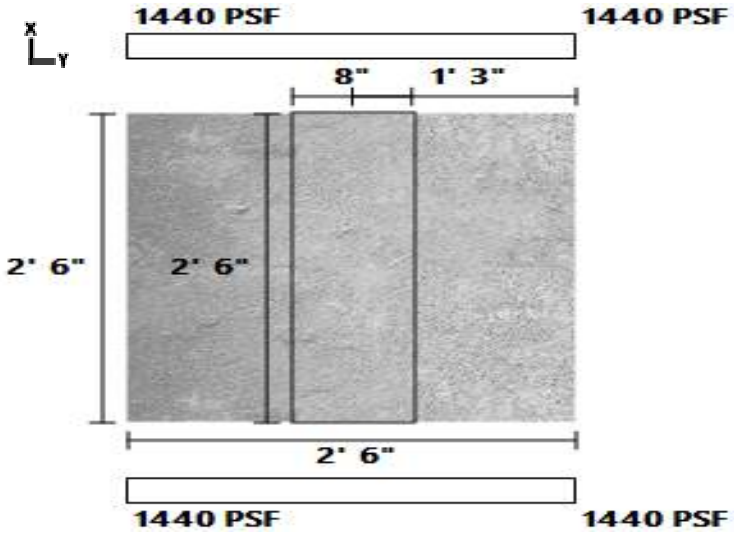
PASS

DATE:	2/11/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJ. ADDRESS:	--	PROJECT NAME:	Foundation 1500psf
	--		
LEVEL:	Roof	LOADING:	
MEMBER NAME:	30x30x10	CODE:	2018 International Building Code
MEMBER TYPE:	ISOLATED FOOTING	ACI:	ACI 318-14
MATERIAL:	Concrete		

2.5 (ft) X 2.5 (ft) X 10 (in)	Soil Depth TOF: 0 (ft)	(4) #4 Long, (4) #4 Short

30x30x10 DIAGRAMS





MATERIAL PROPERTIES

FOOTING

fc' (psi)	Ec (psi)	Density (lbf/ft³)	Width (ft)	Length (ft)	Depth (in)	Volume (ft³)
2500	2880952	145	2.5	2.5	10	5.21

CALCULATION VARIABLES

Bo (in)	Φ-X	Φ-Y
0	0	0

COLUMN

Width (in)	Length (in)	Material	Offset (in)
8	30	Concrete	0

SOIL

Bearing Strength (lbf/ft²)	Density (lbf/ft³)	Cohesion	Friction Angle	Depth (ft)	Rankine Coefficient (Kp)
1500	140	0	30	0	3

REBAR

Bar Size #	# Bars Long	# Bars Short	fy (psi)	Es (psi)
4	4	4	40000	2.9E+07

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOAD COMBO
Soil Bearing Pressure (lbf/ft²)	PASS (4.0%)	1440.0	1500.0	D+L
One-Way Shear Y (lbf)	PASS (87.1%)	1890.0	14625.0	1.2D+1.6L+0.5Lr
Moment Y (lbf-ft)	PASS (47.1%)	2117.5	4000.0	1.2D+1.6L+0.5Lr
Crushing (psi)	PASS (96.2%)	52.5	1381.3	1.2D+1.6L+0.5Lr

LOAD LIST

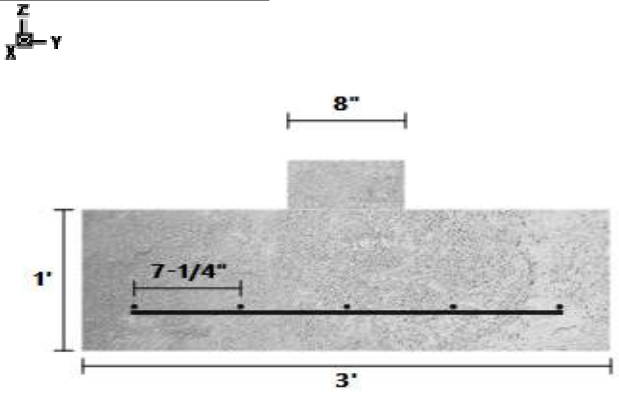
Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	4500	-	0	-	Live	Z
Point (lbf)	4500	-	0	-	Dead	Z

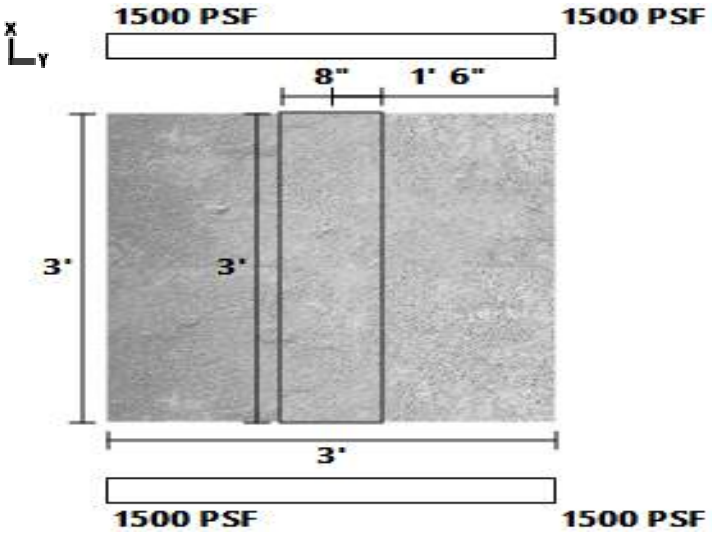
PASS

DATE:	2/11/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJ. ADDRESS:	--	PROJECT NAME:	Foundation 1500psf
	--		
LEVEL:	Roof	LOADING:	
MEMBER NAME:	36x36x12	CODE:	2018 International Building Code
MEMBER TYPE:	ISOLATED FOOTING	ACI:	ACI 318-14
MATERIAL:	Concrete		

3 (ft) X 3 (ft) X 12 (in)	Soil Depth TOF: 0 (ft)	(5) #4 Long, (5) #4 Short

36x36x12 DIAGRAMS





MATERIAL PROPERTIES

FOOTING

fc' (psi)	Ec (psi)	Density (lbf/ft³)	Width (ft)	Length (ft)	Depth (in)	Volume (ft³)
2500	2880952	145	3	3	12	9

CALCULATION VARIABLES

Bo (in)	Φ-X	Φ-Y
0	0	0

COLUMN

Width (in)	Length (in)	Material	Offset (in)
8	36	Concrete	0

SOIL

Bearing Strength (lbf/ft²)	Density (lbf/ft³)	Cohesion	Friction Angle	Depth (ft)	Rankine Coefficient (Kp)
1500	140	0	30	0	3

REBAR

Bar Size #	# Bars Long	# Bars Short	fy (psi)	Es (psi)
4	5	5	40000	2.9E+07

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOAD COMBO
Soil Bearing Pressure (lbf/ft²)	PASS (0.0%)	1500.0	1500.0	D+L
One-Way Shear Y (lbf)	PASS (87.4%)	2902.8	22950.0	1.2D+1.6L+0.5Lr
Moment Y (lbf-ft)	PASS (42.5%)	4310.2	7500.0	1.2D+1.6L+0.5Lr
Crushing (psi)	PASS (95.2%)	66.0	1381.3	1.2D+1.6L+0.5Lr

LOAD LIST

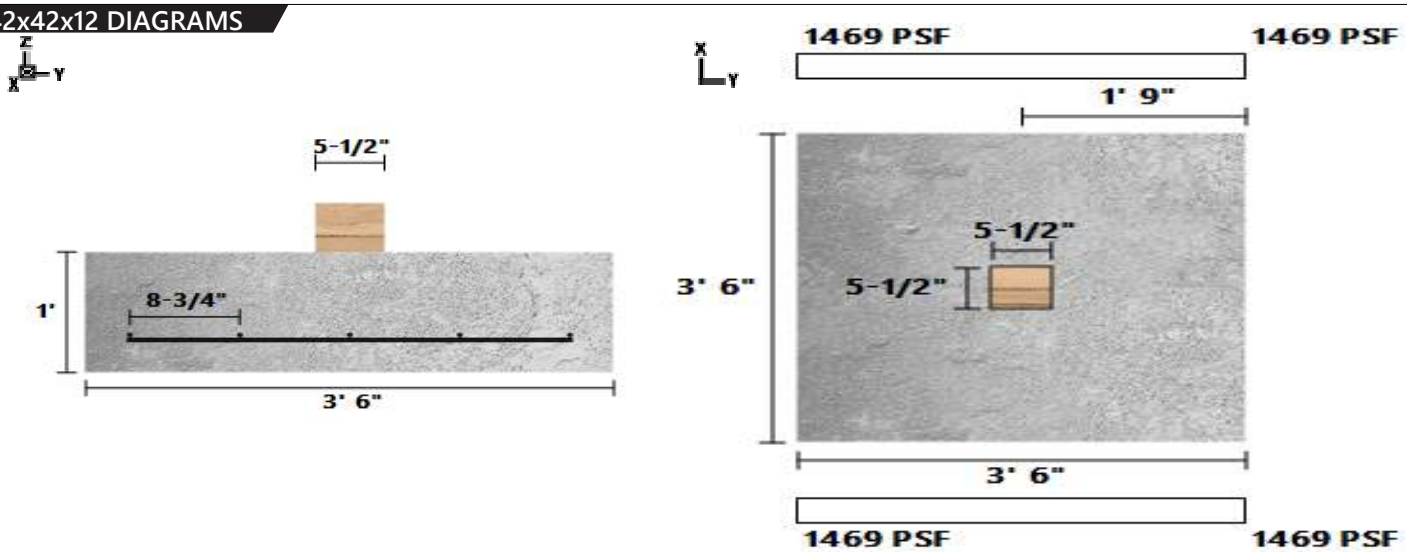
Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	7000	-	0	-	Live	Z
Point (lbf)	6500	-	0	-	Dead	Z

PASS

DATE:	10/8/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJ. ADDRESS:	--	PROJECT NAME:	Foundation 1500psf
	--		
LEVEL:	Roof	LOADING:	
MEMBER NAME:	42x42x12	CODE:	2018 International Building Code
MEMBER TYPE:	ISOLATED FOOTING	ACI:	ACI 318-14
MATERIAL:	Concrete		

3.5 (ft) X 3.5 (ft) X 12 (in)	Soil Depth TOF: 0 (ft)	(5) #4 Long, (5) #4 Short

42x42x12 DIAGRAMS



MATERIAL PROPERTIES

FOOTING

fc' (psi)	Ec (psi)	Density (lbf/ft³)	Width (ft)	Length (ft)	Depth (in)	Volume (ft³)
2500	2880952	145	3.5	3.5	12	12.25

CALCULATION VARIABLES

Bo (in)	Φ-X	Φ-Y
56	0	0

COLUMN

Width (in)	Length (in)	Material	Offset (in)
5.5	5.5	Wood	0

SOIL

Bearing Strength (lbf/ft²)	Density (lbf/ft³)	Cohesion	Friction Angle	Depth (ft)	Rankine Coefficient (Kp)
1500	140	0	30	0	3

REBAR

Bar Size #	# Bars Long	# Bars Short	fy (psi)	Es (psi)
4	5	5	40000	2.9E+07

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOAD COMBO
Soil Bearing Pressure (lbf/ft²)	PASS (2.0%)	1469.4	1500.0	D+L
Two-Way Shear (Punching) (lbf)	PASS (59.7%)	28800.0	71400.0	1.2D+1.6L+0.5Lr
One-Way Shear X (lbf)	PASS (75.0%)	6685.7	26775.0	1.2D+1.6L+0.5Lr
Moment X (lbf-ft)	PASS (61.7%)	9516.1	24827.7	1.2D+1.6L+0.5Lr
One-Way Shear Y (lbf)	PASS (75.0%)	6685.7	26775.0	1.2D+1.6L+0.5Lr
Moment Y (lbf-ft)	PASS (61.7%)	9516.1	24827.7	1.2D+1.6L+0.5Lr
Crushing (psi)	PASS (31.1%)	952.1	1381.3	1.2D+1.6L+0.5Lr

LOAD LIST

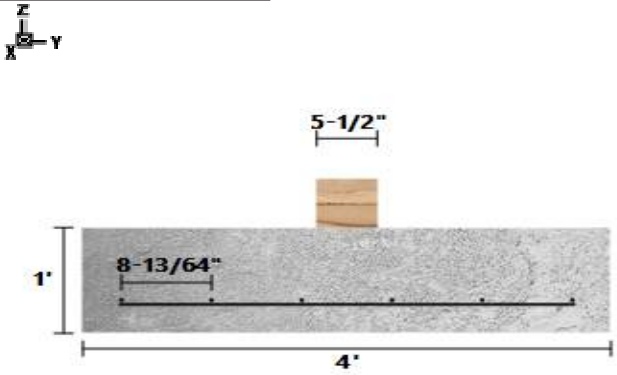
Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	9000	-	0	-	Live	Z
Point (lbf)	9000	-	0	-	Live	Z

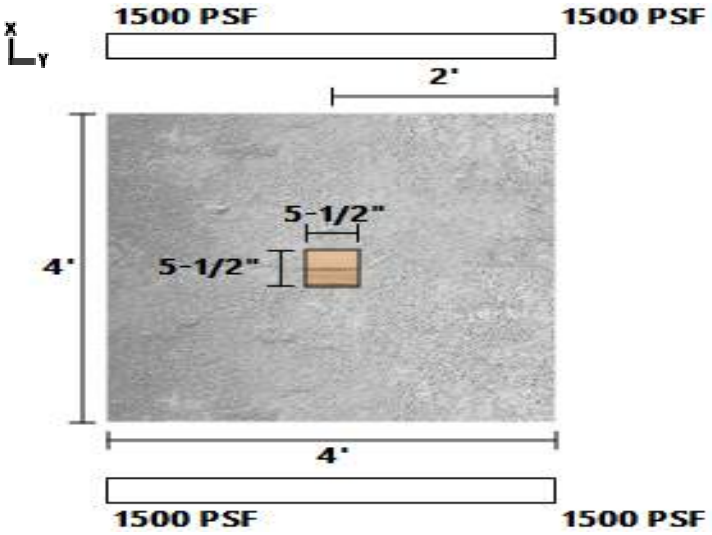
PASS

DATE:	2/11/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJ. ADDRESS:	--	PROJECT NAME:	Foundation 1500psf
	--		
LEVEL:	Roof	LOADING:	
MEMBER NAME:	48x48x12	CODE:	2018 International Building Code
MEMBER TYPE:	ISOLATED FOOTING	ACI:	ACI 318-14
MATERIAL:	Concrete		

4 (ft) X 4 (ft) X 12 (in)	Soil Depth TOF: 0 (ft)	(6) #4 Long, (6) #4 Short

48x48x12 DIAGRAMS





MATERIAL PROPERTIES

FOOTING

fc' (psi)	Ec (psi)	Density (lbf/ft³)	Width (ft)	Length (ft)	Depth (in)	Volume (ft³)
2500	2880952	145	4	4	12	16

CALCULATION VARIABLES

Bo (in)	Φ-X	Φ-Y
56	0	0

COLUMN

Width (in)	Length (in)	Material	Offset (in)
5.5	5.5	Wood	0

SOIL

Bearing Strength (lbf/ft²)	Density (lbf/ft³)	Cohesion	Friction Angle	Depth (ft)	Rankine Coefficient (Kp)
1500	140	0	30	0	3

REBAR

Bar Size #	# Bars Long	# Bars Short	fy (psi)	Es (psi)
4	6	6	40000	2.9E+07

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOAD COMBO
Soil Bearing Pressure (lbf/ft²)	PASS (0.0%)	1500.0	1500.0	D+L
Two-Way Shear (Punching) (lbf)	PASS (52.9%)	33600.0	71400.0	1.2D+1.6L+0.5Lr
One-Way Shear X (lbf)	PASS (70.8%)	8925.0	30600.0	1.2D+1.6L+0.5Lr
Moment X (lbf-ft)	PASS (55.7%)	13170.6	29752.9	1.2D+1.6L+0.5Lr
One-Way Shear Y (lbf)	PASS (70.8%)	8925.0	30600.0	1.2D+1.6L+0.5Lr
Moment Y (lbf-ft)	PASS (55.7%)	13170.6	29752.9	1.2D+1.6L+0.5Lr
Crushing (psi)	PASS (19.6%)	1110.7	1381.3	1.2D+1.6L+0.5Lr

LOAD LIST

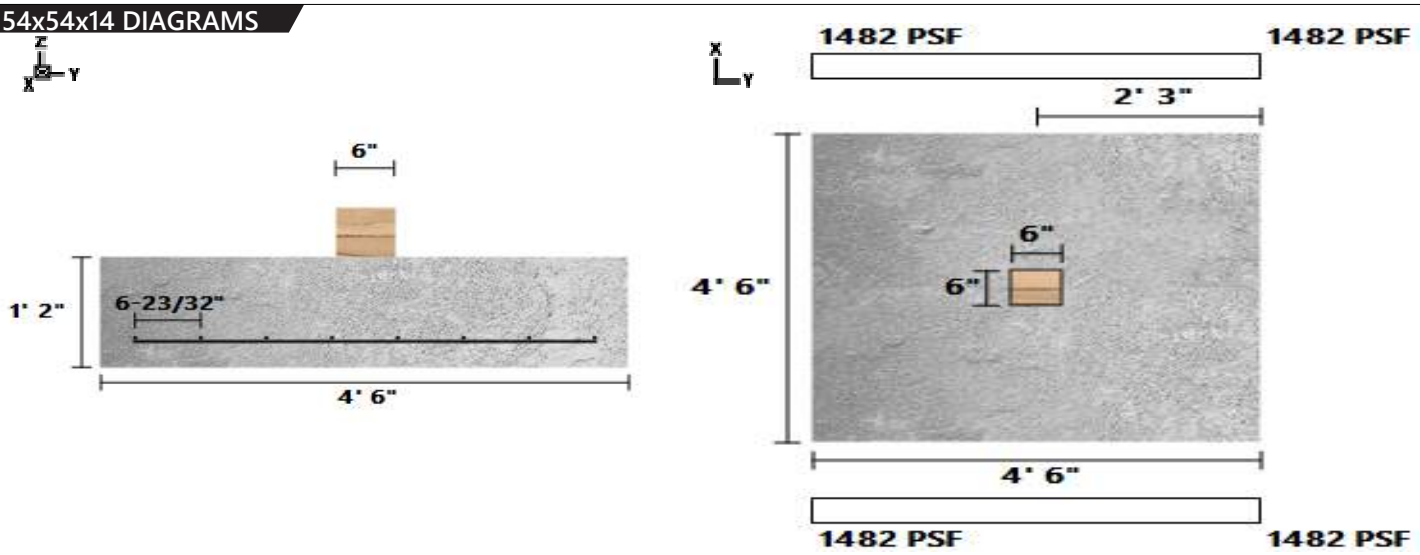
Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	12000	-	0	-	Live	Z
Point (lbf)	12000	-	0	-	Dead	Z

PASS

DATE:	6/21/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJ. ADDRESS:	--	PROJECT NAME:	Foundation 1500psf
	--		
LEVEL:	Roof	LOADING:	
MEMBER NAME:	54x54x14	CODE:	2018 International Building Code
MEMBER TYPE:	ISOLATED FOOTING	ACI:	ACI 318-14
MATERIAL:	Concrete		

4.5 (ft) X 4.5 (ft) X 14 (in)	Soil Depth TOF: 0 (ft)	(8) #4 Long, (8) #4 Short

54x54x14 DIAGRAMS



MATERIAL PROPERTIES

FOOTING

fc' (psi)	Ec (psi)	Density (lbf/ft³)	Width (ft)	Length (ft)	Depth (in)	Volume (ft³)
2500	2880952	145	4.5	4.5	14	23.62

CALCULATION VARIABLES

Bo (in)	Φ-X	Φ-Y
66	0	0

COLUMN

Width (in)	Length (in)	Material	Offset (in)
6	6	Wood	0

SOIL

Bearing Strength (lbf/ft²)	Density (lbf/ft³)	Cohesion	Friction Angle	Depth (ft)	Rankine Coefficient (Kp)
1500	140	0	30	0	3

REBAR

Bar Size #	# Bars Long	# Bars Short	fy (psi)	Es (psi)
4	8	8	40000	2.9E+07

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOAD COMBO
Soil Bearing Pressure (lbf/ft²)	PASS (1.2%)	1481.5	1500.0	D+L
Two-Way Shear (Punching) (lbf)	PASS (59.6%)	42000.0	103950.0	1.2D+1.6L+0.5Lr
One-Way Shear X (lbf)	PASS (75.3%)	10500.0	42525.0	1.2D+1.6L+0.5Lr
Moment X (lbf-ft)	PASS (62.0%)	18666.7	49061.4	1.2D+1.6L+0.5Lr
One-Way Shear Y (lbf)	PASS (75.3%)	10500.0	42525.0	1.2D+1.6L+0.5Lr
Moment Y (lbf-ft)	PASS (62.0%)	18666.7	49061.4	1.2D+1.6L+0.5Lr
Crushing (psi)	PASS (15.5%)	1166.7	1381.3	1.2D+1.6L+0.5Lr

LOAD LIST

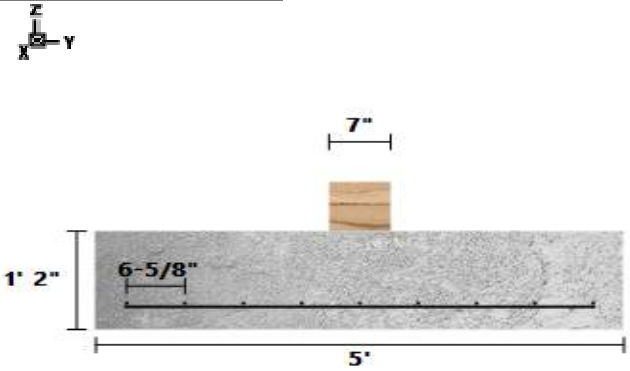
Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	15000	-	0	-	Live	Z
Point (lbf)	15000	-	0	-	Dead	Z

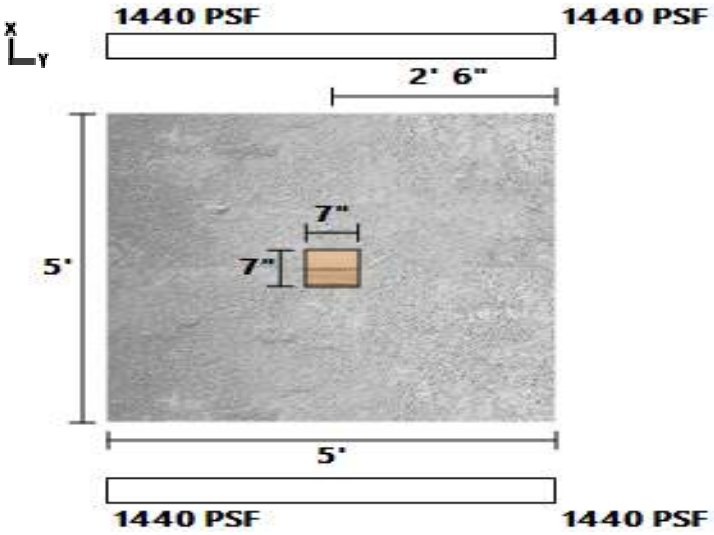
PASS

DATE:	6/21/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJ. ADDRESS:	--	PROJECT NAME:	Foundation 1500psf
	--		
LEVEL:	Roof	LOADING:	
MEMBER NAME:	60x60x14	CODE:	2018 International Building Code
MEMBER TYPE:	ISOLATED FOOTING	ACI:	ACI 318-14
MATERIAL:	Concrete		

5 (ft) X 5 (ft) X 14 (in)	Soil Depth TOF: 0 (ft)	(9) #4 Long, (9) #4 Short

60x60x14 DIAGRAMS





MATERIAL PROPERTIES

FOOTING

fc' (psi)	Ec (psi)	Density (lbf/ft³)	Width (ft)	Length (ft)	Depth (in)	Volume (ft³)
2500	2880952	145	5	5	14	29.17

CALCULATION VARIABLES

Bo (in)	Φ-X	Φ-Y
70	0	0

COLUMN

Width (in)	Length (in)	Material	Offset (in)
7	7	Wood	0

SOIL

Bearing Strength (lbf/ft²)	Density (lbf/ft³)	Cohesion	Friction Angle	Depth (ft)	Rankine Coefficient (Kp)
1500	140	0	30	0	3

REBAR

Bar Size #	# Bars Long	# Bars Short	fy (psi)	Es (psi)
4	9	9	40000	2.9E+07

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOAD COMBO
Soil Bearing Pressure (lbf/ft²)	PASS (4.0%)	1440.0	1500.0	D+L
Two-Way Shear (Punching) (lbf)	PASS (54.3%)	50400.0	110250.0	1.2D+1.6L+0.5Lr
One-Way Shear X (lbf)	PASS (71.6%)	13440.0	47250.0	1.2D+1.6L+0.5Lr
Moment X (lbf-ft)	PASS (55.5%)	24578.8	55175.3	1.2D+1.6L+0.5Lr
One-Way Shear Y (lbf)	PASS (71.6%)	13440.0	47250.0	1.2D+1.6L+0.5Lr
Moment Y (lbf-ft)	PASS (55.5%)	24578.8	55175.3	1.2D+1.6L+0.5Lr
Crushing (psi)	PASS (25.5%)	1028.6	1381.3	1.2D+1.6L+0.5Lr

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	18000	-	0	-	Live	Z
Point (lbf)	18000	-	0	-	Dead	Z

LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

Supplementary Calculations for the following:

- ***Hold-down anchor design/calculations***
- ***Hand-rail calculations (wood/concrete)***
- ***Balloon framed stud design***

- ***Ledger Calculations/Data***

- ***Typical Posts***

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LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

Hold-down anchor design calculations

(206) 790 9502
L120Engineering.com

Company:	L120 Engineering & Design	Date:	5/3/2018
Engineer:	MRT	Page:	1/4
Project:	Hold-down Anchors		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description: 5/8" DIA Anchor

2. Input Data & Anchor Parameters

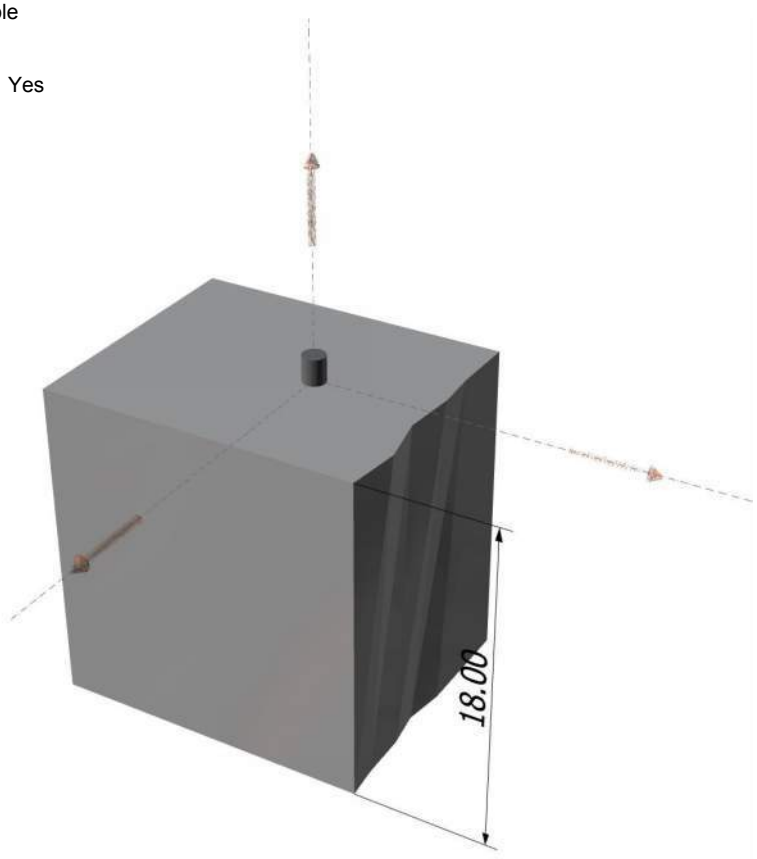
General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Cast-in-place
Material: AB_H
Diameter (inch): 0.625
Effective Embedment depth, h_{ef} (inch): 4.000
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 6.13
C_{min} (inch): 1.38
S_{min} (inch): 2.50

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (a) (iii)-(vi) is satisfied
Ductility section for shear: 17.2.3.5.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Yes
Build-up grout pad: No

<Figure 1>



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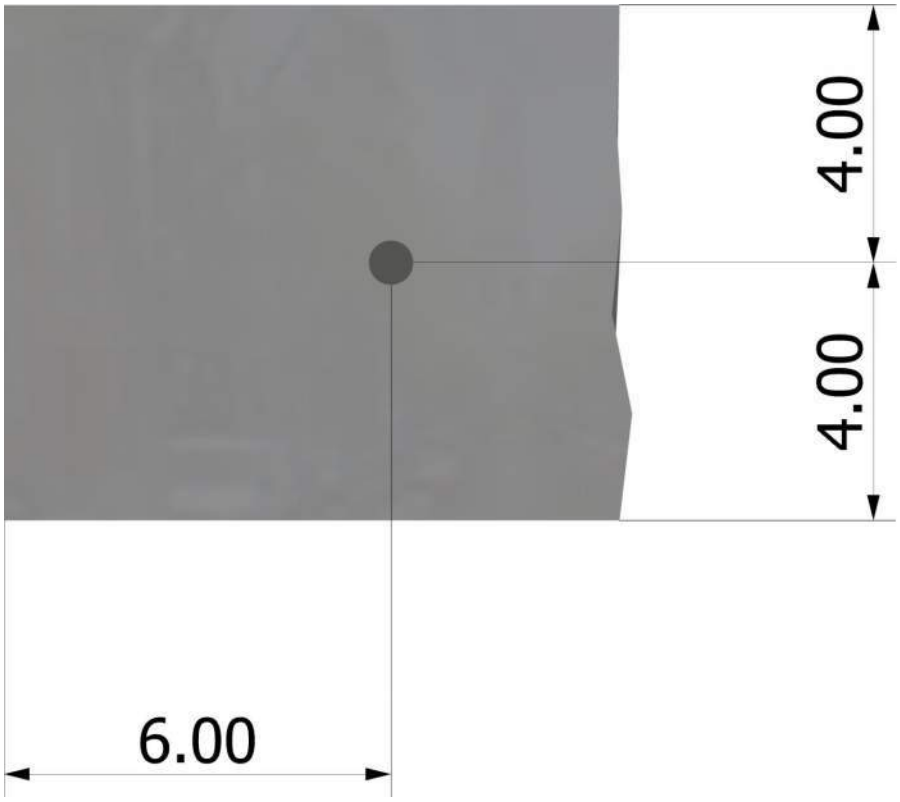


Recommended Anchor
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB5H (5/8"Ø)

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	2925.0	0.0	0.0	0.0
Sum	2925.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 2925
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
27120	0.75	20340

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
24.0	1.00	2500	4.000	9600

$0.75\phi N_{cb} = 0.75\phi \, (A_{Nc} / A_{Nco}) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1a)

A_{Nc} (in^2)	A_{Nco} (in^2	$c_{a,min}$ (in)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cb}$ (lb)
103.00	144.00	4.00	0.900	1.00	1.000	9600	0.75	3476

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi \Psi_{c,P} N_p = 0.75\phi \Psi_{c,P} 8 A_{brg} f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

$\Psi_{c,P}$	A_{brg} (in^2)	f'_c (psi)	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	2.10	2500	0.70	22029

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	2925	20340	0.14	Pass
Concrete breakout	**2925**	**3476**	**0.84**	**Pass (Governs)**
Pullout	2925	22029	0.13	Pass

PAB5H (5/8"Ø) with hef = 4.000 inch meets the selected design criteria.

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) Calculations for Ductility requirement for tension load

Steel	Factored Load, N_{ua} (lb)	1.2 x Nominal Strength, N_n (lb)	Ratio	
Steel	2925	32544	9.0 %	
Concrete	Nominal Strength, N_n (lb)	Nominal Strength, N_n (lb)	Ratio	
Concrete breakout	**2925**	**6180**	**47.3 %**	**Governs**
Pullout	2925	41960	7.0 %	

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) is not satisfied since steel ratio does not govern.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Brittle failure governs for tension. Governing anchor failure mode is brittle failure. Attachment shall be designed to satisfy the requirements of ACI 318-14 Section 17.2.3.4.3 for structures assigned to Seismic Design Category C, D, E, or F when the component of the strength level earthquake force applied to anchors exceeds 20 percent of the total factored anchor force associated with the same load combination. In case when ACI 318-14 Sections 17.2.3.4.3 (a)(iii) to (vi), (b), (c) or (d) is satisfied for tension loading, select appropriate checkbox from Inputs tab to disable this message. Alternatively, Ω0 factor can be entered to satisfy ACI 318-14 Section 17.2.3.4.3(d) to increase the earthquake portion of the loads as required.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

3/4" DIA Anchor

2. Input Data & Anchor Parameters

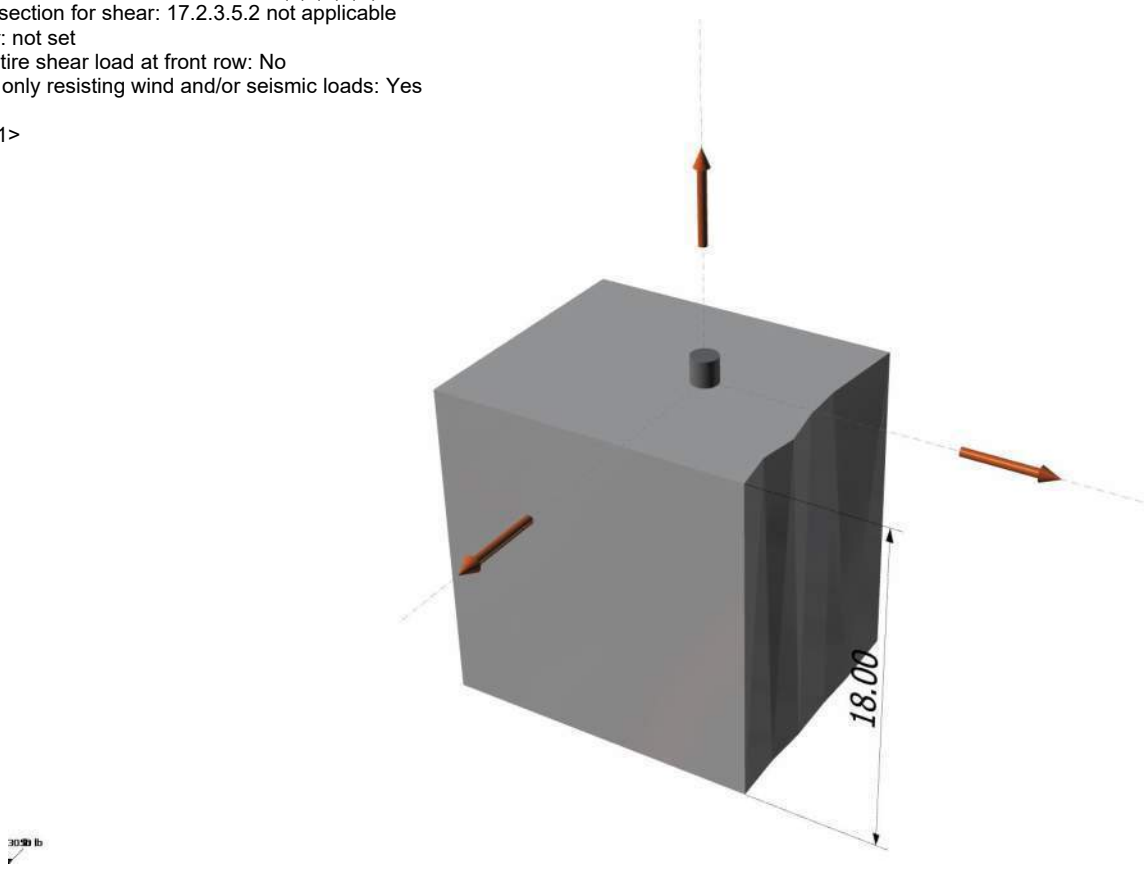
General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Cast-in-place
Material: AB
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 12.000
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 14.25
C_{min} (inch): 1.63
S_{min} (inch): 3.00

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (a) (iii)-(vi) is satisfied
Ductility section for shear: 17.2.3.5.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: Yes
Build-up grout pad: No

<Figure 1>



<Figure 2>

Recommended Anchor
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB6 (3/4"Ø)

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	13050.0	0.0	0.0	0.0
Sum	13050.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}N_p = 0.75\phi\Psi_{c,P}8A_{brg}f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

$\Psi_{c,P}$	A_{brg} (in^2)	f'_c (psi)	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	3.53	2500	0.70	37107

7. Side-Face Blowout Strength of Anchor in Tension (Sec. 17.4.4)

$0.75\phi N_{sb} = 0.75\phi\{(1+c_{a2}/c_{a1})/4\}(160c_{a1}\sqrt{A_{brg}})\lambda\sqrt{f'_c}$ (Sec. 17.3.1 & Eq. 17.4.4.1)

c_{a1} (in)	c_{a2} (in)	A_{brg} (in^2)	λ_a	f'_c (psi)	ϕ	$0.75\phi N_{sbg}$ (lb)
4.00	6.00	3.53	1.00	2500	0.75	21149

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	**13050**	**14528**	**0.90**	**Pass (Governs)**
Pullout	13050	37107	0.35	Pass
Side-face blowout	13050	21149	0.62	Pass

PAB6 (3/4"Ø) with hef = 12.000 inch meets the selected design criteria.

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) Calculations for Ductility requirement for tension load

Steel	Factored Load, N_{ua} (lb)	1.2 x Nominal Strength, N_n (lb)	Ratio	
Steel	**13050**	**23244**	**56.1%**	**Governs**

Concrete	Nominal Strength, N_n (lb)	Nominal Strength, N_n (lb)	Ratio
Pullout	13050	70680	18.5%
Side-face blowout	13050	37598	34.7%

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) satisfied since steel ratio governs and the steel element is ductile.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

Company:	L120 Engineering & Design	Date:	1/14/2018
Engineer:	MRT	Page:	1/5
Project:	Hold-down Anchors		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

7/8" DIA Anchor

2. Input Data & Anchor Parameters

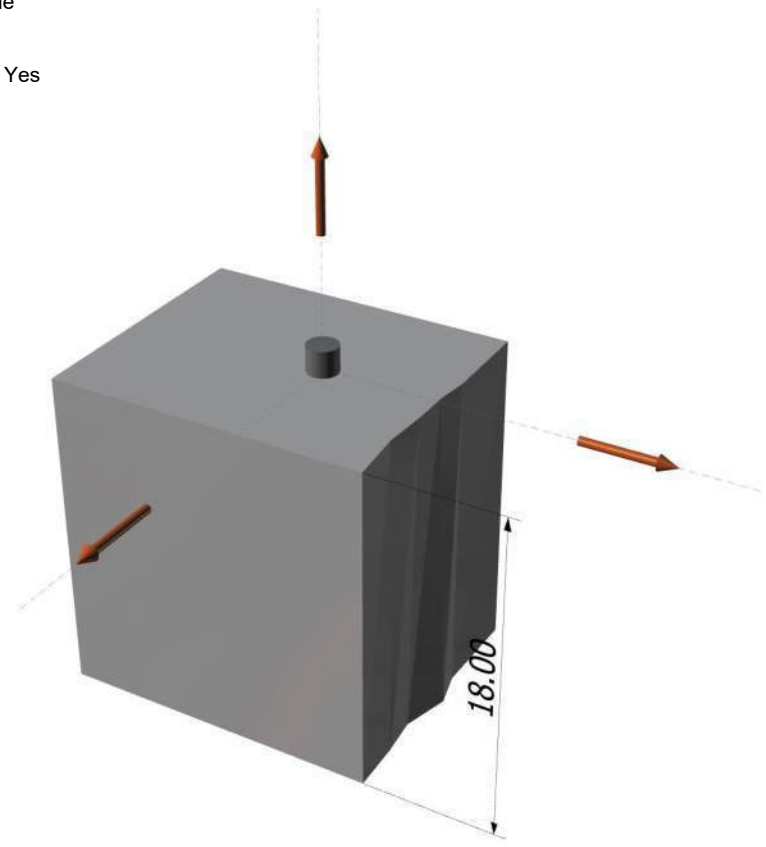
General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Cast-in-place
Material: AB_H
Diameter (inch): 0.875
Effective Embedment depth, h_{ef} (inch): 12.000
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 14.38
C_{min} (inch): 1.75
S_{min} (inch): 3.50

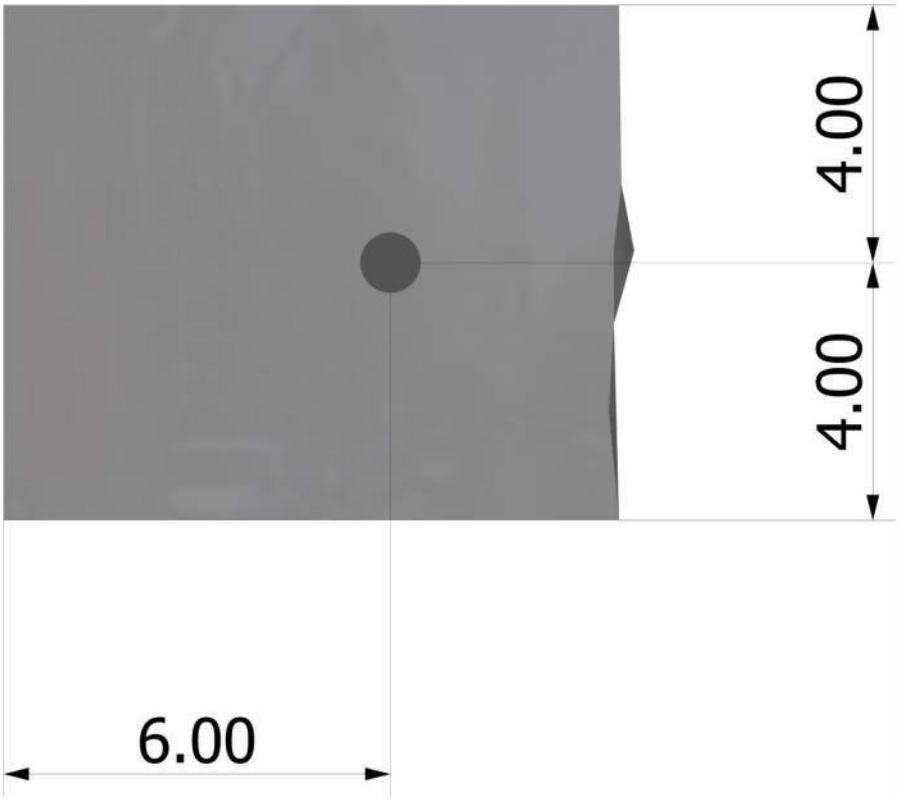
Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (a) (iii)-(vi) is satisfied
Ductility section for shear: 17.2.3.5.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: Yes
Build-up grout pad: No

<Figure 1>



<Figure 2>



Recommended Anchor
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB7H (7/8"Ø)

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	18000.0	0.0	0.0	0.0
Sum	18000.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
55440	0.75	41580

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}N_p = 0.75\phi\Psi_{c,P}8A_{brg}f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

$\Psi_{c,P}$	A_{brg} (in^2)	f'_c (psi)	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	4.07	2500	0.70	42683

7. Side-Face Blowout Strength of Anchor in Tension (Sec. 17.4.4)

$0.75\phi N_{sb} = 0.75\phi\{(1+c_{a2}/c_{a1})/4\}(160c_{a1}\sqrt{A_{brg}})\lambda\sqrt{f'_c}$ (Sec. 17.3.1 & Eq. 17.4.4.1)

c_{a1} (in)	c_{a2} (in)	A_{brg} (in^2)	λ_a	f'_c (psi)	ϕ	$0.75\phi N_{sbg}$ (lb)
4.00	6.00	4.07	1.00	2500	0.75	22682

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	18000	41580	0.43	Pass
Pullout	18000	42683	0.42	Pass
Side-face blowout	**18000**	**22682**	**0.79**	**Pass (Governs)**

PAB7H (7/8"Ø) with hef = 12.000 inch meets the selected design criteria.

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) Calculations for Ductility requirement for tension load

Steel	Factored Load, N_{ua} (lb)	1.2 x Nominal Strength, N_n (lb)	Ratio	
Steel	18000	66528	27.1%	

Concrete	Nominal Strength, N_n (lb)	Nominal Strength, N_n (lb)	Ratio	
Pullout	18000	81300	22.1%	
Side-face blowout	**18000**	**40324**	**44.6%**	**Governs**

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) is not satisfied since steel ratio does not govern.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Brittle failure governs for tension. Governing anchor failure mode is brittle failure. Attachment shall be designed to satisfy the requirements of ACI 318-14 Section 17.2.3.4.3 for structures assigned to Seismic Design Category C, D, E, or F when the component of the strength level earthquake force applied to anchors exceeds 20 percent of the total factored anchor force associated with the same load combination. In case when ACI 318-14 Sections 17.2.3.4.3 (a)(iii) to (vi), (b), (c) or (d) is satisfied for tension loading, select appropriate checkbox from Inputs tab to disable this message. Alternatively, Ω0 factor can be entered to satisfy ACI 318-14 Section 17.2.3.4.3(d) to increase the earthquake portion of the loads as required.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

Company:	L120 Engineering & Design	Date:	1/14/2018
Engineer:	MRT	Page:	1/5
Project:	Hold-down Anchors		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description: 1" DIA Anchor

2. Input Data & Anchor Parameters

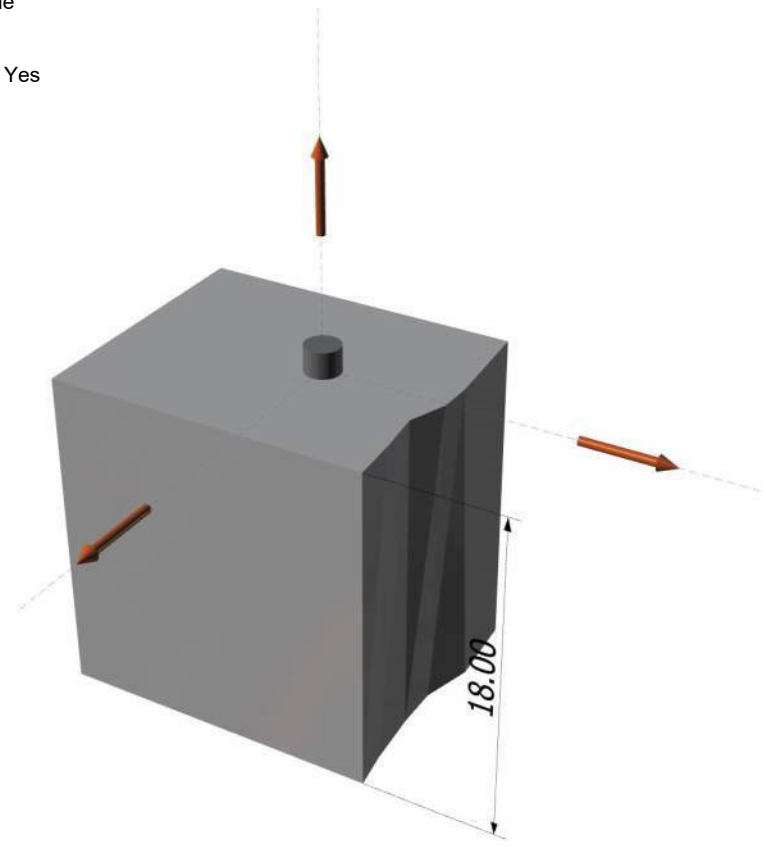
General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Cast-in-place
Material: AB_H
Diameter (inch): 1.000
Effective Embedment depth, h_{ef} (inch): 15.000
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 17.63
C_{min} (inch): 1.88
S_{min} (inch): 4.00

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (a) (iii)-(vi) is satisfied
Ductility section for shear: 17.2.3.5.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: Yes
Build-up grout pad: No

<Figure 1>



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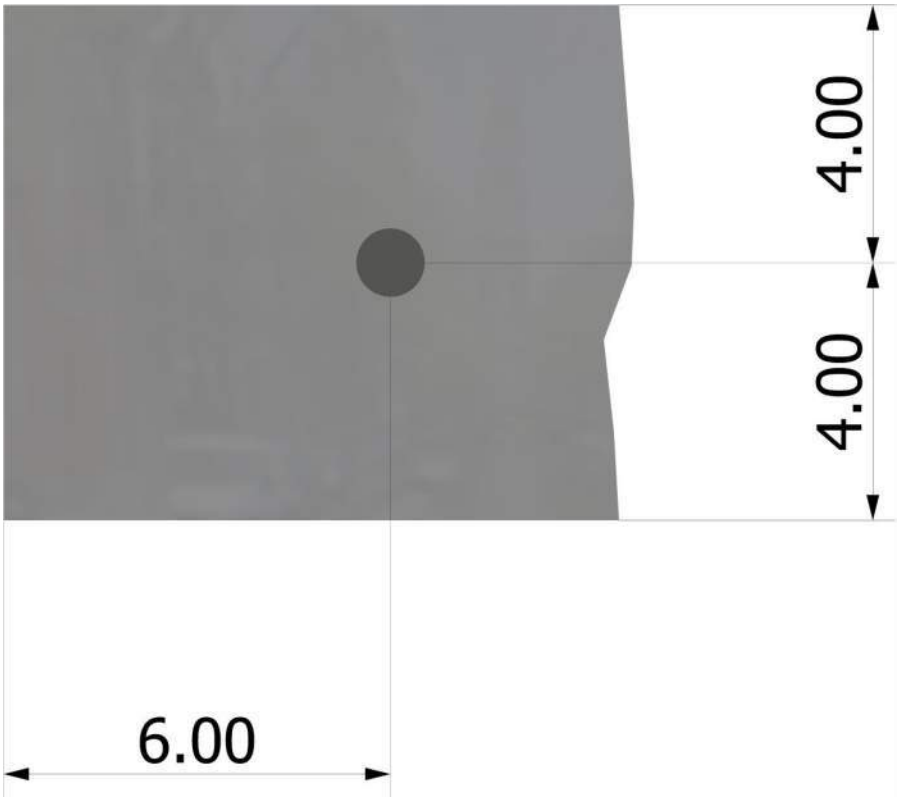


Recommended Anchor
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB8H (1"Ø)

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	22500.0	0.0	0.0	0.0
Sum	22500.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
72720	0.75	54540

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}N_p = 0.75\phi\Psi_{c,P}8A_{brg}f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

$\Psi_{c,P}$	A_{brg} (in^2)	f'_c (psi)	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	5.15	2500	0.70	54117

7. Side-Face Blowout Strength of Anchor in Tension (Sec. 17.4.4)

$0.75\phi N_{sb} = 0.75\phi\{(1+c_{a2}/c_{a1})/4\}(160c_{a1}\sqrt{A_{brg}})\lambda\sqrt{f'_c}$ (Sec. 17.3.1 & Eq. 17.4.4.1)

c_{a1} (in)	c_{a2} (in)	A_{brg} (in^2)	λ_a	f'_c (psi)	ϕ	$0.75\phi N_{sbg}$ (lb)
4.00	6.00	5.15	1.00	2500	0.75	25540

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	22500	54540	0.41	Pass
Pullout	22500	54117	0.42	Pass
Side-face blowout	**22500**	**25540**	**0.88**	**Pass (Governs)**

PAB8H (1"Ø) with hef = 15.000 inch meets the selected design criteria.

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) Calculations for Ductility requirement for tension load

Steel	Factored Load, N_{ua} (lb)	1.2 x Nominal Strength, N_n (lb)	Ratio	
Steel	22500	87264	25.8%	

Concrete	Nominal Strength, N_n (lb)	Nominal Strength, N_n (lb)	Ratio	
Pullout	22500	103080	21.8%	
Side-face blowout	**22500**	**45405**	**49.6%**	**Governs**

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) is not satisfied since steel ratio does not govern.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Brittle failure governs for tension. Governing anchor failure mode is brittle failure. Attachment shall be designed to satisfy the requirements of ACI 318-14 Section 17.2.3.4.3 for structures assigned to Seismic Design Category C, D, E, or F when the component of the strength level earthquake force applied to anchors exceeds 20 percent of the total factored anchor force associated with the same load combination. In case when ACI 318-14 Sections 17.2.3.4.3 (a)(iii) to (vi), (b), (c) or (d) is satisfied for tension loading, select appropriate checkbox from Inputs tab to disable this message. Alternatively, Ω0 factor can be entered to satisfy ACI 318-14 Section 17.2.3.4.3(d) to increase the earthquake portion of the loads as required.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

Company:	L120 Engineering & Design	Date:	1/14/2018
Engineer:	MRT	Page:	1/5
Project:	Hold-down Anchors		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

1 1/8" DIA Anchor

2. Input Data & Anchor Parameters

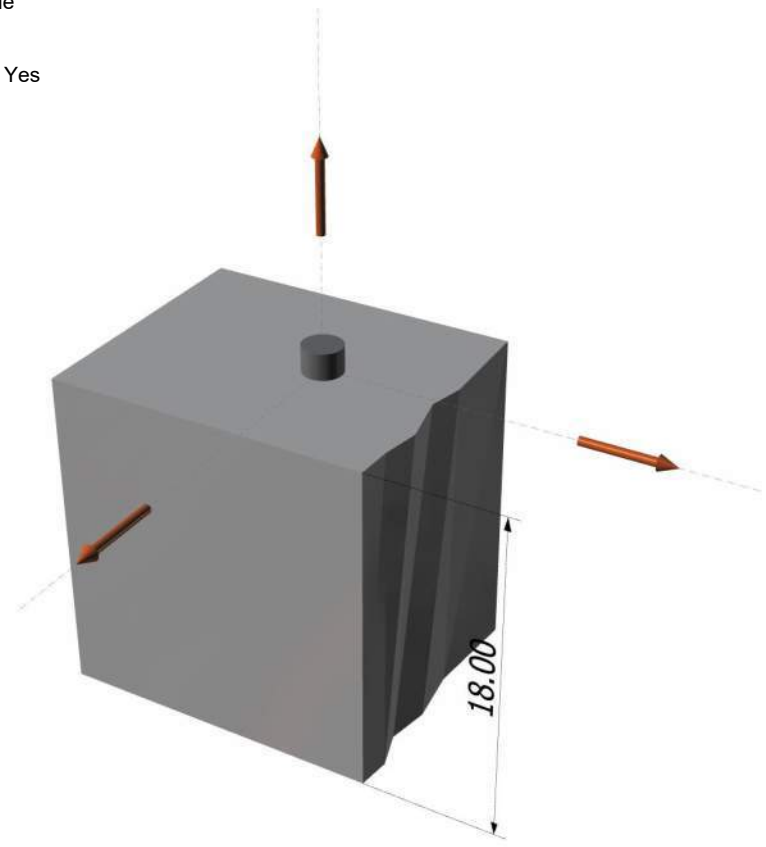
General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Cast-in-place
Material: AB
Diameter (inch): 1.125
Effective Embedment depth, h_{ef} (inch): 15.000
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 17.75
C_{min} (inch): 2.13
S_{min} (inch): 4.50

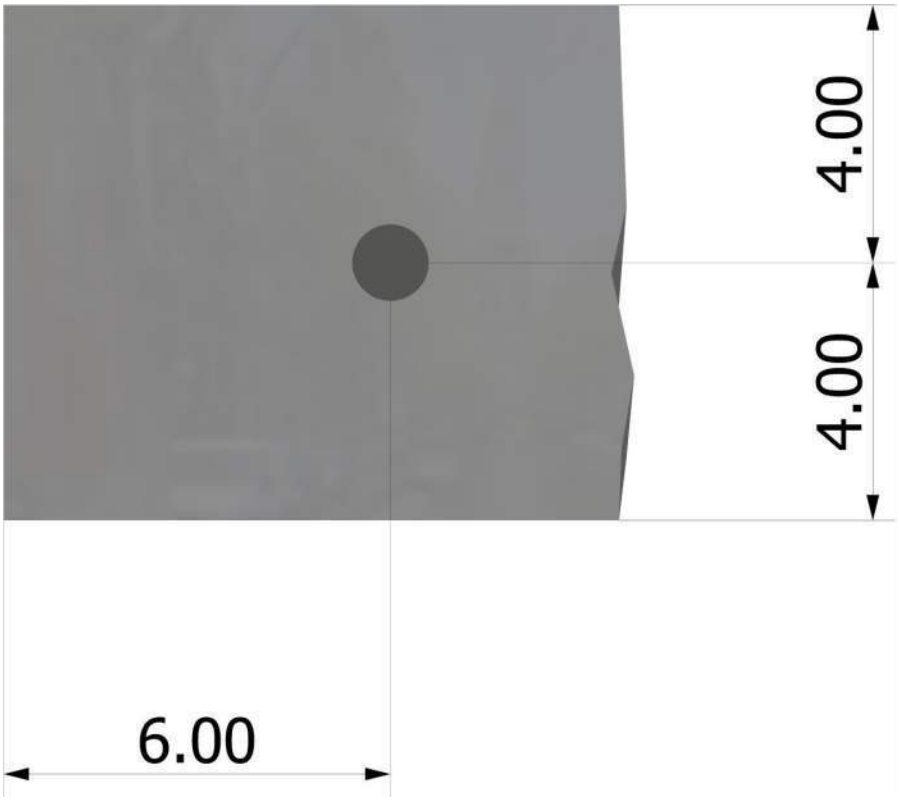
Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (a) (iii)-(vi) is satisfied
Ductility section for shear: 17.2.3.5.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: Yes
Build-up grout pad: No

<Figure 1>



<Figure 2>



Recommended Anchor
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB9 (1 1/8"Ø)

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	27900.0	0.0	0.0	0.0
Sum	27900.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
44255	0.75	33191

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}N_p = 0.75\phi\Psi_{c,P}8A_{brg}f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

$\Psi_{c,P}$	A_{brg} (in^2)	f'_c (psi)	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	6.37	2500	0.70	66885

7. Side-Face Blowout Strength of Anchor in Tension (Sec. 17.4.4)

$0.75\phi N_{sb} = 0.75\phi\{(1+c_{a2}/c_{a1})/4\}(160c_{a1}\sqrt{A_{brg}})\lambda\sqrt{f'_c}$ (Sec. 17.3.1 & Eq. 17.4.4.1)

c_{a1} (in)	c_{a2} (in)	A_{brg} (in^2)	λ_a	f'_c (psi)	ϕ	$0.75\phi N_{sbg}$ (lb)
4.00	6.00	6.37	1.00	2500	0.75	28394

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	27900	33191	0.84	Pass
Pullout	27900	66885	0.42	Pass
Side-face blowout	**27900**	**28394**	**0.98**	**Pass (Governs)**

PAB9 (1 1/8"Ø) with hef = 15.000 inch meets the selected design criteria.

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) Calculations for Ductility requirement for tension load

Steel	Factored Load, N_{ua} (lb)	1.2 x Nominal Strength, N_n (lb)	Ratio	
Steel	27900	53106	52.5%	

Concrete	Nominal Strength, N_n (lb)	Nominal Strength, N_n (lb)	Ratio	
Pullout	27900	127400	21.9%	
Side-face blowout	**27900**	**50478**	**55.3%**	**Governs**

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) is not satisfied since steel ratio does not govern.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Brittle failure governs for tension. Governing anchor failure mode is brittle failure. Attachment shall be designed to satisfy the requirements of ACI 318-14 Section 17.2.3.4.3 for structures assigned to Seismic Design Category C, D, E, or F when the component of the strength level earthquake force applied to anchors exceeds 20 percent of the total factored anchor force associated with the same load combination. In case when ACI 318-14 Sections 17.2.3.4.3 (a)(iii) to (vi), (b), (c) or (d) is satisfied for tension loading, select appropriate checkbox from Inputs tab to disable this message. Alternatively, Ω0 factor can be entered to satisfy ACI 318-14 Section 17.2.3.4.3(d) to increase the earthquake portion of the loads as required.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

Company:	L120 Engineering & Design	Date:	1/14/2018
Engineer:	MRT	Page:	1/5
Project:	Hold-down Anchors		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

1 1/4" DIA Anchor

2. Input Data & Anchor Parameters

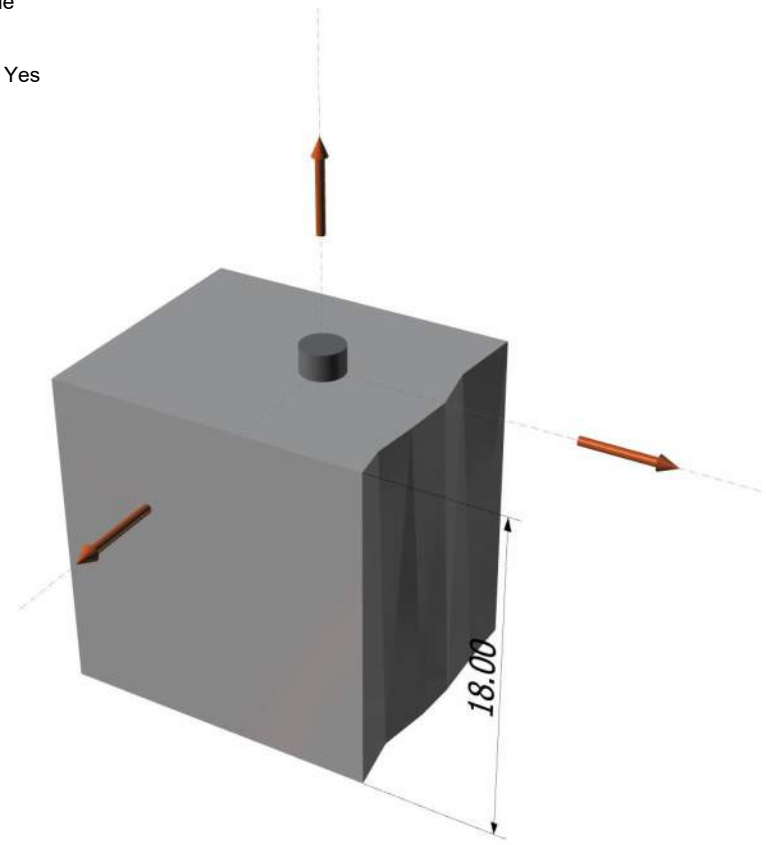
General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Cast-in-place
Material: AB
Diameter (inch): 1.250
Effective Embedment depth, h_{ef} (inch): 15.000
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 18.00
C_{min} (inch): 2.25
S_{min} (inch): 5.00

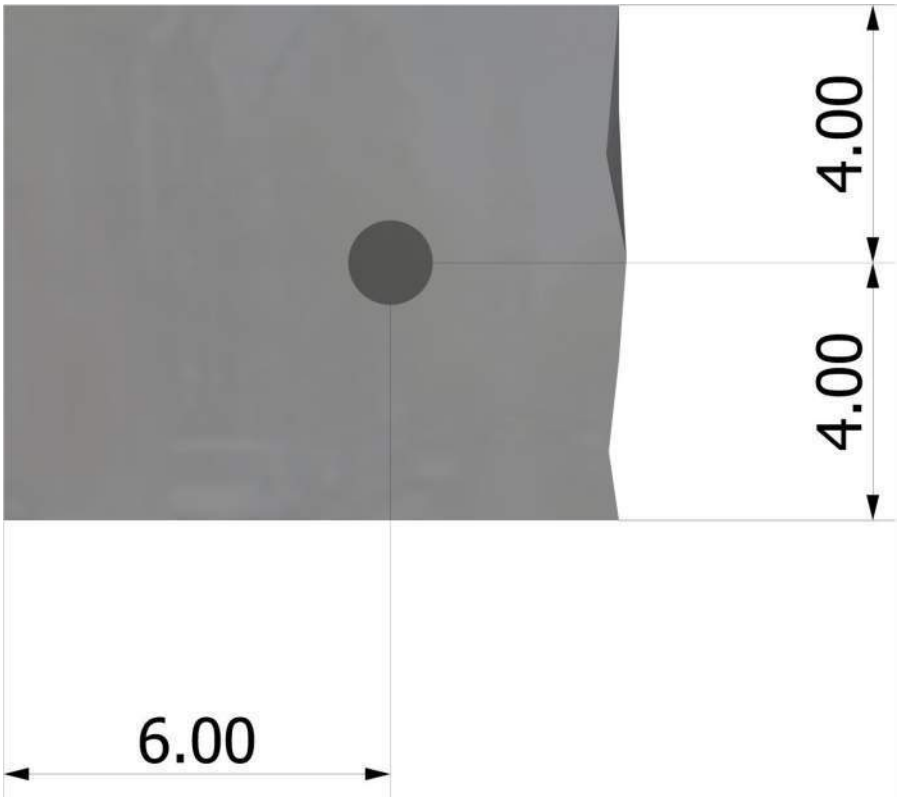
Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (a) (iii)-(vi) is satisfied
Ductility section for shear: 17.2.3.5.2 not applicable
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: Yes
Build-up grout pad: No

<Figure 1>



<Figure 2>



Recommended Anchor
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB10 (1 1/4"Ø)

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	31500.0	0.0	0.0	0.0
Sum	31500.0	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 0
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
56200	0.75	42150

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}N_p = 0.75\phi\Psi_{c,P}8A_{brg}f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

$\Psi_{c,P}$	A_{brg} (in^2)	f'_c (psi)	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	8.39	2500	0.70	88137

7. Side-Face Blowout Strength of Anchor in Tension (Sec. 17.4.4)

$0.75\phi N_{sb} = 0.75\phi\{(1+c_{a2}/c_{a1})/4\}(160c_{a1}\sqrt{A_{brg}})\lambda\sqrt{f'_c}$ (Sec. 17.3.1 & Eq. 17.4.4.1)

c_{a1} (in)	c_{a2} (in)	A_{brg} (in^2)	λ_a	f'_c (psi)	ϕ	$0.75\phi N_{sbg}$ (lb)
4.00	6.00	8.39	1.00	2500	0.75	32594

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	31500	42150	0.75	Pass
Pullout	31500	88137	0.36	Pass
Side-face blowout	**31500**	**32594**	**0.97**	**Pass (Governs)**

PAB10 (1 1/4"Ø) with hef = 15.000 inch meets the selected design criteria.

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) Calculations for Ductility requirement for tension load

Steel	Factored Load, N_{ua} (lb)	1.2 x Nominal Strength, N_n (lb)	Ratio	
Steel	31500	67440	46.7%	

Concrete	Nominal Strength, N_n (lb)	Nominal Strength, N_n (lb)	Ratio	
Pullout	31500	167880	18.8%	
Side-face blowout	**31500**	**57945**	**54.4%**	**Governs**

ACI 318-14 Section 17.2.3.4.3(a) (i) & (ii) is not satisfied since steel ratio does not govern.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Brittle failure governs for tension. Governing anchor failure mode is brittle failure. Attachment shall be designed to satisfy the requirements of ACI 318-14 Section 17.2.3.4.3 for structures assigned to Seismic Design Category C, D, E, or F when the component of the strength level earthquake force applied to anchors exceeds 20 percent of the total factored anchor force associated with the same load combination. In case when ACI 318-14 Sections 17.2.3.4.3 (a)(iii) to (vi), (b), (c) or (d) is satisfied for tension loading, select appropriate checkbox from Inputs tab to disable this message. Alternatively, Ω0 factor can be entered to satisfy ACI 318-14 Section 17.2.3.4.3(d) to increase the earthquake portion of the loads as required.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

LONGITUDE
ONE TWENTY°
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Hand-rail Calculations

(206) 790 9502
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LONGITUDE
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ENGINEERING & DESIGN

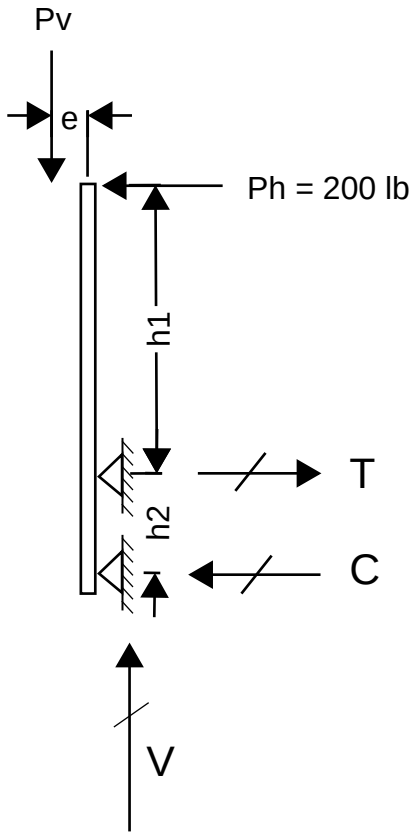
PROJECT NO.	SHEET NO.

PROJECT _____

SUBJECT GuardRail Design

BY _____ DATE / /

End Post Anchor Bolt Design:



Pv = 25 lbs

Ph = 200 lbs

h1 = 46"

h2 = 5.5"

e = 1.5"

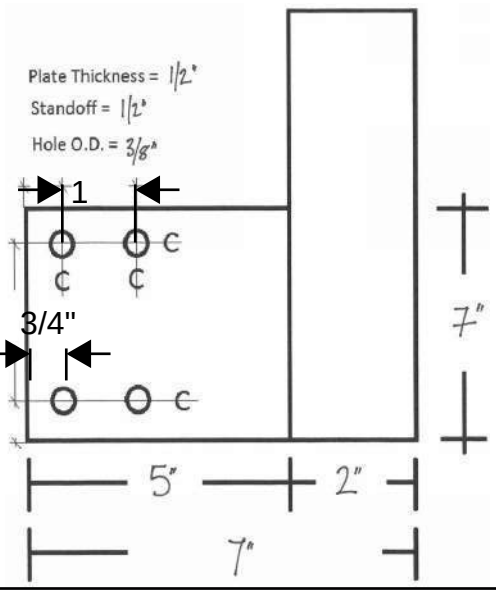
Anchor Moment Mx = Pv(e) + Ph (h1 + h2/2)
= 25 x 1.5 + 200x (46+5.5/2)
= 9788 #"

My = 200# x 4.5" = 900 #"

Anchor Forces T = [Pv (e) + Ph (h1+h2)] / h2 + My/1.5"
= 2480 #

Anchor Forces C = T - Ph
= 2280 #

Each Bolt Force T = T / 2 = 1240 #
V = Pv / 4 + Pv x 4.5"/(4x2.85")= 16 #



Wood Lag Screw: 3/8" dia with 3" min. embed into DF beam.

Withdrawal Wa = 305 #/" x 1.6 x 3" = 1460 # > T O.K.
Shear Za = 180 # x 1.6 = 280 # O.K.

LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

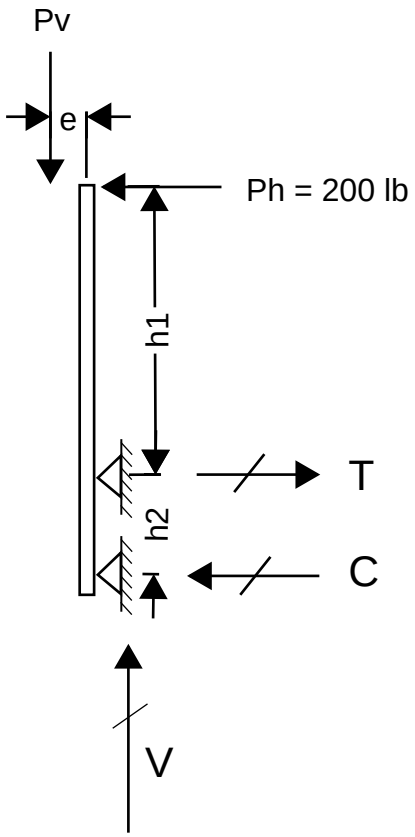
PROJECT NO.	SHEET NO.

PROJECT _____

SUBJECT GuardRail Design

BY _____ DATE / /

Middle Post Anchor Bolt Design:



Pv = 25 lbs

Ph = 250 lbs

h1 = 46"

h2 = 5.5"

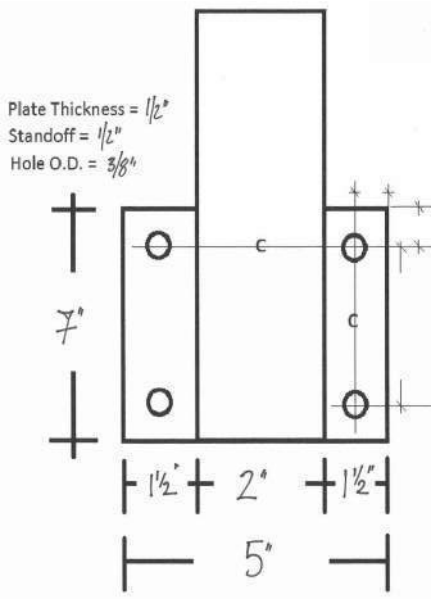
e = 1.5"

Anchor Moment M = Pv(e) + Ph (h1 + h2/2)
= 25 x 1.5 + 250 (46+5.5/2)
= 12,250

Anchor Forces T = [Pv (e) + Ph (h1+h2)] / h2
= 2347 #

Anchor Forces C = T - Ph
= 2147 #

Each Bolt Force T = T / 2 = 1174 #
V = Pv / 4 = 6 #



Wood Lag Screw: 3/8" dia with 3" min. embed into DF beam.

Withdrawal Wa = 305 #/" x 1.6 x 3" = 1460 # > T O.K.
Shear Za = 180 # x 1.6 = 280 # O.K.

LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

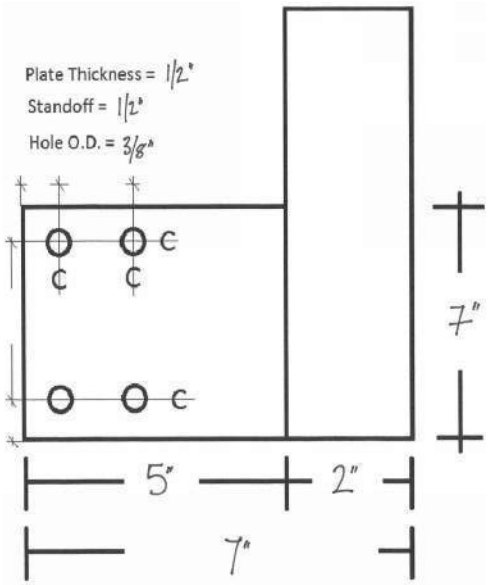
PROJECT NO.	SHEET NO.

PROJECT _____

SUBJECT GuardRail Design

BY _____ DATE / /

Mounting Plate Design:



Apply Forces: Mx = 9788 #"
My = 900 #"
T = 200 #
V = 25 #

Try 1/2" thick Plate

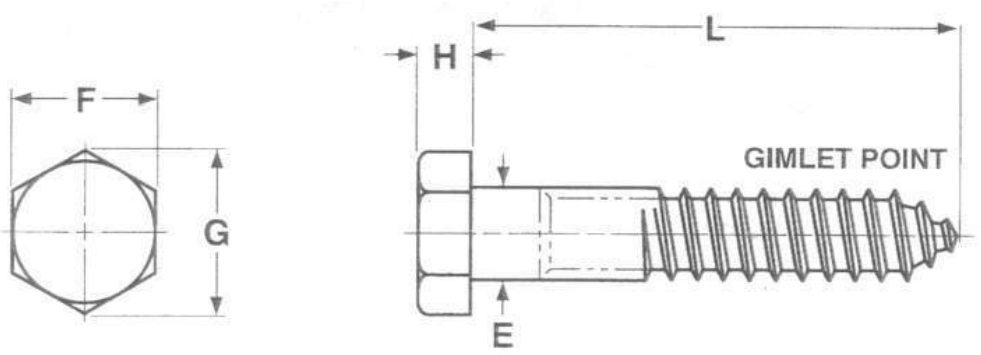
Plate Bending Stress: fbx = Mx/2/Sx
= 9788/2/(1/4 x 5" x (1/2)^2)
= 15,660 psi
fby = My/Sy
= 900/(1/4 x 7" x (1/2)^2)
= 2,057 psi

For Plate 6061-T6 Fb =35 ksi / 1.65
= 21,200 psi > fb O.K.

Plate Combined Stress
fbx/Fb + fby/Fb = 0.83 < 1.0 O.K.

Hex Lag Screws, Hot Dipped Galvanized

The information below lists the required dimensional, chemical and physical characteristics of the products in this purchase order. If the order received does not meet these requirements, it may result in a supplier corrective action request, which could jeopardize your status as an approved vendor. Unless otherwise specified, all referenced consensus standards must be adhered to in their entirety.



Diameter	E		F		G		H	
	Body Diameter		Width Across Flats		Width Across Corners		Height	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
10	.199	.178	.281	.271	.323	.309	.140	.110
1/4	.260	.237	.438	.425	.505	.484	.188	.150
5/16	.324	.298	.500	.484	.577	.552	.235	.195
3/8	.388	.360	.562	.544	.650	.620	.268	.226
7/16	.452	.421	.625	.603	.722	.687	.316	.272
1/2	.515	.482	.750	.725	.866	.826	.364	.302
5/8	.642	.605	.938	.906	1.083	1.033	.444	.378
3/4	.768	.729	1.125	1.088	1.299	1.240	.524	.455
7/8	.895	.852	1.312	1.269	1.516	1.447	.604	.531
1	1.022	.976	1.500	1.450	1.732	1.653	.700	.591
1 1/8	1.149	1.098	1.688	1.631	1.949	1.859	.780	.658
1 1/4	1.277	1.223	1.875	1.812	2.165	2.066	.876	.749

Dimensions above are prior to coating

Specification Requirements:

- Dimensions: ASME B18.2.1.
- Material: Per ASTM A307, Grade A
- Thread requirements: The minimum thread length must be equal to one half the nominal Screw length plus ½", or 6 inch, whichever is shorter. Screws too short to conform to this formula must be threaded as close to the head as possible.
- Coating: Hot Dip Zinc per ASTM F2329 or in accordance with Class C of ASTM A153 and Class D for 3/8" diameter and less.

Table 2.3.2 Frequently Used Load Duration Factors, C_D[1]

Load Duration	C_D	Typical Design Loads
Permanent	0.9	Dead Load
Ten years	1.0	Occupancy Live Load
Two months	1.15	Snow Load
Seven days	1.25	Construction Load
Ten minutes	1.6	Wind/Earthquake Load
Impact[2]	2.0	Impact Load

1. Load duration factors shall not apply to reference modulus of elasticity, E, reference modulus of elasticity for beam and column stability, E_{min}, nor to reference compression perpendicular to grain design values, $F_{c\perp}$, based on a deformation limit.
2. Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with water-borne preservatives (see Reference 30), or fire retardant chemicals. The impact load duration factor shall not apply to connections.

2.3.3 Temperature Factor, C_t

Reference design values shall be multiplied by the temperature factors, C_t, in Table 2.3.3 for structural members that will experience sustained exposure to elevated temperatures up to 150°F (see Appendix C).

2.3.4 Fire Retardant Treatment

The effects of fire retardant chemical treatment on strength shall be accounted for in the design. Adjusted design values, including adjusted connection design values, for lumber and structural glued laminated timber pressure-treated with fire retardant chemicals shall be obtained from the company providing the treatment and redrying service. Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with fire retardant chemicals (see Table 2.3.2).

2.3.5 Format Conversion Factor, K_F (LRFD Only)

For LRFD, reference design values shall be multiplied by the format conversion factor, K_F, specified in Table 2.3.5. The format conversion factor, K_F, shall not apply for designs in accordance with ASD methods specified herein.

2.3.6 Resistance Factor, ϕ (LRFD Only)

For LRFD, reference design values shall be multiplied by the resistance factor, ϕ, specified in Table 2.3.6. The resistance factor, ϕ, shall not apply for designs in accordance with ASD methods specified herein.

2.3.7 Time Effect Factor, λ (LRFD Only)

For LRFD, reference design values shall be multiplied by the time effect factor, λ, specified in Appendix N.3.3. The time effect factor, λ, shall not apply for designs in accordance with ASD methods specified herein.

Table 2.3.3 Temperature Factor, C_t

Reference Design Values	In-Service Moisture Conditions[1]	C_t		
		T≤100°F	100°F<T≤125°F	125°F<T≤150°F
F_t, E, E_{min}	Wet or Dry	1.0	0.9	0.9
F_b, F_v, F_c, and $F_{c\perp}$	Dry	1.0	0.8	0.7
	Wet	1.0	0.7	0.5

1. Wet and dry service conditions for sawn lumber, structural glued laminated timber, prefabricated wood I-joists, structural composite lumber, wood structural panels and cross-laminated timber are specified in 4.1.4, 5.1.4, 7.1.4, 8.1.4, 9.3.3, and 10.1.5 respectively.

Table 11.3.1 Applicability of Adjustment Factors for Connections

		ASD Only	ASD and LRFD									LRFD Only		
		Load Duration Factor[1]	Wet Service Factor	Temperature Factor	Group Action Factor	Geometry Factor[3]	Penetration Depth Factor[3]	End Grain Factor[3]	Metal Side Plate Factor[3]	Diaphragm Factor[3]	Toe-Nail Factor[3]	Format Conversion Factor K_F	Resistance Factor ϕ	Time Effect Factor
Lateral Loads														
Dowel-type Fasteners (e.g. bolts, lag screws, wood screws, nails, spikes, drift bolts, & drift pins)	$Z' = Z$ x	C_D	C_M	C_t	C_g	C_Δ	-	C_{eg}	-	C_{di}	C_{tn}	3.32	0.65	λ
Split Ring and Shear Plate Connectors	$P' = P$ x	C_D	C_M	C_t	C_g	C_Δ	C_d	-	C_{st}	-	-	3.32	0.65	λ
	$Q' = Q$ x	C_D	C_M	C_t	C_g	C_Δ	C_d	-	-	-	-	3.32	0.65	λ
Timber Rivets	$P' = P$ x	C_D	C_M	C_t	-	-	-	-	C_{st}[4]	-	-	3.32	0.65	λ
	$Q' = Q$ x	C_D	C_M	C_t	-	C_Δ[5]	-	-	C_{st}[4]	-	-	3.32	0.65	λ
Spike Grids	$Z' = Z$ x	C_D	C_M	C_t	-	C_Δ	-	-	-	-	-	3.32	0.65	λ
Withdrawal Loads														
Nails, spikes, lag screws, wood screws, & drift pins	$W' = W$ x	C_D	C_M[2]	C_t	-	-	-	C_{eg}	-	-	C_{tn}	3.32	0.65	λ

1. The load duration factor, C_D, shall not exceed 1.6 for connections (see 11.3.2).
2. The wet service factor, C_M, shall not apply to toe-nails loaded in withdrawal (see 12.5.4.1).
3. Specific information concerning geometry factors C_Δ, penetration depth factors C_d, end grain factors, C_{eg}, metal side plate factors, C_{st}, diaphragm factors, C_{di}, and toe-nail factors, C_{tn}, is provided in Chapters 12, 13, and 14.
4. The metal side plate factor, C_{st}, is only applied when rivet capacity (P_r, Q_r) controls (see Chapter 14).
5. The geometry factor, C_Δ, is only applied when wood capacity, Q_w, controls (see Chapter 14).

11.3.2 Load Duration Factor, C_D (ASD Only)

Reference design values shall be multiplied by the load duration factors, $C_D \leq 1.6$, specified in 2.3.2 and Appendix B, except when the capacity of the connection is controlled by metal strength or strength of concrete/masonry (see 11.2.3, 11.2.4, and Appendix B.3). The impact load duration factor shall not apply to connections.

11.3.3 Wet Service Factor, C_M

Reference design values are for connections in wood seasoned to a moisture content of 19% or less and used under continuously dry conditions, as in most covered structures. For connections in wood that is unseasoned or partially seasoned, or when connections are exposed to wet service conditions in use, reference design values shall be multiplied by the wet service factors, C_M, specified in Table 11.3.3.

11.3.4 Temperature Factor, C_t

Reference design values shall be multiplied by the temperature factors, C_t, in Table 11.3.4 for connections that will experience sustained exposure to elevated temperatures up to 150°F (see Appendix C).

Table 12.2A Lag Screw Reference Withdrawal Design Values, W[1]

Tabulated withdrawal design values (W) are in pounds per inch of thread penetration into side grain of wood member. Length of thread penetration in main member shall not include the length of the tapered tip (see 12.2.1.1).

Specific Gravity, G[2]	Lag Screw Diameter, D										
	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"
0.73	397	469	538	604	668	789	905	1016	1123	1226	1327
0.71	381	450	516	579	640	757	868	974	1077	1176	1273
0.68	357	422	484	543	600	709	813	913	1009	1103	1193
0.67	349	413	473	531	587	694	796	893	987	1078	1167
0.58	281	332	381	428	473	559	641	719	795	869	940
0.55	260	307	352	395	437	516	592	664	734	802	868
0.51	232	274	314	353	390	461	528	593	656	716	775
0.50	225	266	305	342	378	447	513	576	636	695	752
0.49	218	258	296	332	367	434	498	559	617	674	730
0.47	205	242	278	312	345	408	467	525	580	634	686
0.46	199	235	269	302	334	395	453	508	562	613	664
0.44	186	220	252	283	312	369	423	475	525	574	621
0.43	179	212	243	273	302	357	409	459	508	554	600
0.42	173	205	235	264	291	344	395	443	490	535	579
0.41	167	198	226	254	281	332	381	428	473	516	559
0.40	161	190	218	245	271	320	367	412	455	497	538
0.39	155	183	210	236	261	308	353	397	438	479	518
0.38	149	176	202	227	251	296	340	381	422	461	498
0.37	143	169	194	218	241	285	326	367	405	443	479
0.36	137	163	186	209	231	273	313	352	389	425	460
0.35	132	156	179	200	222	262	300	337	373	407	441
0.31	110	130	149	167	185	218	250	281	311	339	367

1. Tabulated withdrawal design values, W, for lag screw connections shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Specific gravity, G, shall be determined in accordance with Table 12.3.3A.

12.2.3.2 For calculation of the fastener reference withdrawal design value in pounds, the unit reference withdrawal design value in lbs/in. of fastener penetration from 12.2.3.1 shall be multiplied by the length of fastener penetration, p_t, into the wood member.

12.2.3.3 The reference withdrawal design value, in lbs/in. of penetration, for a single post-frame ring shank nail driven in the side grain of the main member, with the nail axis perpendicular to the wood fibers, shall be determined from Table 12.2D or Equation 12.2-4, within the range of specific gravities and nail diameters given in Table 12.2D. Reference withdrawal design values, W, shall be multiplied by all applicable adjustment factors (see Table 11.3.1) to obtain adjusted withdrawal design values, W'.

$$W = 1800\ G^2\ D \qquad (12.2\text{-}4)$$

12.2.3.4 For calculation of the fastener reference withdrawal design value in pounds, the unit reference withdrawal design value in lbs/in. of ring shank penetration from 12.2.3.3 shall be multiplied by the length of ring shank penetration, p_t, into the wood member.

12.2.3.5 Nails and spikes shall not be loaded in withdrawal from end grain of wood (C_{eg}=0.0).

12.2.3.6 Nails, and spikes shall not be loaded in withdrawal from end-grain of laminations in cross-laminated timber (C_{eg}=0.0).

12.2.4 Drift Bolts and Drift Pins

Reference withdrawal design values, W, for connections using drift bolt and drift pin connections shall be determined in accordance with 11.1.1.3.

Table 12.3.3A Assigned Specific Gravities

Species Combination	Specific[1] Gravity, G
Alaska Cedar	0.47
Alaska Hemlock	0.46
Alaska Spruce	0.41
Alaska Yellow Cedar	0.46
Aspen	0.39
Balsam Fir	0.36
Beech-Birch-Hickory	0.71
Coast Sitka Spruce	0.39
Cottonwood	0.41
Douglas Fir-Larch	0.50
Douglas Fir-Larch (North)	0.49
Douglas Fir-South	0.46
Eastern Hemlock	0.41
Eastern Hemlock-Balsam Fir	0.36
Eastern Hemlock-Tamarack	0.41
Eastern Hemlock-Tamarack (North)	0.47
Eastern Softwoods	0.36
Eastern Spruce	0.41
Eastern White Pine	0.36
Engelmann Spruce-Lodgepole Pine	0.38
Hem-Fir	0.43
Hem-Fir (North)	0.46
Mixed Maple	0.55
Mixed Oak	0.68
Mixed Southern Pine	0.51
Mountain Hemlock	0.47
Northern Pine	0.42
Northern Red Oak	0.68
Northern Species	0.35
Northern White Cedar	0.31
Ponderosa Pine	0.43
Red Maple	0.58
Red Oak	0.67
Red Pine	0.44
Redwood, close grain	0.44
Redwood, open grain	0.37
Sitka Spruce	0.43
Southern Pine	0.55
Spruce-Pine-Fir	0.42
Spruce-Pine-Fir (South)	0.36
Western Cedars	0.36
Western Cedars (North)	0.35
Western Hemlock	0.47
Western Hemlock (North)	0.46
Western White Pine	0.40
Western Woods	0.36
White Oak	0.73
Yellow Poplar	0.43

Species Combinations of MSR and MEL Lumber	Specific[1] Gravity, G
Douglas Fir-Larch	
E=1,900,000 psi and lower grades of MSR	0.50
E=2,000,000 psi grades of MSR	0.51
E=2,100,000 psi grades of MSR	0.52
E=2,200,000 psi grades of MSR	0.53
E=2,300,000 psi grades of MSR	0.54
E=2,400,000 psi grades of MSR	0.55
Douglas Fir-Larch (North)	
E=1,900,000 psi and lower grades of MSR and MEL	0.49
E=2,000,000 psi to 2,200,000 psi grades of MSR and MEL	0.53
E=2,300,000 psi and higher grades of MSR and MEL	0.57
Douglas Fir-Larch (South)	
E=1,000,000 psi and higher grades of MSR	0.46
Engelmann Spruce-Lodgepole Pine	
E=1,400,000 psi and lower grades of MSR	0.38
E=1,500,000 psi and higher grades of MSR	0.46
Hem-Fir	
E=1,500,000 psi and lower grades of MSR	0.43
E=1,600,000 psi grades of MSR	0.44
E=1,700,000 psi grades of MSR	0.45
E=1,800,000 psi grades of MSR	0.46
E=1,900,000 psi grades of MSR	0.47
E=2,000,000 psi grades of MSR	0.48
E=2,100,000 psi grades of MSR	0.49
E=2,200,000 psi grades of MSR	0.50
E=2,300,000 psi grades of MSR	0.51
E=2,400,000 psi grades of MSR	0.52
Hem-Fir (North)	
E=1,000,000 psi and higher grades of MSR and MEL	0.46
Southern Pine	
E=1,700,000 psi and lower grades of MSR and MEL	0.55
E=1,800,000 psi and higher grades of MSR and MEL	0.57
Spruce-Pine-Fir	
E=1,700,000 psi and lower grades of MSR and MEL	0.42
E=1,800,000 psi and 1,900,000 grades of MSR and MEL	0.46
E=2,000,000 psi and higher grades of MSR and MEL	0.50
Spruce-Pine-Fir (South)	
E=1,100,000 psi and lower grades of MSR	0.36
E=1,200,000 psi to1,900,000 psi grades of MSR	0.42
E=2,000,000 psi and higher grades of MSR	0.50
Western Cedars	
E=1,000,000 psi and higher grades of MSR	0.36
Western Woods	
E=1,000,000 psi and higher grades of MSR	0.36

1. Specific gravity, G, based on weight and volume when oven-dry. Different specific gravities, G, are possible for different grades of MSR and MEL lumber (see Table 4C, Footnote 2).

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BY _____ DATE ___/___/___

LAG SCREWS

Table 12K **LAG SCREWS: Reference Lateral Design Values, Z, for Single Shear (two member) Connections[1,2,3,4]**

for sawn lumber or SCL with ASTM A653, Grade 33 steel side plate (for t_s<1/4") or ASTM A 36 steel side plate (for t_s=1/4")
(tabulated lateral design values are calculated based on an assumed length of lag screw penetration, p, into the main member equal to 8D)

Side Member Thickness	Lag Screw Diameter	G=0.67 Red Oak		G=0.55 Mixed Maple Southern Pine		G=0.5 Douglas Fir-Larch		G=0.49 Douglas Fir-Larch (N)		G=0.46 Douglas Fir(S) Hem-Fir(N)		G=0.43 Hem-Fir		G=0.42 Spruce-Pine-Fir		G=0.37 Redwood (open grain)		G=0.36 Eastern Softwoods Spruce-Pine-Fir(S) Western Cedars Western Woods		G=0.35 Northern Species	
t_s	D	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$
in.	in.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0.075	1/4	170	130	160	120	150	110	150	110	150	100	140	100	140	100	130	90	130	90	130	90
(14 gage)	5/16	220	160	200	140	190	130	190	130	190	130	180	120	180	120	170	110	170	110	160	100
	3/8	220	160	200	140	200	130	190	130	190	120	180	120	180	120	170	110	170	100	170	100
0.105	1/4	180	140	170	130	160	120	160	120	160	110	150	110	150	110	140	100	140	100	140	90
(12 gage)	5/16	230	170	210	150	200	140	200	140	190	130	190	130	190	120	180	110	170	110	170	110
	3/8	230	160	210	140	200	140	200	130	200	130	190	120	190	120	180	110	180	110	170	110
0.120	1/4	190	150	180	130	170	120	170	120	160	120	160	110	160	110	150	100	150	100	140	100
(11 gage)	5/16	230	170	210	150	210	140	200	140	200	140	190	130	190	130	180	120	180	120	180	110
	3/8	240	170	220	150	210	140	210	140	200	130	200	130	190	120	180	110	180	110	180	110
0.134	1/4	200	150	180	140	180	130	170	130	170	120	160	120	160	110	150	110	150	100	150	100
(10 gage)	5/16	240	180	220	160	210	150	210	140	200	140	200	130	200	130	190	120	180	120	180	120
	3/8	240	170	220	150	220	140	210	140	210	140	200	130	200	130	190	120	190	120	180	110
0.179	1/4	220	170	210	150	200	150	200	140	190	140	190	130	190	130	180	120	170	120	170	120
(7 gage)	5/16	260	190	240	170	230	160	230	160	230	150	220	150	220	150	210	130	200	130	200	130
	3/8	270	190	250	170	240	160	240	160	230	150	220	140	220	140	210	130	210	130	200	130
0.239	1/4	240	180	220	160	210	150	210	150	200	140	190	140	190	130	180	120	180	120	180	120
(3 gage)	5/16	300	220	280	190	270	180	260	180	260	170	250	160	250	160	230	150	230	150	230	140
	3/8	310	220	280	190	270	180	270	180	260	170	250	160	250	160	240	140	230	140	230	140
	7/16	420	290	390	260	380	240	370	240	360	230	350	220	350	220	330	200	330	200	320	190
	1/2	510	340	470	300	460	290	450	280	440	270	430	260	420	260	400	240	400	230	390	230
	5/8	770	490	710	430	680	400	680	400	660	380	640	370	630	360	600	330	590	330	580	320
	3/4	1110	670	1020	590	980	560	970	550	950	530	920	500	910	500	860	450	850	450	840	440
	7/8	1510	880	1390	780	1330	730	1320	710	1280	690	1250	650	1230	650	1170	590	1160	590	1140	570
	1	1940	1100	1780	960	1710	910	1700	890	1650	860	1600	820	1590	810	1500	740	1480	730	1460	710
1/4	1/4	240	180	220	160	210	150	210	150	200	140	200	140	190	130	180	120	180	120	180	120
	5/16	310	220	280	200	270	180	270	180	260	170	250	170	250	160	230	150	230	150	230	140
	3/8	320	220	290	190	280	180	270	180	270	170	260	160	250	160	240	150	240	140	230	140
	7/16	480	320	440	280	420	270	420	260	410	250	390	240	390	230	370	220	360	210	360	210
	1/2	580	390	540	340	520	320	510	320	500	310	480	290	480	290	460	270	450	260	440	260
	5/8	850	530	780	470	750	440	740	440	720	420	700	400	690	400	660	370	650	360	640	350
	3/4	1200	730	1100	640	1060	600	1050	590	1020	570	990	540	980	530	930	490	920	480	900	470
	7/8	1600	930	1470	820	1410	770	1400	750	1360	720	1320	690	1310	680	1240	630	1220	620	1200	600
	1	2040	1150	1870	1000	1800	950	1780	930	1730	900	1680	850	1660	840	1570	770	1550	760	1530	740

1. Tabulated lateral design values, Z, shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Tabulated lateral design values, Z, are for "reduced body diameter" lag screws (see Appendix Table L2) inserted in side grain with screw axis perpendicular to wood fibers; screw penetration, p, into the main member equal to 8D; dowel bearing strengths, F_e, of 61,850 psi for ASTM A653, Grade 33 steel and 87,000 psi for ASTM A36 steel and screw bending yield strengths, F_{yb}, of 70,000 psi for D = 1/4", 60,000 psi for D = 5/16", and 45,000 psi for D ≥3/8".
3. Where the lag screw penetration, p, is less than 8D but not less than 4D, tabulated lateral design values, Z, shall be multiplied by p/8D or lateral design values shall be calculated using the provisions of 12.3 for the reduced penetration.
4. The length of lag screw penetration, p, not including the length of the tapered tip, E (see Appendix Table L2), of the lag screw into the main member shall not be less than 4D. See 12.1.4.6 for minimum length of penetration, p_{min}.

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To determine the minimum required hand-rail connections, with a pre-manufactured hand-rail system provided by others. Our scope is limited to assess the minimum connection requirements of the hand-rail system as listed below. Our assumptions are that the base-plates, welds and metal member properties of the pre-manufactured complete system are sufficient in strength to support the code prescribed design loads, for which our design have been provided to comply with.

We have analyzed and verified the minimum connection requirements, for the following conditions:

- Wall connection (sloping wall @ stair)
  Result: minimum (2) ¼" DIA x 3" SDS screws to a minimum of (1) support studs at each connection

- Base-plate connection (vertical post application, typical)
  Result: The base-plate column connection to have a minimum of (4) 3/8" x 4 ½ lag-screws into full width support member/beams below

- *Wall connection (horizontal typical application)*
  Result: (2) ¼" DIA x 3" SDS screws to a minimum of (2) support studs at each connection

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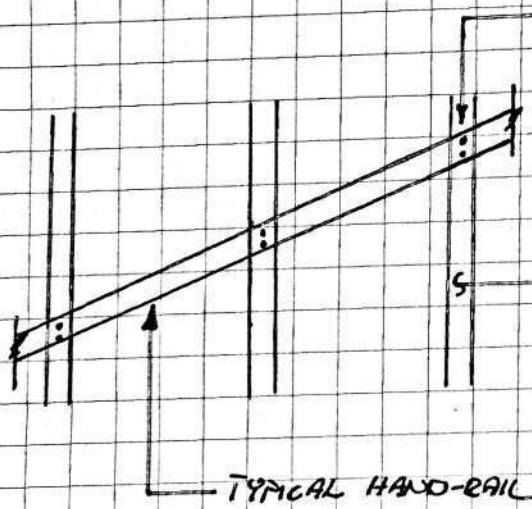
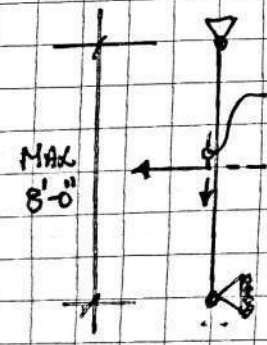
BY MRT, P.E DATE 12/4/2017

CALCULATIONS

CASE 1: SLOPING HAND-RAIL @ WALL / STAIR





→ SEE ATTACHED CALCULATION OF STUD MEMBER ANALYSIS

V = Shear capacity ($C_f = C_t = 1.0$, $C_M = 4.0$, $C_g = 0.9$)

$V = C_D \times \underbrace{100\ \text{Lbs}}_{1/4"\phi\ \text{W/ 2X}} = 1.6 \times 100\ \text{Lbs} \times 1.0 \times 0.9 \approx 160\ \text{Lbs}$

$V_{(2)\,1/4"\phi\ \text{LAGS MIN INTO 2X HF \#2 OR BETTER}} = 2 \times 160 = 320\ \text{Lbs}$

200 Lbs demand < 320 Lbs CAPACITY ✓

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BY MRT, P.E DATE 12/4/2017

CONT. CASE 1: SLOPING HAND RAIL @ WALL/STAIR

W = WITHDRAWAL CAPACITY ($C_t = C_t = C_{eg} = 1.0$) = 179 Lbs/inch

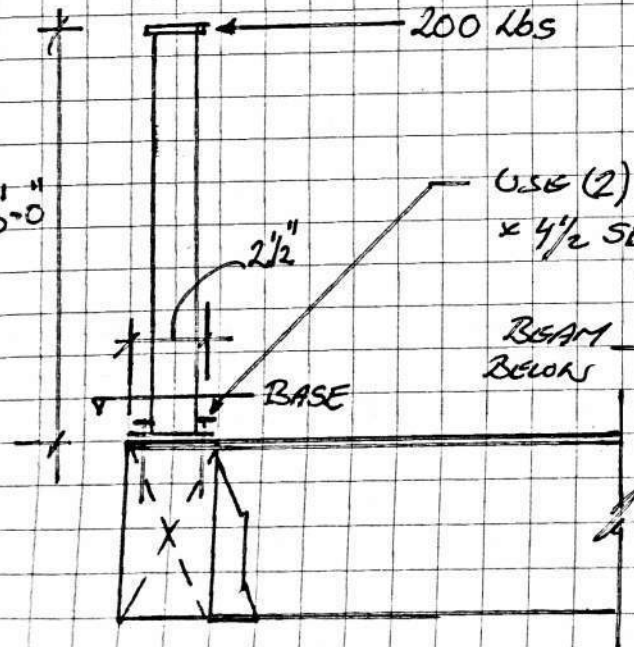
W_{CD} = 1.6 x 440 Lbs per screw/lag

= 179 Lbs/inch x 2½" ≅ 446 Lbs per ¼"ϕ lag x 3"

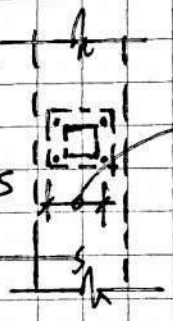
$W_{(2)\ 1/4"\ LAGS \times 3"\ MIN}$ = 2 x 440 Lbs x 1.6 = 1,408 Lbs

200 Lbs WITHDRAWAL DEMAND < 1,408 Lbs CAPACITY ☑

CASE 2: BASE PLATE CONNECTION



M_{ROT} = 200 Lbs x 36" / 2½" = 2,880 Lbs



WITHDRAWAL CAPACITY W/ ¼" x 4½ LAG-SCREWS = 179 Lbs/inch

W = 179 Lbs x 4" x 1.6 (2 x ¼"ϕ x 4½" LAGS) = 1,145 Lbs per ¼"ϕ LAG x 4½"

"NOT WORKING" $W_{(2)\ 1/4" \times 4\frac{1}{2}}$ 6 x 2 = 1,145 Lbs

$W_{(2)\ 3/8" \times 4\frac{1}{2}} \times 2$ = 243 x 4". x 2 x 1.6 = 3,110

2,880 Lbs demand < 3,110 CAPACITY

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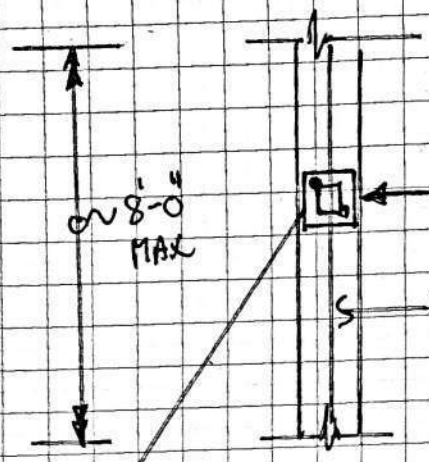
BY MRT, P.E DATE 12/4/2014

CASE 3: HORIZONTAL END-PLATE CONNECTIONS



→ SEE ATTACHED CALCULATIONS OF STUD CALCULATIONS.

V = SHEAR CAPACITY ($C_t = C_i = C_M = 1.0$, $C_g = 0.9$)

$V = C_D \times \underbrace{100\,\text{LBS}}_{1/4"\phi\ \text{W/2x}} = 1.6 \times 0.9 \times 100\,\text{LBS} = 144\,\text{LBS}$

$V_{(2)\,1/4"\phi \times 3"\ \text{LAG-SCREWS}} = 2 \times 144\,\text{LBS} = 288\,\text{LBS}$

200 LBS demand ≤ 288 LBS CAPACITY ✓

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

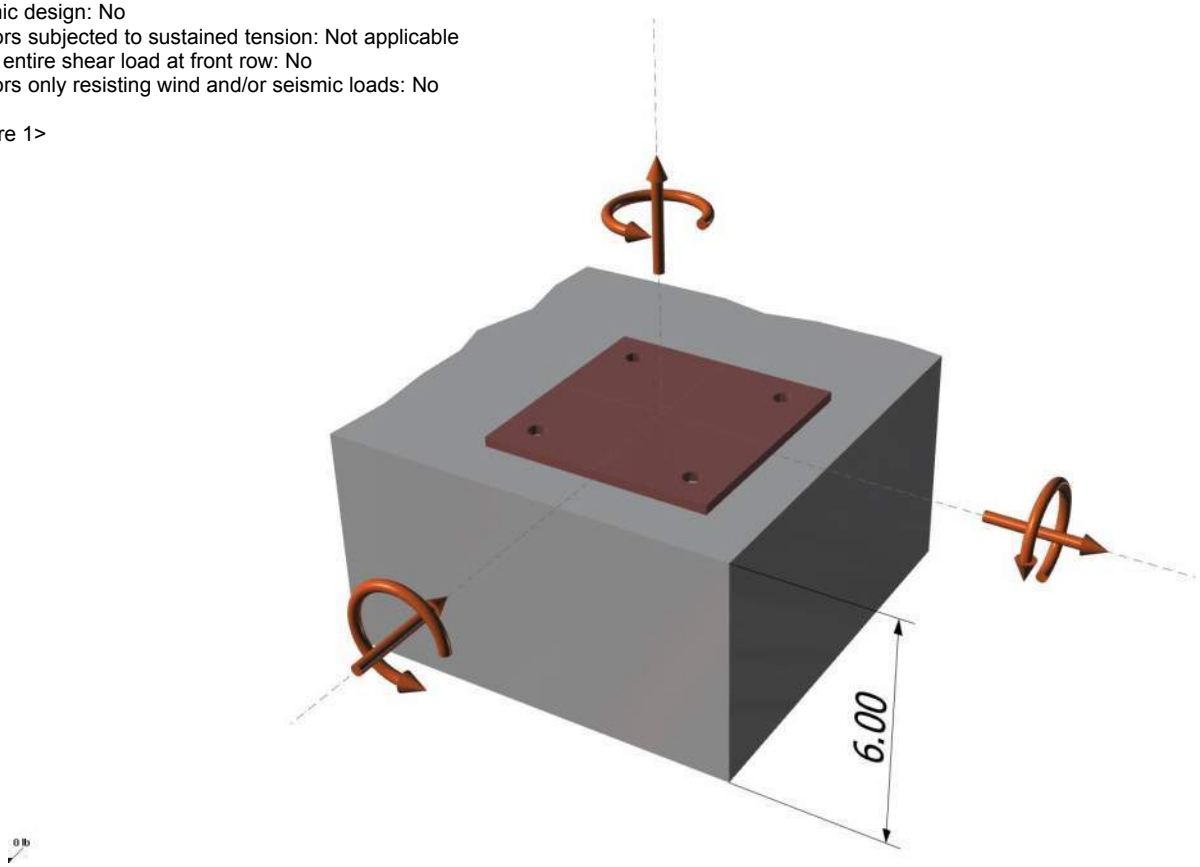
Anchor Information:
Anchor type: Concrete screw
Material: Carbon Steel
Diameter (inch): 0.375
Nominal Embedment depth (inch): 3.250
Effective Embedment depth, h_{ef} (inch): 2.400
Code report: ICC-ES ESR-2713
Anchor category: 1
Anchor ductility: No
h_{min} (inch): 5.00
c_{ac} (inch): 3.63
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: U = 1.2(D + F) + 1.6(L) + 0.5(Lr or S or R)
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

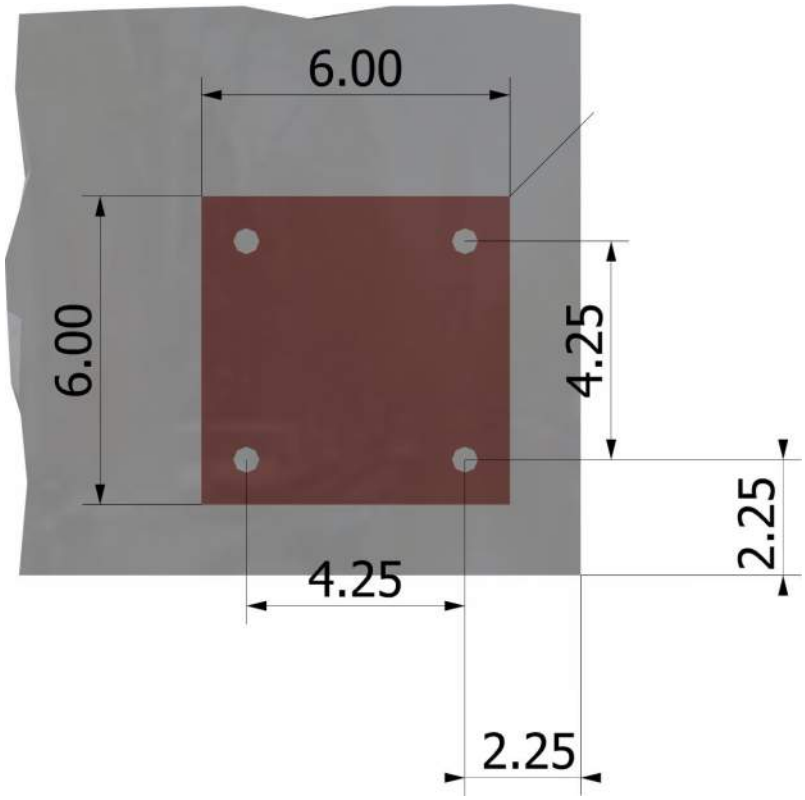
Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 6.00
State: Cracked
Compressive strength, f'_c (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 6.00 x 6.00 x 0.25

<Figure 1>



<Figure 2>



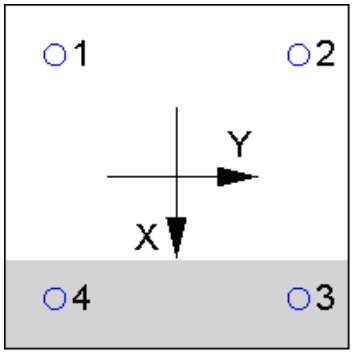
Recommended Anchor
Anchor Name: Titen HD® - 3/8"Ø Titen HD, hnom:3.25" (83mm)
Code Report: ICC-ES ESR-2713

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	1250.4	-80.0	0.0	80.0
2	1250.4	-80.0	0.0	80.0
3	0.0	-80.0	0.0	80.0
4	0.0	-80.0	0.0	80.0
Sum	2500.7	-320.0	0.0	320.0

Maximum concrete compression strain (‰): 0.12
Maximum concrete compression stress (psi): 538
Resultant tension force (lb): 2501
Resultant compression force (lb): 2501
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
10890	0.65	7079

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	2500	2.400	3160

$\phi N_{cbg} = \phi \, (A_{Nc} / A_{Nco}) \, \Psi_{ec,N} \, \Psi_{ed,N} \, \Psi_{c,N} \, \Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
72.72	51.84	2.25	1.000	0.888	1.00	1.000	3160	0.65	2557

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$\phi N_{pn} = \phi \Psi_{c,P} \lambda_a N_p (f'_c / 2{,}500)^n$ (Sec. 17.3.1, Eq. 17.4.3.1 & Code Report)

$\Psi_{c,P}$	λ_a	N_p (lb)	f'_c (psi)	n	ϕ	ϕN_{pn} (lb)
1.0	1.00	2700	2500	0.50	0.65	1755

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
4460	1.0	0.60	2676

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
2.40	0.375	1.00	2500	2.25	1049

$\phi V_{cbgx} = \phi\ (2)(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
33.33	22.78	1.000	1.000	1.000	1.000	1049	0.70	2148

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi k_{cp}N_{cbg} = \phi k_{cp}(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cpg} (lb)
1.0	102.01	51.84	1.000	0.888	1.000	1.000	3160	0.70	3863

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, øN_n (lb)	Ratio	Status
Steel	1250	7079	0.18	Pass
Concrete breakout	**2501**	**2557**	**0.98**	**Pass (Governs)**
Pullout	1250	1755	0.71	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, øV_n (lb)	Ratio	Status
Steel	80	2676	0.03	Pass
|| Concrete breakout y+	160	2148	0.07	Pass
Pryout	**320**	**3863**	**0.08**	**Pass (Governs)**

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.98	0.00	97.8 %	1.0	Pass

3/8"Ø Titen HD, hnom:3.25" (83mm) meets the selected design criteria.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

Project:

Location: Single 2x4 stud (staircase)
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
1.5 IN x 3.5 IN x 8.0 FT
#2 - Hem-Fir - Dry Use
Section Adequate By: 0.8%
Controlling Factor: Deflection

StruCalc 9.0

StruCalc Version 10.0.1.6 12/4/2017 4:33:33 PM

DEFLECTIONS	Center	
Live Load	0.53	IN L/181
Dead Load	0.01	in
Total Load	0.54	IN L/177

Live Load Deflection Criteria: L/180 Total Load Deflection Criteria: L/120

REACTIONS	A		B	
Live Load	100	lb	100	lb
Dead Load	4	lb	4	lb
Total Load	104	lb	104	lb
Bearing Length	0.17	in	0.17	in

BEAM DATA	Center	
Span Length	8	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	8	ft
Live Load Duration Factor	1.60	
Notch Depth	0.00	

MATERIAL PROPERTIES

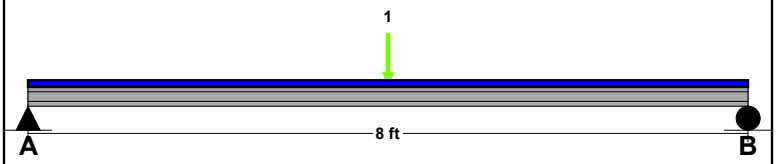
#2 - Hem-Fir

	Base Values			Adjusted		
Bending Stress:	Fb =	850	psi	Fb' =	2040	psi
	Cd=1.60 CF=1.50					
Shear Stress:	Fv =	150	psi	Fv' =	240	psi
	Cd=1.60					
Modulus of Elasticity:	E =	1300	ksi	E' =	1300	ksi
Comp. ⊥ to Grain:	Fc - ⊥ =	405	psi	Fc - ⊥' =	405	psi

Controlling Moment: 408 ft-lb
4.0 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -104 lb
At right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	2.4	in3	3.06	in3
Area (Shear):	0.65	in2	5.25	in2
Moment of Inertia (deflection):	5.32	in4	5.36	in4
Moment:	408	ft-lb	521	ft-lb
Shear:	-104	lb	840	lb

LOADING DIAGRAM



UNIFORM LOADS	Center	
Uniform Live Load	0	plf
Uniform Dead Load	0	plf
Beam Self Weight	1	plf
Total Uniform Load	1	plf

POINT LOADS - CENTER SPAN	
Load Number	One
Live Load	200 lb
Dead Load	0 lb
Location	4 ft

Project:

Location: Single 2x6 stud (staircase)
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
1.5 IN x 5.5 IN x 9.0 FT
#2 - Hem-Fir - Dry Use
Section Adequate By: 139.3%
Controlling Factor: Moment

StruCalc 9.0

StruCalc Version 10.0.1.6 12/4/2017 4:34:53 PM

DEFLECTIONS	Center	
Live Load	0.19	IN L/556
Dead Load	0.01	in
Total Load	0.20	IN L/533

Live Load Deflection Criteria: L/180 Total Load Deflection Criteria: L/120

REACTIONS	A		B	
Live Load	100	lb	100	lb
Dead Load	7	lb	7	lb
Total Load	107	lb	107	lb
Bearing Length	0.18	in	0.18	in

BEAM DATA	Center	
Span Length	9	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	9	ft
Live Load Duration Factor	1.60	
Notch Depth	0.00	

MATERIAL PROPERTIES

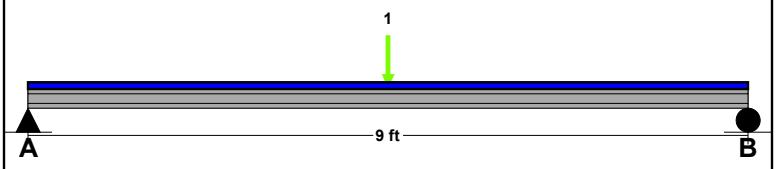
#2 - Hem-Fir

	Base Values			Adjusted		
Bending Stress:	Fb =	850	psi	Fb' =	1768	psi
	Cd=1.60 CF=1.30					
Shear Stress:	Fv =	150	psi	Fv' =	240	psi
	Cd=1.60					
Modulus of Elasticity:	E =	1300	ksi	E' =	1300	ksi
Comp. ⊥ to Grain:	Fc - ⊥ =	405	psi	Fc - ⊥' =	405	psi

Controlling Moment: 466 ft-lb
4.5 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: -107 lb
At right support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd	Provided
Section Modulus:	3.16 in3	7.56 in3
Area (Shear):	0.67 in2	8.25 in2
Moment of Inertia (deflection):	6.73 in4	20.8 in4
Moment:	466 ft-lb	1114 ft-lb
Shear:	-107 lb	1320 lb

LOADING DIAGRAM



UNIFORM LOADS	Center	
Uniform Live Load	0	plf
Uniform Dead Load	0	plf
Beam Self Weight	2	plf
Total Uniform Load	2	plf

POINT LOADS - CENTER SPAN		
Load Number	One	
Live Load	200	lb
Dead Load	0	lb
Location	4.5	ft

Project:

Location: Double 2x4 stud (flat orientation connection/top)
Multi-Loaded Multi-Span Beam
[2015 International Building Code(2015 NDS)]
(2) 1.5 IN x 3.5 IN x 8.0 FT
#2 - Hem-Fir - Dry Use
Section Adequate By: 101.6%
Controlling Factor: Deflection

StruCalc 9.0

StruCalc Version 10.0.1.6 12/4/2017 4:38:42 PM

DEFLECTIONS	Center	
Live Load	0.26	IN L/363
Dead Load	0.01	in
Total Load	0.28	IN L/346

Live Load Deflection Criteria: L/180 Total Load Deflection Criteria: L/120

REACTIONS	A		B	
Live Load	100	lb	100	lb
Dead Load	8	lb	8	lb
Total Load	108	lb	108	lb
Bearing Length	0.09	in	0.09	in

BEAM DATA	Center	
Span Length	8	ft
Unbraced Length-Top	0	ft
Unbraced Length-Bottom	8	ft
Live Load Duration Factor	1.60	
Notch Depth	0.00	

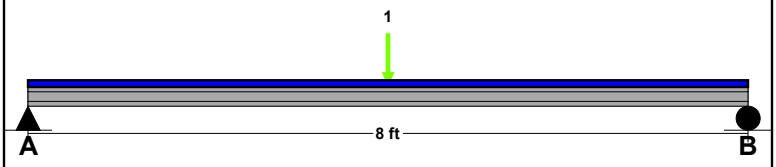
MATERIAL PROPERTIES
#2 - Hem-Fir

	Base Values			Adjusted		
Bending Stress:	Fb =	850	psi	Fb' =	2040	psi
	Cd=1.60 CF=1.50					
Shear Stress:	Fv =	150	psi	Fv' =	240	psi
	Cd=1.60					
Modulus of Elasticity:	E =	1300	ksi	E' =	1300	ksi
Comp. ⊥ to Grain:	Fc - ⊥ =	405	psi	Fc - ⊥' =	405	psi

Controlling Moment: 416 ft-lb
4.0 Ft from left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2
Controlling Shear: 108 lb
At left support of span 2 (Center Span)
Created by combining all dead loads and live loads on span(s) 2

Comparisons with required sections:	Req'd		Provided	
Section Modulus:	2.45	in3	6.13	in3
Area (Shear):	0.67	in2	10.5	in2
Moment of Inertia (deflection):	5.32	in4	10.72	in4
Moment:	416	ft-lb	1041	ft-lb
Shear:	108	lb	1680	lb

LOADING DIAGRAM



UNIFORM LOADS	Center	
Uniform Live Load	0	plf
Uniform Dead Load	0	plf
Beam Self Weight	2	plf
Total Uniform Load	2	plf

POINT LOADS - CENTER SPAN	
Load Number	One
Live Load	200 lb
Dead Load	0 lb
Location	4 ft

LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

Balloon Framed stud calculations

(206) 790 9502
L120Engineering.com

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	2x6 Balloon Frame (12" o.c.) (wind load factor applied as shown)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(1) 1.5 X 5.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 17.25 Member Slope: 0/12 Actual Length (ft): 17.25

Area (in^2)	Ix (in^4)	Iy (in^4)	BSW (lbf/ft)	Lams	G	Kcr Creep Factor
8.25	20.8	1.55	1.63	1	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1105	682	150	1430	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.3	1.3	1	1.1	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	17.25	17.25	1	0	0.18	1.00	1.00	37.64	8

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Shear Stress Y (psi)	PASS (89.5%)	15.7	150.0	17.25	D+L	1
Bending Stress Y (psi)	PASS (46.3%)	590.2	1099.4	8.62	D+L	1
Deflection (in)	PASS (35.9%)	0.737 (=L/281)	1.150 (=L/180)	8.62	L	
Compressive Stress (psi)	PASS (61.6%)	100.4	261.1	0	D+L	1
Bearing Stress (psi)	PASS (98.9%)	16.4	1430.0	0	D+L	1
Bending-Compression (Unit)	PASS (1.6%)	0.98	1.00	8.62	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	328	500	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0
Y axis											
A	0	86	0	0	0	0	0	0	0	0	0
B	0	86	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Uniform (lbf/ft)	10	10	0	17.25	Live	Y
Point (lbf)	-500	-	17.25	-	Live	Z
Point (lbf)	-300	-	17.25	-	Dead	Z
Self Weight (lbf/ft)	1.63	1.63	0	17.25	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	1.75x5.5 LSL Balloon Frame (@12") (wind load factors applied to ASD)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	STRUCTURAL COMPOSITE LUMBER		

Weyerhaeuser	1.55E TimberStrand LSL	(1) 1.75 X 5.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 17.25 Member Slope: 0/12 Actual Length (ft): 17.25

Area (in^2)	Ix (in^4)	Iy (in^4)	BSW (lbf/ft)	Lams	Cfn	Kcr Creep Factor
9.62	24.26	2.46	3.01	1	10.87	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	2325	1290	310	2170	900	1550	787.815
Adjusted Values	2325	1290	310	2170	900	1550	788
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1

Bending Adjustment Factors C_V = 1.07 C_r = 1 Volume factor Is applied on a load combination basis And Is Not reflected in the adjusted values

COLUMN DATA

Span	Length (ft)	Unbraced Length (ft) X	Unbraced Length (ft) Y	Column End Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	17.25	17.25	1	0	0.21	1.00	1.00	37.64	6.86

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Shear Stress Y (psi)	PASS (95.7%)	13.4	310.0	17.25	D+L	1
Bending Stress Y (psi)	PASS (79.7%)	505.9	2486.4	8.62	D+L	1
Deflection (in)	PASS (53.9%)	0.530 (=L/391)	1.150 (=L/180)	8.62	L	
Compressive Stress (psi)	PASS (40.5%)	265.1	445.7	0	D+L	1
Bearing Stress (psi)	PASS (99.4%)	14.1	2170.0	0	D+L	1
Bending-Compression (Unit)	PASS (17.5%)	0.82	1.00	8.45	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	1052	1500	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0
Y axis											
A	0	86	0	0	0	0	0	0	0	0	0
B	0	86	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-1500	-	17.25	-	Live	Z
Point (lbf)	-1000	-	17.25	-	Dead	Z
Uniform (lbf/ft)	10	10	0	17.25	Live	Y
Self Weight (lbf/ft)	3.01	3.01	0	17.25	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	2x6 Balloon Frame (8" o.c.) (Wind load factors applied and shown as LL)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(1) 1.5 X 5.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 17.25 Member Slope: 0/12 Actual Length (ft): 17.25

Area (in^2)	Ix (in^4)	Iy (in^4)	BSW (lbf/ft)	Lams	G	Kcr Creep Factor
8.25	20.8	1.55	1.63	1	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1105	682	150	1430	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.3	1.3	1	1.1	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	17.25	17.25	1	0	0.18	1.00	1.00	37.64	8

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Shear Stress Y (psi)	PASS (92.7%)	11.0	150.0	17.25	D+L	1
Bending Stress Y (psi)	PASS (62.4%)	413.1	1099.4	8.62	D+L	1
Deflection (in)	PASS (55.1%)	0.516 (=L/401)	1.150 (=L/180)	8.62	L	
Compressive Stress (psi)	PASS (49.9%)	130.7	261.1	0	D+L	1
Bearing Stress (psi)	PASS (99.2%)	11.5	1430.0	0	D+L	1
Bending-Compression (Unit)	PASS (4.3%)	0.96	1.00	8.45	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	528	550	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0
Y axis											
A	0	60	0	0	0	0	0	0	0	0	0
B	0	60	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-550	-	17.25	-	Live	Z
Point (lbf)	-500	-	17.25	-	Dead	Z
Uniform (lbf/ft)	7	7	0	17.25	Live	Y
Self Weight (lbf/ft)	1.63	1.63	0	17.25	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	175x5.5 LSL Balloon Frame (@ 8") (Wind load factor applied and Building Code	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	STRUCTURAL COMPOSITE LUMBER		

Weyerhaeuser	1.55E TimberStrand LSL	(1) 1.75 X 5.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 17.25 Member Slope: 0/12 Actual Length (ft): 17.25

Area (in^2)	Ix (in^4)	Iy (in^4)	BSW (lbf/ft)	Lams	Cfn	Kcr Creep Factor
9.62	24.26	2.46	3.01	1	10.87	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	2325	1290	310	2170	900	1550	787.815
Adjusted Values	2325	1290	310	2170	900	1550	788
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1

Bending Adjustment Factors C_V = 1.07 C_r = 1 Volume factor Is applied on a load combination basis And Is Not reflected in the adjusted values

COLUMN DATA

Span	Length (ft)	Unbraced Length (ft) X	Unbraced Length (ft) Y	Column End Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	17.25	17.25	1	0	0.21	1.00	1.00	37.64	6.86

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Shear Stress Y (psi)	PASS (97.0%)	9.4	310.0	17.25	D+L	1
Bending Stress Y (psi)	PASS (85.8%)	354.1	2486.4	8.62	D+L	1
Deflection (in)	PASS (67.7%)	0.371 (=L/558)	1.150 (=L/180)	8.62	L	
Compressive Stress (psi)	PASS (28.9%)	317.1	445.7	0	D+L	1
Bearing Stress (psi)	PASS (99.5%)	9.9	2170.0	0	D+L	1
Bending-Compression (Unit)	PASS (4.6%)	0.95	1.00	8.45	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	1052	2000	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0
Y axis											
A	0	60	0	0	0	0	0	0	0	0	0
B	0	60	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-1000	-	17.25	-	Dead	Z
Point (lbf)	-2000	-	17.25	-	Live	Z
Uniform (lbf/ft)	7	7	0	17.25	Live	Y
Self Weight (lbf/ft)	3.01	3.01	0	17.25	Dead	Z

NOTES

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Table 12.3.3A Assigned Specific Gravities

Species Combination	Specific[1] Gravity, G
Alaska Cedar	0.47
Alaska Hemlock	0.46
Alaska Spruce	0.41
Alaska Yellow Cedar	0.46
Aspen	0.39
Balsam Fir	0.36
Beech-Birch-Hickory	0.71
Coast Sitka Spruce	0.39
Cottonwood	0.41
Douglas Fir-Larch	0.50
Douglas Fir-Larch (North)	0.49
Douglas Fir-South	0.46
Eastern Hemlock	0.41
Eastern Hemlock-Balsam Fir	0.36
Eastern Hemlock-Tamarack	0.41
Eastern Hemlock-Tamarack (North)	0.47
Eastern Softwoods	0.36
Eastern Spruce	0.41
Eastern White Pine	0.36
Engelmann Spruce-Lodgepole Pine	0.38
Hem-Fir	0.43
Hem-Fir (North)	0.46
Mixed Maple	0.55
Mixed Oak	0.68
Mixed Southern Pine	0.51
Mountain Hemlock	0.47
Northern Pine	0.42
Northern Red Oak	0.68
Northern Species	0.35
Northern White Cedar	0.31
Ponderosa Pine	0.43
Red Maple	0.58
Red Oak	0.67
Red Pine	0.44
Redwood, close grain	0.44
Redwood, open grain	0.37
Sitka Spruce	0.43
Southern Pine	0.55
Spruce-Pine-Fir	0.42
Spruce-Pine-Fir (South)	0.36
Western Cedars	0.36
Western Cedars (North)	0.35
Western Hemlock	0.47
Western Hemlock (North)	0.46
Western White Pine	0.40
Western Woods	0.36
White Oak	0.73
Yellow Poplar	0.43

BEAMS (DF #2, and Engineered Lumber)

Joists and 2x members (HF #2)

Species Combinations of MSR and MEL Lumber	Specific[1] Gravity, G
Douglas Fir-Larch	
E=1,900,000 psi and lower grades of MSR	0.50
E=2,000,000 psi grades of MSR	0.51
E=2,100,000 psi grades of MSR	0.52
E=2,200,000 psi grades of MSR	0.53
E=2,300,000 psi grades of MSR	0.54
E=2,400,000 psi grades of MSR	0.55
Douglas Fir-Larch (North)	
E=1,900,000 psi and lower grades of MSR and MEL	0.49
E=2,000,000 psi to 2,200,000 psi grades of MSR and MEL	0.53
E=2,300,000 psi and higher grades of MSR and MEL	0.57
Douglas Fir-Larch (South)	
E=1,000,000 psi and higher grades of MSR	0.46
Engelmann Spruce-Lodgepole Pine	
E=1,400,000 psi and lower grades of MSR	0.38
E=1,500,000 psi and higher grades of MSR	0.46
Hem-Fir	
E=1,500,000 psi and lower grades of MSR	0.43
E=1,600,000 psi grades of MSR	0.44
E=1,700,000 psi grades of MSR	0.45
E=1,800,000 psi grades of MSR	0.46
E=1,900,000 psi grades of MSR	0.47
E=2,000,000 psi grades of MSR	0.48
E=2,100,000 psi grades of MSR	0.49
E=2,200,000 psi grades of MSR	0.50
E=2,300,000 psi grades of MSR	0.51
E=2,400,000 psi grades of MSR	0.52
Hem-Fir (North)	
E=1,000,000 psi and higher grades of MSR and MEL	0.46
Southern Pine	
E=1,700,000 psi and lower grades of MSR and MEL	0.55
E=1,800,000 psi and higher grades of MSR and MEL	0.57
Spruce-Pine-Fir	
E=1,700,000 psi and lower grades of MSR and MEL	0.42
E=1,800,000 psi and 1,900,000 grades of MSR and MEL	0.46
E=2,000,000 psi and higher grades of MSR and MEL	0.50
Spruce-Pine-Fir (South)	
E=1,100,000 psi and lower grades of MSR	0.36
E=1,200,000 psi to1,900,000 psi grades of MSR	0.42
E=2,000,000 psi and higher grades of MSR	0.50
Western Cedars	
E=1,000,000 psi and higher grades of MSR	0.36
Western Woods	
E=1,000,000 psi and higher grades of MSR	0.36

1. Specific gravity, G, based on weight and volume when oven-dry. Different specific gravities, G, are possible for different grades of MSR and MEL lumber (see Table 4C, Footnote 2).

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LAG SCREWS

Table 12K **LAG SCREWS: Reference Lateral Design Values, Z, for Single Shear (two member) Connections[1,2,3,4]**

for sawn lumber or SCL with ASTM A653, Grade 33 steel side plate (for t_s<1/4") or ASTM A 36 steel side plate (for t_s=1/4")
(tabulated lateral design values are calculated based on an assumed length of lag screw penetration, p, into the main member equal to 8D)

Side Member Thickness	Lag Screw Diameter	G=0.67 Red Oak		G=0.55 Mixed Maple Southern Pine		G=0.5 Douglas Fir-Larch		G=0.49 Douglas Fir-Larch (N)		G=0.46 Douglas Fir(S) Hem-Fir(N)		G=0.43 Hem-Fir		G=0.42 Spruce-Pine-Fir		G=0.37 Redwood (open grain)		G=0.36 Eastern Softwoods Spruce-Pine-Fir(S) Western Cedars Western Woods		G=0.35 Northern Species	
t_s	D	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$
in.	in.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0.075	1/4	170	130	160	120	150	110	150	110	150	100	140	100	140	100	130	90	130	90	130	90
(14 gage)	5/16	220	160	200	140	190	130	190	130	190	130	180	120	180	120	170	110	170	110	160	100
	3/8	220	160	200	140	200	130	190	130	190	120	180	120	180	120	170	110	170	100	170	100
0.105	1/4	180	140	170	130	160	120	160	120	160	110	150	110	150	110	140	100	140	100	140	90
(12 gage)	5/16	230	170	210	150	200	140	200	140	190	130	190	130	190	120	180	110	170	110	170	110
	3/8	230	160	210	140	200	140	200	130	200	130	190	120	190	120	180	110	180	110	170	110
0.120	1/4	190	150	180	130	170	120	170	120	160	120	160	110	160	110	150	100	150	100	140	100
(11 gage)	5/16	230	170	210	150	210	140	200	140	200	140	190	130	190	130	180	120	180	120	180	110
	3/8	240	170	220	150	210	140	210	140	200	130	200	130	190	120	180	110	180	110	180	110
0.134	1/4	200	150	180	140	180	130	170	130	170	120	160	120	160	110	150	110	150	100	150	100
(10 gage)	5/16	240	180	220	160	210	150	210	140	200	140	200	130	200	130	190	120	180	120	180	120
	3/8	240	170	220	150	220	140	210	140	210	140	200	130	200	130	190	120	190	120	180	110
0.179	1/4	220	170	210	150	200	150	200	140	190	140	190	130	190	130	180	120	170	120	170	120
(7 gage)	5/16	260	190	240	170	230	160	230	160	230	150	220	150	220	150	210	130	200	130	200	130
	3/8	270	190	250	170	240	160	240	160	230	150	220	140	220	140	210	130	210	130	200	130
0.239	1/4	240	180	220	160	210	150	210	150	200	140	190	140	190	130	180	120	180	120	180	120
(3 gage)	5/16	300	220	280	190	270	180	260	180	260	170	250	160	250	160	230	150	230	150	230	140
	3/8	310	220	280	190	270	180	270	180	260	170	250	160	250	160	240	140	230	140	230	140
	7/16	420	290	390	260	380	240	370	240	360	230	350	220	350	220	330	200	330	200	320	190
	1/2	510	340	470	300	460	290	450	280	440	270	430	260	420	260	400	240	400	230	390	230
	5/8	770	490	710	430	680	400	680	400	660	380	640	370	630	360	600	330	590	330	580	320
	3/4	1110	670	1020	590	980	560	970	550	950	530	920	500	910	500	860	450	850	450	840	440
	7/8	1510	880	1390	780	1330	730	1320	710	1280	690	1250	650	1230	650	1170	590	1160	590	1140	570
	1	1940	1100	1780	960	1710	910	1700	890	1650	860	1600	820	1590	810	1500	740	1480	730	1460	710
1/4	1/4	240	180	220	160	210	150	210	150	200	140	200	140	190	130	180	120	180	120	180	120
	5/16	310	220	280	200	270	180	270	180	260	170	250	170	250	160	230	150	230	150	230	140
	3/8	320	220	290	190	280	180	270	180	270	170	260	160	250	160	240	150	240	140	230	140
	7/16	480	320	440	280	420	270	420	260	410	250	390	240	390	230	370	220	360	210	360	210
	1/2	580	390	540	340	520	320	510	320	500	310	480	290	480	290	460	270	450	260	440	260
	5/8	850	530	780	470	750	440	740	440	720	420	700	400	690	400	660	370	650	360	640	350
	3/4	1200	730	1100	640	1060	600	1050	590	1020	570	990	540	980	530	930	490	920	480	900	470
	7/8	1600	930	1470	820	1410	770	1400	750	1360	720	1320	690	1310	680	1240	630	1220	620	1200	600
	1	2040	1150	1870	1000	1800	950	1780	930	1730	900	1680	850	1660	840	1570	770	1550	760	1530	740

1. Tabulated lateral design values, Z, shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Tabulated lateral design values, Z, are for "reduced body diameter" lag screws (see Appendix Table L2) inserted in side grain with screw axis perpendicular to wood fibers; screw penetration, p, into the main member equal to 8D; dowel bearing strengths, F_e, of 61,850 psi for ASTM A653, Grade 33 steel and 87,000 psi for ASTM A36 steel and screw bending yield strengths, F_{yb}, of 70,000 psi for D = 1/4", 60,000 psi for D = 5/16", and 45,000 psi for D ≥3/8".
3. Where the lag screw penetration, p, is less than 8D but not less than 4D, tabulated lateral design values, Z, shall be multiplied by p/8D or lateral design values shall be calculated using the provisions of 12.3 for the reduced penetration.
4. The length of lag screw penetration, p, not including the length of the tapered tip, E (see Appendix Table L2), of the lag screw into the main member shall not be less than 4D. See 12.1.4.6 for minimum length of penetration, p_{min}.

SDS connection of steel plate to wood, assuming HF, 100 lbs per 1/4" DIA SDS un-factored, without group action reduction, pending application/spacing.

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Table 12L **WOOD SCREWS: Reference Lateral Design Values, Z, for Single Shear (two member) Connections[1,2,3]**

for sawn lumber or SCL with both members of identical specific gravity (tabulated lateral design values are calculated based on an assumed length of wood screw penetration, p, into the main member equal to 10D)

Side Member Thickness t_s in.	Wood Screw Diameter D in.	Wood Screw Number	G=0.67 Red Oak lbs.	G=0.55 Mixed Maple Southern Pine lbs.	G=0.5 Douglas Fir-Larch lbs.	G=0.49 Douglas Fir-Larch(N) lbs.	G=0.46 Douglas Fir(S) Hem-Fir(N) lbs.	G=0.43 Hem-Fir lbs.	G=0.42 Spruce-Pine-Fir lbs.	G=0.37 Redwood (open grain) lbs.	G=0.36 Eastern Softwoods Spruce-Pine-Fir(S) Western Cedars Western Woods lbs.	G=0.35 Northern Species lbs.
1/2	0.138	6	88	67	59	57	53	49	47	41	40	38
	0.151	7	96	74	65	63	59	54	52	45	44	42
	0.164	8	107	82	73	71	66	61	59	51	50	48
	0.177	9	121	94	83	81	76	70	68	59	58	56
	0.190	10	130	101	90	87	82	75	73	64	63	60
	0.216	12	156	123	110	107	100	93	91	79	78	75
	0.242	14	168	133	120	117	110	102	99	87	86	83
5/8	0.138	6	94	76	66	64	59	53	52	44	43	41
	0.151	7	104	83	72	70	64	58	56	48	47	45
	0.164	8	120	92	80	77	72	65	63	54	53	51
	0.177	9	136	103	91	88	81	74	72	62	61	58
	0.190	10	146	111	97	94	88	80	78	67	65	63
	0.216	12	173	133	117	114	106	97	95	82	80	77
	0.242	14	184	142	126	123	115	106	103	89	87	84
3/4	0.138	6	94	79	72	71	65	58	57	47	46	44
	0.151	7	104	87	80	77	71	64	62	52	50	48
	0.164	8	120	101	88	85	78	71	69	58	56	54
	0.177	9	142	114	99	96	88	80	78	66	64	61
	0.190	10	153	122	107	103	95	86	83	71	69	66
								03	100	86	84	80
								11	108	93	91	87
								3	61	55	54	51
								9	68	60	59	56
								0	78	67	65	62
	0.177	9	142	118	108	106	100	94	90	75	73	70
	0.190	10	153	128	117	114	108	101	97	81	78	75
	0.216	12	193	161	147	143	131	118	114	96	93	89
	0.242	14	213	178	157	152	139	126	122	102	100	95
1-1/4	0.138	6	94	79	72	71	67	63	61	55	54	52
	0.151	7	104	87	80	78	74	69	68	60	59	57
	0.164	8	120	101	92	90	85	80	78	70	68	66
	0.177	9	142	118	108	106	100	94	92	82	80	78
	0.190	10	153	128	117	114	108	101	99	88	87	84
	0.216	12	193	161	147	144	137	128	125	108	105	100
	0.242	14	213	178	163	159	151	141	138	115	111	106
1-1/2	0.138	6	94	79	72	71	67	63	61	55	54	52
	0.151	7	104	87	80	78	74	69	68	60	59	57
	0.164	8	120	101	92	90	85	80	78	70	68	66
	0.177	9	142	118	108	106	100	94	92	82	80	78
	0.190	10	153	128	117	114	108	101	99	88	87	84
	0.216	12	193	161	147	144	137	128	125	111	109	106
	0.242	14	213	178	163	159	151	141	138	123	120	117
1-3/4	0.138	6	94	79	72	71	67	63	61	55	54	52
	0.151	7	104	87	80	78	74	69	68	60	59	57
	0.164	8	120	101	92	90	85	80	78	70	68	66
	0.177	9	142	118	108	106	100	94	92	82	80	78
	0.190	10	153	128	117	114	108	101	99	88	87	84
	0.216	12	193	161	147	144	137	128	125	111	109	106
	0.242	14	213	178	163	159	151	141	138	123	120	117

1. Tabulated lateral design values, Z, shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Tabulated lateral design values, Z, are for rolled thread wood screws (see Appendix Table L3) inserted in side grain with screw axis perpendicular to wood fibers; screw penetration, p, into the main member equal to 10D; and screw bending yield strengths, F_{yb}, of 100,000 psi for 0.099" ≤ D ≤ 0.142", 90,000 psi for 0.142" < D ≤ 0.177", 80,000 psi for 0.177" < D ≤ 0.236", and 70,000 psi for 0.236" < D ≤ 0.273".
3. Where the wood screw penetration, p, is less than 10D but not less than 6D, tabulated lateral design values, Z, shall be multiplied by p/10D or lateral design values shall be calculated using the provisions of 12.3 for the reduced penetration.

Exterior: Typical Ledger connection w/ SDS, un-factored since typical Deck loading application with duration = 1. Minimum (3) SDSW screws into RIM @ 12" o.c stud. Assuming worst case with 12' deck framing with connections into RIM @ 12" o.c w/ 60 psf LL and 10 psf DL - loading on each connection, staggered, (and ignoring capacity of typical nailing of rim). Connection is 6' x 72 psf x 1.00 = 432# versus capacity into DF/Engineered lumber (LSL) - 489#, ok.

Interior: Typical Ledger connection w/ SDS, un-factored since typical floor loading application with duration = 1. Minimum (3) SDSW screws into studs/rim @ 16" o.c stud. Assuming worst case with 14' floor framing with connections into RIM @ 16" o.c w/ 40 psf LL and 12 psf DL - loading on each connection, staggered, (and ignoring capacity of typical nailing of rim). Connection is 7' x 52 psf x 1.00 = 364# versus capacity into HF lumber (SS) - 423#, ok.

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Table 12.2A Lag Screw Reference Withdrawal Design Values, W[1]

Tabulated withdrawal design values (W) are in pounds per inch of thread penetration into side grain of wood member. Length of thread penetration in main member shall not include the length of the tapered tip (see 12.2.1.1).

Specific Gravity, G[2]	Lag Screw Diameter, D										
	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"
0.73	397	469	538	604	668	789	905	1016	1123	1226	1327
0.71	381	450	516	579	640	757	868	974	1077	1176	1273
0.68	357	422	484	543	600	709	813	913	1009	1103	1193
0.67	349	413	473	531	587	694	796	893	987	1078	1167
0.58	281	332	381	428	473	559	641	719	795	869	940
0.55	260	307	352	395	437	516	592	664	734	802	868
0.51	232	274	314	353	390	461	528	593	656	716	775
0.50	225	266	305	342	378	447	513	576	636	695	752
0.49	218	258	296	332	367	434	498	559	617	674	730
0.47	205	242	278	312	345	408	467	525	580	634	686
0.46	199	235	269	302	334	395	453	508	562	613	664
0.44	186	220	252	283	312	369	423	475	525	574	621
0.43	179	212	243	273	302	357	409	459	508	554	600
0.42	173	205	235	264	291	344	395	443	490	535	579
0.41	167	198	226	254	281	332	381	428	473	516	559
0.40	161	190	218	245	271	320	367	412	455	497	538
0.39	155	183	210	236	261	308	353	397	438	479	518
0.38	149	176	202	227	251	296	340	381	422	461	498
0.37	143	169	194	218	241	285	326	367	405	443	479
0.36	137	163	186	209	231	273	313	352	389	425	460
0.35	132	156	179	200	222	262	300	337	373	407	441
0.31	110	130	149	167	185	218	250	281	311	339	367

1. Tabulated withdrawal design values, W, for lag screw connections shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Specific gravity, G, shall be determined in accordance with Table 12.3.3A.

12.2.3.2 For calculation of the fastener reference withdrawal design value in pounds, the unit reference withdrawal design value in lbs/in. of fastener penetration from 12.2.3.1 shall be multiplied by the length of fastener penetration, p_t, into the wood member.

12.2.3.3 The reference withdrawal design value, in lbs/in. of penetration, for a single post-frame ring shank nail driven in the side grain of the main member, with the nail axis perpendicular to the wood fibers, shall be determined from Table 12.2D or Equation 12.2-4, within the range of specific gravities and nail diameters given in Table 12.2D. Reference withdrawal design values, W, shall be multiplied by all applicable adjustment factors (see Table 11.3.1) to obtain adjusted withdrawal design values, W'.

$$W = 1800\ G^2\ D \qquad (12.2\text{-}4)$$

12.2.3.4 For calculation of the fastener reference withdrawal design value in pounds, the unit reference withdrawal design value in lbs/in. of ring shank penetration from 12.2.3.3 shall be multiplied by the length of ring shank penetration, p_t, into the wood member.

12.2.3.5 Nails and spikes shall not be loaded in withdrawal from end grain of wood (C_{eg}=0.0).

12.2.3.6 Nails, and spikes shall not be loaded in withdrawal from end-grain of laminations in cross-laminated timber (C_{eg}=0.0).

12.2.4 Drift Bolts and Drift Pins

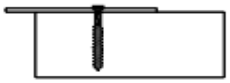
Reference withdrawal design values, W, for connections using drift bolt and drift pin connections shall be determined in accordance with 11.1.1.3.

Ledger withdrawal capacity - assuming minimum 1 1/2" embed (tip discounted) into SS/HF material = 179# x 1.5 x 3 = 805# per 16" of ledger connection (maximum utilized)

WOOD SCREWS

Table 12M **WOOD SCREWS: Reference Lateral Design Values, Z, for Single Shear (two member) Connections[1,2,3]**

for sawn lumber or SCL with ASTM 653, Grade 33 steel side plate
(tabulated lateral design values are calculated based on an assumed length of wood screw penetration, p, into the main member equal to 10D)

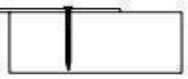


Side Member Thickness t_s	Wood Screw Diameter D	Wood Screw Number	G=0.67 Red Oak	G=0.55 Mixed Maple Southern Pine	G=0.5 Douglas Fir-Larch	G=0.49 Douglas Fir-Larch(N)	G=0.46 Douglas Fir(S) Hem-Fir(N)	G=0.43 Hem-Fir	G=0.42 Spruce-Pine-Fir	G=0.37 Redwood (open grain)	G=0.36 Eastern Softwoods Spruce-Pine-Fir(S) Western Cedars Western Woods	G=0.35 Northern Species
in.	in.		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0.036	0.138	6	89	76	70	69	66	62	60	54	53	52
(20 gage)	0.151	7	99	84	78	76	72	68	67	60	59	57
	0.164	8	113	97	89	87	83	78	77	69	67	66
0.048	0.138	6	90	77	71	70	67	63	61	55	54	53
(18 gage)	0.151	7	100	85	79	77	74	69	68	61	60	58
	0.164	8	114	98	90	89	84	79	78	70	69	67
0.060	0.138	6	92	79	73	72	68	64	63	57	56	54
(16 gage)	0.151	7	101	87	81	79	75	71	70	63	61	60
	0.164	8	116	100	92	90	86	81	79	71	70	68
	0.177	9	136	116	107	105	100	94	93	83	82	79
	0.190	10	146	125	116	114	108	102	100	90	88	86
0.075	0.138	6	95	82	76	75	71	67	66	59	58	57
(14 gage)	0.151	7	105	90	84	82	78	74	72	65	64	62
	0.164	8	119	103	95	93	89	84	82	74	73	71
	0.177	9	139	119	110	108	103	97	95	86	84	82
	0.190	10	150	128	119	117	111	105	103	92	91	88
	0.216	12	186	159	147	145	138	130	127	114	112	109
	0.242	14	204	175	162	158	151	142	139	125	123	120
0.105	0.138	6	104	90	84	82	79	74	73	66	65	63
(12 gage)	0.151	7	114	99	92	90	86	81	80	72	71	69
	0.164	8	129	111	103	102	97	92	90	81	80	77
	0.177	9	148	128	119	116	111	105	103	93	91	89
	0.190	10	160	138	128	125	120	113	111	100	98	96
	0.216	12	196	168	156	153	146	138	135	122	120	116
	0.242	14	213	183	170	167	159	150	147	132	130	126
0.120	0.138	6	110	95	89	87	83	79	77	70	68	67
(11 gage)	0.151	7	120	104	97	95	91	86	84	76	75	73
	0.164	8	135	117	109	107	102	96	94	85	84	82
	0.177	9	154	133	124	121	116	110	107	97	95	93
	0.190	10	166	144	133	131	125	118	116	104	103	100
	0.216	12	202	174	162	159	152	143	140	126	124	121
	0.242	14	219	189	175	172	164	155	152	137	134	131
0.134	0.138	6	116	100	93	92	88	83	81	73	72	70
(10 gage)	0.151	7	126	110	102	100	96	91	89	80	79	77
	0.164	8	141	122	114	112	107	101	99	89	88	86
	0.177	9	160	139	129	127	121	114	112	101	100	97
	0.190	10	173	149	139	136	130	123	121	109	107	104
	0.216	12	209	180	167	164	157	148	145	131	129	126
	0.242	14	226	195	181	177	169	160	157	141	139	135
0.179	0.138	6	126	107	99	97	92	86	84	76	74	72
(7 gage)	0.151	7	139	118	109	107	102	95	93	84	82	80
	0.164	8	160	136	126	123	117	110	108	96	95	92
	0.177	9	184	160	148	145	138	129	127	113	111	108
	0.190	10	198	172	159	156	149	140	137	122	120	117
	0.216	12	234	203	189	186	178	168	165	149	146	143
	0.242	14	251	217	202	198	190	179	176	159	156	152
0.239	0.138	6	126	107	99	97	92	86	84	76	74	72
(3 gage)	0.151	7	139	118	109	107	102	95	93	84	82	80
	0.164	8	160	136	126	123	117	110	108	96	95	92
	0.177	9	188	160	148	145	138	129	127	113	111	108
	0.190	10	204	173	159	156	149	140	137	122	120	117
	0.216	12	256	218	201	197	187	176	172	154	151	147
	0.242	14	283	241	222	217	207	194	190	170	167	162

1. Tabulated lateral design values, Z, shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Tabulated lateral design values, Z, are for rolled thread wood screws (see Appendix L) inserted in side grain with screw axis perpendicular to wood fibers; screw penetration, p, into the main member equal to 10D; dowel bearing strength, F_e, of 61,850 psi for ASTM A653, Grade 33 steel and screw bending yield strengths, F_{yb}, of 100,000 psi for $0.099" \le D \le 0.142"$, 90,000 psi for $0.142" < D \le 0.177"$, 80,000 psi for $0.177" < D \le 0.236"$, 70,000 psi for $0.236" < D \le 0.273"$.
3. Where the wood screw penetration, p, is less than 10D but not less than 6D, tabulated lateral design values, Z, shall be multiplied by p/10D or lateral design values shall be calculated using the provisions of 12.3 for the reduced penetration.

Table 12P (Cont.) **COMMON, BOX, or SINKER STEEL WIRE NAILS: Reference Lateral Design Values, Z, for Single Shear (two member) Connections[1,2,3]**

for sawn lumber or SCL with ASTM 653, Grade 33 steel side plate
(tabulated lateral design values are calculated based on an assumed length of nail penetration, p, into the main member equal to 10D)



Side Member Thickness t_s	Nail Diameter D	Common Wire Nail	Box Nail	Sinker Nail	G=0.67 Red Oak	G=0.55 Mixed Maple Southern Pine	G=0.5 Douglas Fir-Larch	G=0.49 Douglas Fir-Larch (N)	G=0.46 Douglas Fir(S) Hem-Fir(N)	G=0.43 Hem-Fir	G=0.42 Spruce-Pine-Fir	G=0.37 Redwood (open grain)	G=0.36 Eastern Softwoods Spruce-Pine-Fir(S) Western Cedars Western Woods	G=0.35 Northern Species
in.	in.	Pennyweight			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
0.120	0.099		6d	7d	90	78	72	71	68	64	63	57	56	53
(11 gage)	0.113	6d	8d	8d	110	95	89	87	83	79	77	70	68	66
	0.120			10d	121	105	97	96	91	86	85	76	75	73
	0.128		10d		134	116	108	106	101	96	94	85	83	81
	0.131	8d			140	121	112	110	105	99	97	88	86	84
	0.135		16d	12d	147	127	118	116	110	104	102	92	91	88
	0.148	10d	20d	16d	165	143	133	130	124	117	115	104	102	99
	0.162	16d	40d		193	166	154	152	145	137	134	121	119	115
	0.177			20d	218	188	174	171	163	154	151	136	134	130
	0.192	20d		30d	226	195	181	177	169	159	156	141	138	135
	0.207	30d		40d	244	210	194	191	182	172	168	151	149	145
	0.225	40d			265	228	211	207	198	186	183	164	161	157
	0.244	50d		60d	272	234	217	213	203	191	187	169	166	161
0.134	0.099		6d	7d	95	82	76	74	71	66	65	58	56	54
(10 gage)	0.113	6d	8d	8d	116	100	93	92	88	83	81	73	72	69
	0.120			10d	127	110	102	100	96	91	89	80	79	76
	0.128		10d		140	122	113	111	106	100	98	89	87	85
	0.131	8d			146	126	117	115	110	104	102	92	90	88
	0.135		16d	12d	153	132	123	121	115	109	107	96	95	92
	0.148	10d	20d	16d	172	148	138	135	129	122	120	108	106	104
	0.162	16d	40d		199	172	160	157	150	142	139	125	123	120
	0.177			20d	224	194	180	176	169	159	156	141	138	135
	0.192	20d		30d	232	200	186	182	174	164	161	145	143	139
	0.207	30d		40d	249	215	199	196	187	176	173	156	153	149
	0.225	40d			270	233	216	212	202	191	187	168	165	161
	0.244	50d		60d	277	239	221	217	207	195	192	173	170	165
0.179	0.099		6d	7d	97	82	76	74	71	66	65	58	56	54
(7 gage)	0.113	6d	8d	8d	126	107	99	97	92	86	84	76	74	70
	0.120			10d	142	121	111	109	104	97	95	85	83	79
	0.128		10d		161	137	126	124	118	111	108	97	94	90
	0.131	8d			168	144	132	130	123	116	114	102	99	94
	0.135		16d	12d	175	152	141	138	131	123	121	108	105	100
	0.148	10d	20d	16d	195	170	158	155	148	140	137	123	121	117
	0.162	16d	40d		224	194	180	177	169	160	157	142	140	136
	0.177			20d	249	215	200	197	188	178	174	157	155	151
	0.192	20d		30d	256	222	206	203	194	183	179	162	159	155
	0.207	30d		40d	272	236	219	215	205	194	190	172	169	164
	0.225	40d			292	252	234	230	220	207	203	184	180	176
	0.244	50d		60d	299	258	240	235	225	212	208	188	185	180
0.239	0.099		6d	7d	97	82	76	74	71	66	65	58	56	54
(3 gage)	0.113	6d	8d	8d	126	107	99	97	92	86	84	76	74	70
	0.120			10d	142	121	111	109	104	97	95	85	83	79
	0.128		10d		161	137	126	124	118	111	108	97	94	90
	0.131	8d			169	144	132	130	123	116	114	102	99	94
	0.135		16d	12d	180	153	141	138	131	123	121	108	105	100
	0.148	10d	20d	16d	205	174	160	157	149	140	137	123	121	117
	0.162	16d	40d		245	209	192	188	179	168	165	147	145	140
	0.177			20d	284	241	222	218	207	195	191	170	167	162
	0.192	20d		30d	295	251	231	227	216	202	198	177	174	169
	0.207	30d		40d	310	270	251	246	236	222	217	194	191	185
	0.225	40d			328	285	265	260	249	235	231	209	205	200
	0.244	50d		60d	336	291	271	266	254	240	236	213	210	204

1. Tabulated lateral design values, Z, shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Tabulated lateral design values, Z, are for common, box, or sinker steel wire nails (see Appendix Table L4) inserted in side grain with nail axis perpendicular to wood fibers; nail penetration, p, into the main member equal to 10D; dowel bearing strength, F_e, of 61,850 psi for ASTM A653, Grade 33 steel and nail bending yield strengths, F_{yb}, of 100,000 psi for $0.099" \le D \le 0.142"$, 90,000 psi for $0.142" < D \le 0.177"$, 80,000 psi for $0.177" < D \le 0.236"$, 70,000 psi for $0.236" < D \le 0.273"$.
3. Where the nail or spike penetration, p, is less than 10D but not less than 6D, tabulated lateral design values, Z, shall be multiplied by p/10D or lateral design values shall be calculated using the provisions of 12.3 for the reduced penetration.

Table 11.3.6A Group Action Factors, C_g, for Bolt or Lag Screw Connections with Wood Side Members[2]

For D = 1", s = 4", E = 1,400,000 psi												
A_s/A_m[1]	A_s[1] in.^{2}	Number of fasteners in a row										
		2	3	4	5	6	7	8	9	10	11	12
0.5	5	0.98	0.92	0.84	0.75	0.68	0.61	0.55	0.50	0.45	0.41	0.38
	12	0.99	0.96	0.92	0.87	0.81	0.76	0.70	0.65	0.61	0.57	0.53
	20	0.99	0.98	0.95	0.91	0.87	0.83	0.78	0.74	0.70	0.66	0.62
	28	1.00	0.98	0.96	0.93	0.90	0.87	0.83	0.79	0.76	0.72	0.69
	40	1.00	0.99	0.97	0.95	0.93	0.90	0.87	0.84	0.81	0.78	0.75
	64	1.00	0.99	0.98	0.97	0.95	0.93	0.91	0.89	0.87	0.84	0.82
1	5	1.00	0.97	0.91	0.85	0.78	0.71	0.64	0.59	0.54	0.49	0.45
	12	1.00	0.99	0.96	0.93	0.88	0.84	0.79	0.74	0.70	0.65	0.61
	20	1.00	0.99	0.98	0.95	0.92	0.89	0.86	0.82	0.78	0.75	0.71
	28	1.00	0.99	0.98	0.97	0.94	0.92	0.89	0.86	0.83	0.80	0.77
	40	1.00	1.00	0.99	0.98	0.96	0.94	0.92	0.90	0.87	0.85	0.82
	64	1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.93	0.91	0.90	0.88

1. Where $A_s/A_m > 1.0$, use A_m/A_s and use A_m instead of A_s.
2. Tabulated group action factors (C_g) are conservative for D < 1", s < 4", or E > 1,400,000 psi.

Table 11.3.6B Group Action Factors, C_g, for 4" Split Ring or Shear Plate Connectors with Wood Side Members[2]

s = 9", E = 1,400,000 psi												
A_s/A_m[1]	A_s[1] in.^{2}	Number of fasteners in a row										
		2	3	4	5	6	7	8	9	10	11	12
0.5	5	0.90	0.73	0.59	0.48	0.41	0.35	0.31	0.27	0.25	0.22	0.20
	12	0.95	0.83	0.71	0.60	0.52	0.45	0.40	0.36	0.32	0.29	0.27
	20	0.97	0.88	0.78	0.69	0.60	0.53	0.47	0.43	0.39	0.35	0.32
	28	0.97	0.91	0.82	0.74	0.66	0.59	0.53	0.48	0.44	0.40	0.37
	40	0.98	0.93	0.86	0.79	0.72	0.65	0.59	0.54	0.49	0.45	0.42
	64	0.99	0.95	0.91	0.85	0.79	0.73	0.67	0.62	0.58	0.54	0.50
1	5	1.00	0.87	0.72	0.59	0.50	0.43	0.38	0.34	0.30	0.28	0.25
	12	1.00	0.93	0.83	0.72	0.63	0.55	0.48	0.43	0.39	0.36	0.33
	20	1.00	0.95	0.88	0.79	0.71	0.63	0.57	0.51	0.46	0.42	0.39
	28	1.00	0.97	0.91	0.83	0.76	0.69	0.62	0.57	0.52	0.47	0.44
	40	1.00	0.98	0.93	0.87	0.81	0.75	0.69	0.63	0.58	0.54	0.50
	64	1.00	0.98	0.95	0.91	0.87	0.82	0.77	0.72	0.67	0.62	0.58

1. Where $A_s/A_m > 1.0$, use A_m/A_s and use A_m instead of A_s.
2. Tabulated group action factors (C_g) are conservative for 2-1/2" split ring connectors, 2-5/8" shear plate connectors, s < 9", or E > 1,400,000 psi.

Table 11.3.6C Group Action Factors, C_g, for Bolt or Lag Screw Connections with Steel Side Plates[1]

For D = 1", s = 4", E_{wood} = 1,400,000 psi, E_{steel} = 30,000,000 psi

A_m/A_s	A_m in.^{2}	Number of fasteners in a row										
		2	3	4	5	6	7	8	9	10	11	12
12	5	0.97	0.89	0.80	0.70	0.62	0.55	0.49	0.44	0.40	0.37	0.34
	8	0.98	0.93	0.85	0.77	0.70	0.63	0.57	0.52	0.47	0.43	0.40
	16	0.99	0.96	0.92	0.86	0.80	0.75	0.69	0.64	0.60	0.55	0.52
	24	0.99	0.97	0.94	0.90	0.85	0.81	0.76	0.71	0.67	0.63	0.59
	40	1.00	0.98	0.96	0.94	0.90	0.87	0.83	0.79	0.76	0.72	0.69
	64	1.00	0.99	0.98	0.96	0.94	0.91	0.88	0.86	0.83	0.80	0.77
	120	1.00	0.99	0.99	0.98	0.96	0.95	0.93	0.91	0.90	0.87	0.85
	200	1.00	1.00	0.99	0.99	0.98	0.97	0.96	0.95	0.93	0.92	0.90
18	5	0.99	0.93	0.85	0.76	0.68	0.61	0.54	0.49	0.44	0.41	0.37
	8	0.99	0.95	0.90	0.83	0.75	0.69	0.62	0.57	0.52	0.48	0.44
	16	1.00	0.98	0.94	0.90	0.85	0.79	0.74	0.69	0.65	0.60	0.56
	24	1.00	0.98	0.96	0.93	0.89	0.85	0.80	0.76	0.72	0.68	0.64
	40	1.00	0.99	0.97	0.95	0.93	0.90	0.87	0.83	0.80	0.77	0.73
	64	1.00	0.99	0.98	0.97	0.95	0.93	0.91	0.89	0.86	0.83	0.81
	120	1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.93	0.92	0.90	0.88
	200	1.00	1.00	0.99	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.92
24	40	1.00	0.99	0.97	0.95	0.93	0.89	0.86	0.83	0.79	0.76	0.72
	64	1.00	0.99	0.98	0.97	0.95	0.93	0.91	0.88	0.85	0.83	0.80
	120	1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.93	0.91	0.90	0.88
	200	1.00	1.00	0.99	0.99	0.98	0.98	0.97	0.96	0.95	0.93	0.92
30	40	1.00	0.98	0.96	0.93	0.89	0.85	0.81	0.77	0.73	0.69	0.65
	64	1.00	0.99	0.97	0.95	0.93	0.90	0.87	0.83	0.80	0.77	0.73
	120	1.00	0.99	0.99	0.97	0.96	0.94	0.92	0.90	0.88	0.85	0.83
	200	1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.92	0.90	0.89
35	40	0.99	0.97	0.94	0.91	0.86	0.82	0.77	0.73	0.68	0.64	0.60
	64	1.00	0.98	0.96	0.94	0.91	0.87	0.84	0.80	0.76	0.73	0.69
	120	1.00	0.99	0.98	0.97	0.95	0.92	0.90	0.88	0.85	0.82	0.79
	200	1.00	0.99	0.99	0.98	0.97	0.95	0.94	0.92	0.90	0.88	0.86
42	40	0.99	0.97	0.93	0.88	0.83	0.78	0.73	0.68	0.63	0.59	0.55
	64	0.99	0.98	0.95	0.92	0.88	0.84	0.80	0.76	0.72	0.68	0.64
	120	1.00	0.99	0.97	0.95	0.93	0.90	0.88	0.85	0.81	0.78	0.75
	200	1.00	0.99	0.98	0.97	0.96	0.94	0.92	0.90	0.88	0.85	0.83
50	40	0.99	0.96	0.91	0.85	0.79	0.74	0.68	0.63	0.58	0.54	0.51
	64	0.99	0.97	0.94	0.90	0.85	0.81	0.76	0.72	0.67	0.63	0.59
	120	1.00	0.98	0.97	0.94	0.91	0.88	0.85	0.81	0.78	0.74	0.71
	200	1.00	0.99	0.98	0.96	0.95	0.92	0.90	0.87	0.85	0.82	0.79

1. Tabulated group action factors (C_g) are conservative for D < 1" or s < 4".

Table 11.3.6D Group Action Factors, C_g, for 4" Shear Plate Connectors with Steel Side Plates[1]

$s = 9"$, $E_{wood} = 1{,}400{,}000$ psi, $E_{steel} = 30{,}000{,}000$ psi

A_m/A_s	A_m in.^{2}	Number of fasteners in a row										
		2	3	4	5	6	7	8	9	10	11	12
12	5	0.91	0.75	0.60	0.50	0.42	0.36	0.31	0.28	0.25	0.23	0.21
	8	0.94	0.80	0.67	0.56	0.47	0.41	0.36	0.32	0.29	0.26	0.24
	16	0.96	0.87	0.76	0.66	0.58	0.51	0.45	0.40	0.37	0.33	0.31
	24	0.97	0.90	0.82	0.73	0.64	0.57	0.51	0.46	0.42	0.39	0.35
	40	0.98	0.94	0.87	0.80	0.73	0.66	0.60	0.55	0.50	0.46	0.43
	64	0.99	0.96	0.91	0.86	0.80	0.74	0.69	0.63	0.59	0.55	0.51
	120	0.99	0.98	0.95	0.91	0.87	0.83	0.79	0.74	0.70	0.66	0.63
	200	1.00	0.99	0.97	0.95	0.92	0.89	0.85	0.82	0.79	0.75	0.72
18	5	0.97	0.83	0.68	0.56	0.47	0.41	0.36	0.32	0.28	0.26	0.24
	8	0.98	0.87	0.74	0.62	0.53	0.46	0.40	0.36	0.32	0.30	0.27
	16	0.99	0.92	0.82	0.73	0.64	0.56	0.50	0.45	0.41	0.37	0.34
	24	0.99	0.94	0.87	0.78	0.70	0.63	0.57	0.51	0.47	0.43	0.39
	40	0.99	0.96	0.91	0.85	0.78	0.72	0.66	0.60	0.55	0.51	0.47
	64	1.00	0.97	0.94	0.89	0.84	0.79	0.74	0.69	0.64	0.60	0.56
	120	1.00	0.99	0.97	0.94	0.90	0.87	0.83	0.79	0.75	0.71	0.67
	200	1.00	0.99	0.98	0.96	0.94	0.91	0.89	0.86	0.82	0.79	0.76
24	40	1.00	0.96	0.91	0.84	0.77	0.71	0.65	0.59	0.54	0.50	0.46
	64	1.00	0.98	0.94	0.89	0.84	0.78	0.73	0.68	0.63	0.58	0.54
	120	1.00	0.99	0.96	0.94	0.90	0.86	0.82	0.78	0.74	0.70	0.66
	200	1.00	0.99	0.98	0.96	0.94	0.91	0.88	0.85	0.82	0.78	0.75
30	40	0.99	0.93	0.86	0.78	0.70	0.63	0.57	0.52	0.47	0.43	0.40
	64	0.99	0.96	0.90	0.84	0.78	0.71	0.66	0.60	0.56	0.51	0.48
	120	0.99	0.98	0.94	0.90	0.86	0.81	0.76	0.71	0.67	0.63	0.59
	200	1.00	0.98	0.96	0.94	0.91	0.87	0.83	0.79	0.76	0.72	0.68
35	40	0.98	0.91	0.83	0.74	0.66	0.59	0.53	0.48	0.43	0.40	0.36
	64	0.99	0.94	0.88	0.81	0.73	0.67	0.61	0.56	0.51	0.47	0.43
	120	0.99	0.97	0.93	0.88	0.82	0.77	0.72	0.67	0.62	0.58	0.54
	200	1.00	0.98	0.95	0.92	0.88	0.84	0.80	0.76	0.71	0.68	0.64
42	40	0.97	0.88	0.79	0.69	0.61	0.54	0.48	0.43	0.39	0.36	0.33
	64	0.98	0.92	0.84	0.76	0.69	0.62	0.56	0.51	0.46	0.42	0.39
	120	0.99	0.95	0.90	0.85	0.78	0.72	0.67	0.62	0.57	0.53	0.49
	200	0.99	0.97	0.94	0.90	0.85	0.80	0.76	0.71	0.67	0.62	0.59
50	40	0.95	0.86	0.75	0.65	0.56	0.49	0.44	0.39	0.35	0.32	0.30
	64	0.97	0.90	0.81	0.72	0.64	0.57	0.51	0.46	0.42	0.38	0.35
	120	0.98	0.94	0.88	0.81	0.74	0.68	0.62	0.57	0.52	0.48	0.45
	200	0.99	0.96	0.92	0.87	0.82	0.77	0.71	0.66	0.62	0.58	0.54

1. Tabulated group action factors (C_g) are conservative for 2-5/8" shear plate connectors or $s < 9"$.

LONGITUDE
ONE TWENTY°
ENGINEERING & DESIGN

TYPICAL POSTS

(206) 790 9502
L120Engineering.com

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	2X4 STUD @ 16"	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(1) 1.5 X 3.5	DRY		

2X4 STUD @ 16" DIAGRAM

COLUMN PROPERTIES

Start (ft): 0 End (ft): 8 Member Slope: 0/12 Actual Length (ft): 8

Area	Ix	Iy	BSW	Lams	G	Kcr
(in^2)	(in^4)	(in^4)	(lbf/ft)			Creep Factor
5.25	5.36	0.98	1.04	1	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1275	788	150	1495	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.5	1.5	1	1.15	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	8	8	4	0	0.24	1.00	1.00	27.43	32

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (90.5%)	0.025 (=L/3795)	0.267 (=L/360)	8	L	
Compressive Stress (psi)	PASS (3.0%)	344.4	355.2	0	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	8	1800	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-1800	-	8	-	Live	Z
Self Weight (lbf/ft)	1.04	1.04	0	8	Dead	Z

NOTES

PASS

DATE:	10/8/2020	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Main Floor	LOADING:	ASD
LOCATION:	2x4 @ 12" o.c.	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(1) 1.5 X 3.5	DRY		

2x4 @ 12" o.c. DIAGRAM

COLUMN PROPERTIES

Start (ft): 0 End (ft): 9 Member Slope: 0/12 Actual Length (ft): 9

Area (in^2)	Ix (in^4)	Iy (in^4)	BSW (lbf/ft)	Lams	G	Kcr Creep Factor
5.25	5.36	0.98	1.04	1	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1275	788	150	1495	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.5	1.5	1	1.15	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	9	9	2	0	0.25	1.00	1.00	30.86	16

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (89.7%)	0.031 (=L/3495)	0.300 (=L/360)	9	L	
Compressive Stress (psi)	PASS (1.8%)	373.2	379.9	0	D+L	1
Tensile Stress (psi)	PASS (100.0%)	0.0	708.8	9	D	0.9

REACTIONS

V-(lbf) M-(lbf-ft)

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	9	1950	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-1950	-	9	-	Live	Z
Self Weight (lbf/ft)	1.04	1.04	0	9	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	(2) 2x4 (unbraced)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(2) 1.5 X 3.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 8 Member Slope: 0/12 Actual Length (ft): 8

Area	Ix	Iy	BSW	Lams	G	Kcr
(in^2)	(in^4)	(in^4)	(lbf/ft)			Creep Factor
10.5	10.72	1.97	2.07	2	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1275	788	150	1495	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.5	1.5	1	1.15	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	8	8	8	0	0.14	1.00	1.00	27.43	32

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (96.0%)	0.011 (=L/9144)	0.267 (=L/360)	8	L	
Compressive Stress (psi)	PASS (0.9%)	211.1	213.1	0	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	717	1500	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-1500	-	8	-	Live	Z
Point (lbf)	-700	-	8	-	Dead	Z
Self Weight (lbf/ft)	2.07	2.07	0	8	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	(3) 2x4 (unbraced)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(3) 1.5 X 3.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 8 Member Slope: 0/12 Actual Length (ft): 8

Area (in^2)	Ix (in^4)	Iy (in^4)	BSW (lbf/ft)	Lams	G	Kcr Creep Factor
15.75	16.08	2.95	3.11	3	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1275	788	150	1495	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.5	1.5	1	1.15	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	8	8	8	0	0.29	1.00	1.00	27.43	21.33

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (93.0%)	0.019 (=L/5107)	0.267 (=L/360)	8	L	
Compressive Stress (psi)	PASS (3.7%)	414.3	430.1	0	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	2525	4000	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-4000	-	8	-	Live	Z
Point (lbf)	-2500	-	8	-	Dead	Z
Self Weight (lbf/ft)	3.11	3.11	0	8	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	(4) 2x4 (Unbraced)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(4) 1.5 X 3.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 8 Member Slope: 0/12 Actual Length (ft): 8

Area	Ix	Iy	BSW	Lams	G	Kcr
(in^2)	(in^4)	(in^4)	(lbf/ft)			Creep Factor
21	21.44	3.94	4.14	4	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1275	788	150	1495	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.5	1.5	1	1.15	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	8	8	8	0	0.32	1.00	1.00	27.43	16

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (92.7%)	0.019 (=L/4975)	0.267 (=L/360)	8	L	
Compressive Stress (psi)	PASS (3.5%)	454.0	470.3	0	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	4033	5500	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-4000	-	8	-	Dead	Z
Point (lbf)	-5500	-	8	-	Live	Z
Self Weight (lbf/ft)	4.14	4.14	0	8	Dead	Z

NOTES

PASS

DATE:	10/9/2020	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Main Floor	LOADING:	ASD
LOCATION:	2x6 stud	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(1) 1.5 X 5.5	DRY		

2x6 stud DIAGRAM

COLUMN PROPERTIES

Start (ft): 0 End (ft): 9 Member Slope: 0/12 Actual Length (ft): 9

Area	Ix	Iy	BSW	Lams	G	Kcr
(in^2)	(in^4)	(in^4)	(lbf/ft)			Creep Factor
8.25	20.8	1.55	1.63	1	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1105	682	150	1430	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.3	1.3	1	1.1	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	9	9	2	0	0.56	1.00	1.00	19.64	16

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (88.3%)	0.035 (=L/3068)	0.300 (=L/360)	9	L	
Compressive Stress (psi)	PASS (1.2%)	789.7	799.3	0	D+L	1

REACTIONS

V-(lbf) M-(lbf-ft)

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	3015	3500	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-3500	-	9	-	Live	Z
Point (lbf)	-3000	-	9	-	Dead	Z
Self Weight (lbf/ft)	1.63	1.63	0	9	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	(2) 2x6 (Unbraced)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(2) 1.5 X 5.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 8 Member Slope: 0/12 Actual Length (ft): 8

Area	Ix	Iy	BSW	Lams	G	Kcr
(in^2)	(in^4)	(in^4)	(lbf/ft)			Creep Factor
16.5	41.59	3.09	3.26	2	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1105	682	150	1430	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.3	1.3	1	1.1	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	8	8	8	0	0.15	1.00	1.00	17.45	32

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (96.6%)	0.009 (=L/10668)	0.267 (=L/360)	8	L	
Compressive Stress (psi)	PASS (2.2%)	207.6	212.4	0	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	1426	2000	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-1400	-	8	-	Dead	Z
Point (lbf)	-2000	-	8	-	Live	Z
Self Weight (lbf/ft)	3.26	3.26	0	8	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	(3) 2x6 (Unbraced)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(3) 1.5 X 5.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 8 Member Slope: 0/12 Actual Length (ft): 8

Area (in^2)	Ix (in^4)	Iy (in^4)	BSW (lbf/ft)	Lams	G	Kcr Creep Factor
24.75	62.39	4.64	4.88	3	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1105	682	150	1430	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.3	1.3	1	1.1	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	8	8	8	0	0.30	1.00	1.00	17.45	21.33

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (93.3%)	0.018 (=L/5364)	0.267 (=L/360)	8	L	
Compressive Stress (psi)	PASS (4.7%)	405.6	425.6	0	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	4039	6000	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-4000	-	8	-	Dead	Z
Point (lbf)	-6000	-	8	-	Live	Z
Self Weight (lbf/ft)	4.88	4.88	0	8	Dead	Z

NOTES

PASS

DATE:	3/3/2021	COMPANY:	L120 Engineering & Design, LLC
VITRUVIUS BUILD:	StruCalc	DESIGNED BY:	Mans Thurfjell
CUSTOMER:		REVIEWED BY:	Mans Thurfjell
PROJECT LOCATION:	,		
LEVEL:	Roof	LOADING:	ASD
LOCATION:	(4) 2x6 (Unbraced)	CODE:	2018 International Building Code
TYPE:	COLUMN	NDS:	2018 NDS
MATERIAL:	SOLID SAWN		

Hem-Fir	No. 2	(4) 1.5 X 5.5	DRY		

COLUMN PROPERTIES

Start (ft): 0 End (ft): 8 Member Slope: 0/12 Actual Length (ft): 8

Area	Ix	Iy	BSW	Lams	G	Kcr
(in^2)	(in^4)	(in^4)	(lbf/ft)			Creep Factor
33	83.19	6.19	6.51	4	0.43	1

STRENGTH PROPERTIES

	Fb (psi)	Ft (psi)	Fv (psi)	Fc (psi)	Fc⊥ (psi)	E (psi) x10^3	Emin (psi) x10^3
Base Values	850	525	150	1300	405	1300	470
Adjusted Values	1105	682	150	1430	405	1300	470
C_M	1	1	1	1	1	1	1
C_T	1	1	1	1	1	1	1
C_i	1	1	1	1	1	1	1
C_F	1.3	1.3	1	1.1	1	1	1

Bending Adjustment Factors C_{fu} = 1 C_r = 1

COLUMN DATA

		Unbraced Length (ft)		Column End					
Span	Length (ft)	X	Y	Offset	CP	Ke(X Axis)	Ke(Y Axis)	KeL/d (X Axis)	KeL/d (Y Axis)
1	8	8	8	0	0.43	1.00	1.00	17.45	16

PASS-FAIL

	PASS/FAIL	MAGNITUDE	STRENGTH	LOCATION (ft)	LOAD COMBO	DURATION FACTOR CD
Deflection (in)	PASS (91.6%)	0.022 (=L/4286)	0.267 (=L/360)	8	L	
Compressive Stress (psi)	PASS (10.1%)	547.0	608.6	0	D+L	1

REACTIONS

Units for V: lbf Units for M: lbf-ft

Z axis	DEAD	LIVE	LIVE ROOF	SNOW	WIND +	WIND -	SEISMIC +	SEISMIC -	ICE	RAIN	EARTH
A	8052	10000	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0

Reaction Location

A B

LOAD LIST

Type	Left Magnitude	Right Magnitude	Load Start (ft)	Load End (ft)	Load Type	Direction
Point (lbf)	-8000	-	8	-	Dead	Z
Point (lbf)	-10000	-	8	-	Live	Z
Self Weight (lbf/ft)	6.51	6.51	0	8	Dead	Z

NOTES

Level, 4x4 POST (10FT)

1 piece(s) 4 x 4 Douglas Fir-Larch No. 2

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	34	50	Passed (69%)	--	--
Compression (lbs)	4500	4710	Passed (96%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	4500	396900	Passed (1%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	2000	2500	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 4x4 POST (9FT)

1 piece(s) 4 x 4 Douglas Fir-Larch No. 2

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	31	50	Passed (62%)	--	--
Compression (lbs)	5500	5727	Passed (96%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	5500	396900	Passed (1%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	2000	3500	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 4x6 POST (10FT)

1 piece(s) 4 x 6 Douglas Fir-Larch No. 2

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	34	50	Passed (69%)	--	--
Compression (lbs)	7000	7380	Passed (95%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	7000	623700	Passed (1%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	3000	4000	Default Load

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 4x6 POST (9FT)

1 piece(s) 4 x 6 Douglas Fir-Larch No. 2

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	31	50	Passed (62%)	--	--
Compression (lbs)	8500	8966	Passed (95%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	8500	623700	Passed (1%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	4000	4500	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 4x8 POST (10FT)

1 piece(s) 4 x 8 Douglas Fir-Larch No. 2

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	34	50	Passed (69%)	--	--
Compression (lbs)	9500	9698	Passed (98%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	9500	822150	Passed (1%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	4500	5000	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 4x8 POST (9FT)

1 piece(s) 4 x 8 Douglas Fir-Larch No. 2

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	31	50	Passed (62%)	--	--
Compression (lbs)	11000	11769	Passed (93%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	11000	822150	Passed (1%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	5000	6000	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 6x6 POST (10FT)

1 piece(s) 6 x 6 Douglas Fir-Larch No. 2

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	22	50	Passed (44%)	--	--
Compression (lbs)	16500	16897	Passed (98%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	16500	980100	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	8000	8500	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 6x6 POST (9FT)

1 piece(s) 6 x 6 Douglas Fir-Larch No. 2

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	20	50	Passed (39%)	--	--
Compression (lbs)	18000	18529	Passed (97%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	18000	980100	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	9000	9000	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 6x8 POST (10FT)

1 piece(s) 6 x 8 Douglas Fir-Larch No. 2

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	22	50	Passed (44%)	--	--
Compression (lbs)	22000	23041	Passed (95%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	22000	1336500	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	11000	11000	Default Load

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 6x8 POST (9FT)

1 piece(s) 6 x 8 Douglas Fir-Larch No. 2

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	20	50	Passed (39%)	--	--
Compression (lbs)	24000	25267	Passed (95%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	24000	1336500	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	11000	13000	Default Load

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Level, 3.5X3.5 PSL (10FT)

1 piece(s) 3 1/2" x 3 1/2" 1.8E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	34	50	Passed (69%)	--	--
Compression (lbs)	7500	7626	Passed (98%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	7500	396900	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	3500	4000	Default Load

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Level, 3.5X3.5 PSL (9FT)
1 piece(s) 3 1/2" x 3 1/2" 1.8E Parallam® PSL

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	31	50	Passed (62%)	--	--
Compression (lbs)	9250	9338	Passed (99%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	9250	396900	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	4250	5000	Default Load

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Level, 3.5X5.25 PSL (10FT)

1 piece(s) 3 1/2" x 5 1/4" 1.8E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	34	50	Passed (69%)	--	--
Compression (lbs)	11000	11439	Passed (96%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	11000	595350	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	5000	6000	Default Load

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Level, 3.5X5.25 PSL (9FT)

1 piece(s) 3 1/2" x 5 1/4" 1.8E Parallam® PSL

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	31	50	Passed (62%)	--	--
Compression (lbs)	14000	14007	Passed (100%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	14000	595350	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	6500	7500	Default Load

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Level, 3.5X7PSL (10FT)

1 piece(s) 3 1/2" x 7" 1.8E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	34	50	Passed (69%)	--	--
Compression (lbs)	15000	15252	Passed (98%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	15000	793800	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	7000	8000	Default Load

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Level, 3.5X7PSL (9FT)

1 piece(s) 3 1/2" x 7" 1.8E Parallam® PSL

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	31	50	Passed (62%)	--	--
Compression (lbs)	18000	18677	Passed (96%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	18000	793800	Passed (2%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	8500	9500	Default Load

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Level, 5.25X5.25 PSL (10FT)
1 piece(s) 5 1/4" x 5 1/4" 1.8E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	23	50	Passed (46%)	--	--
Compression (lbs)	35000	36546	Passed (96%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	35000	893025	Passed (4%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	15000	20000	Default Load

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Level, 5.25X5.25 PSL (9FT)

1 piece(s) 5 1/4" x 5 1/4" 1.8E Parallam® PSL

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	21	50	Passed (41%)	--	--
Compression (lbs)	42500	43634	Passed (97%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	42500	893025	Passed (5%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	20000	22500	Default Load

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Level, 5.25X7 PSL (10FT)

1 piece(s) 5 1/4" x 7" 1.8E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	23	50	Passed (46%)	--	--
Compression (lbs)	47500	48728	Passed (97%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	47500	1190700	Passed (4%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	20000	27500	Default Load

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Level, 5.25X7 PSL (9FT)

1 piece(s) 5 1/4" x 7" 1.8E Parallam® PSL

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	21	50	Passed (41%)	--	--
Compression (lbs)	57500	58179	Passed (99%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	57500	1190700	Passed (5%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	25000	32500	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 7X7 PSL (10FT)

1 piece(s) 7" x 7" 1.8E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	17	50	Passed (34%)	--	--
Compression (lbs)	100000	100441	Passed (100%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	100000	1587600	Passed (6%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	50000	50000	Default Load

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Level, 7X7 PSL (9FT)

1 piece(s) 7" x 7" 1.8E Parallam® PSL

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	15	50	Passed (31%)	--	--
Compression (lbs)	110000	111804	Passed (98%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	110000	1587600	Passed (7%)	--	1.0 D + 1.0 S
Bending/Compression	N/A	1	Passed (N/A)	--	N/A

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	50000	60000	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 7X9.25 PSL (10FT)

1 piece(s) 7" x 9 1/4" 2.0E Parallam® PSL

Post Height: 10'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	17	50	Passed (34%)	--	--
Compression (lbs)	125000	149992	Passed (83%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	125000	2097900	Passed (6%)	--	1.0 D + 1.0 S
Bending/Compression	0.89	1	Passed (89%)	1.15	1.0 D + 1.0 S

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- Initial eccentricity applied as per ESR-1387.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	50000	75000	Default Load

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

Level, 7X9.25 PSL (9FT)

1 piece(s) 7" x 9 1/4" 2.0E Parallam® PSL

Post Height: 9'

Drawing is Conceptual

Design Results	Actual	Allowed	Result	LDF	Load: Combination
Slenderness	15	50	Passed (31%)	--	--
Compression (lbs)	145000	168143	Passed (86%)	1.15	1.0 D + 1.0 S
Base Bearing (lbs)	145000	2097900	Passed (7%)	--	1.0 D + 1.0 S
Bending/Compression	0.91	1	Passed (91%)	1.15	1.0 D + 1.0 S

- Input axial load eccentricity for the design is zero
- Applicable calculations are based on NDS.
- Initial eccentricity applied as per ESR-1387.

Supports	Type	Material
Base	Plate	Steel

Max Unbraced Length	Comments
Full Member Length	No bracing assumed.

Member Type : Free Standing Post
Building Code : IBC 2018
Design Methodology : ASD

Vertical Load	Dead (0.90)	Snow (1.15)	Comments
1 - Point (lb)	65000	80000	Default Load

Weyerhaeuser Notes

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator