Structural Calculations

for

ADDITIONS & ALTERATIONS

DeHaven Residence

3206 74th Pl SE

Mercer Island, WA 98040

PERMIT SUBMITTAL

prepared by:
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Job No. 20025

Date: 4/26/21

Date: 4/27/2021
Job # 20025

Vertical Design Loads

Existing Main Roof		
Metal Roofing	1	psf
Sheathing	2	
Trusses @24"o.c.	4	
Insulation	0.5	
5/8" Gypsum Board	2.8	
Sum	10.3	psf
Slope:	4	:12
Slope Correction Factor	1.05	
Subtotal	10.9	psf
M/E/P/misc.	3.1	psf
DL=	14	psf
SL=	25	psf
RLL=	20	psf

Deck Roof		
Metal Roofing	1	psf
5/8" Plywood	2	
2x10 @24"o.c.	1.5	
Wood Slats	2	
Sum	6.5	psf
Slope:	4	:12
Slope Correction Factor	1.05	
Subtotal	6.9	psf
M/E/P/misc.	3.1	psf
DL=	10	psf
SL=	25	psf
RLL=	20	psf

Existing Upper Floor			
Flooring	4	psf	
3/4" Plywood	2.4		
(E) 11-7/8 TJI @16"o.c.	2.8		
5/8" Gypsum Board	2.8		
M/E/P/misc.	2		
DL=	14	psf	
LL=	40	psf	*Living Areas*

Exterior Decks	
Decking & Insulation Assembly	8 psf
3/4" Plywood	2.4
Joists	2.8
5/8" Gypsum Board	2.8
M/E/P/misc.	3
DL=	19 psf
SL=	25 psf
LL=	60 psf

Exterior Walls	
Wood Siding	2 psf
1/2" Plywood	1.6
2x6 @16"o.c.	1.4
Batt Insulation	0.2
1/2" Gypsum Board	2.2
M/E/P/misc.	2.6
DL=	10 psf

Interior Walls	
2 Layers 1/2" Gypsum Board	4.4 psf
2x4 @16"o.c.	0.9
M/E/P/misc.	1.7
DL=	7 psf

Date: 4/27/2021
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Seismic Design Loads

Seismic Design Parameters (ASCE 7-16 Section 12.8.1)

Approximate Fundamental Period

$T = T_a = C_t h_n^x$

where:

C_t =	0.02	
h_n =	22	
x =	0.75	
T =	0.20	s

Seismic Response Coefficient

S_s =	1.41	
S_1 =	0.49	
S_{ds} =	1.13	
S_{d1} =	0.49	
R =	6.5	
ρ =	1.3	
Ω =	2.5	
C_d =	4	
I_e =	1	

$C_s = S_{ds}/(R/I_e)$ = 0.17 W

T_L = 6 s > T

$C_{s,max} = S_{d1}/[T(R/I_e)]$ = 0.37

$C_{s,min} = 0.044 S_{ds} I_e$ = 0.050

$C_{s,min}$ = 0.01

S_1 < 0.6

$C_{s,min} = 0.5 S_1/(R/I_e)$ = 0.038 **Ignore**

$C_{s,min,gov}$ = 0.050

$C_{s,gov}$ = 0.17 (LRFD)

Effective Seismic Weight				
Floor	Area (sf)	w_{floor} (psf)	w_{walls} (psf)[1]	W (lbs)
Roof	3130	14	10	75120
Upper	2510	14	20	85340
			Sum:	**160460 lbs**

[1]Includes weight of interior/exterior walls as uniform area load

Base Shear (includes ρ)				
$0.7\rho V = 0.7\rho C_s W$ =	0.158	W =	**25272 lbs**	***ASD Level***

Vertical Distribution of Base Shear (ASCE 7-16 Section 12.8.3) - ASD Level						
Floor	W_x (lbs)	h_x (ft)	$w_x h_x^k$	C_{vx}	F_x (lbs)	F_x (psf)
Roof	75120	22	1652640	0.64	**16117**	**5.1**
Upper	85340	11	938740	0.36	**9155**	**3.6**
		Sum:	2591380		25272	

Where k = 1

Diaphragm Forces (ASCE 7-16 Section 12.10.1.1) - ASD Level						
Floor	F_i (lbs)	$\sum F_i$	W_i (lbs)	$\sum W_i$	$\sum F_i / \sum W_i$	F_{px} (lbs)
Roof	16117	16117	75120	75120	0.21	16117
Upper	9155	25272	85340	160460	0.16	13441

Floor	F_{px} Min (lbs)	F_{px} Max (lbs)	F_{px} Gov (lbs)	F_{px} Gov (psf)
Roof	11831	23663	**16117**	**5.1**
Upper	13441	26882	**13441**	**5.4**

Hazards by Location

Search Information

Address:	3206 74th Pl SE, Mercer Island, WA 98040, USA
Coordinates:	47.581423, -122.2390737
Elevation:	289 ft
Timestamp:	2021-04-26T20:28:03.937Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D-default

Basic Parameters

Name	Value	Description
S_S	1.406	MCE_R ground motion (period=0.2s)
S_1	0.489	MCE_R ground motion (period=1.0s)
S_{MS}	1.687	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.125	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.902	Coefficient of risk (0.2s)
CR_1	0.897	Coefficient of risk (1.0s)
PGA	0.602	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.722	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	1.406	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.558	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	3.375	Factored deterministic acceleration value (0.2s)
S1RT	0.489	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.546	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.366	Factored deterministic acceleration value (1.0s)
PGAd	1.16	Factored deterministic acceleration value (PGA)

ASCE 7-16 Wind Forces, Chapter 27, Part I

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DESCRIPTION: 3206 74th PL SE

3206 74th PL SE

Basic Values

Risk Category	2 per ASCE 7-16 Table 1.5-1	Horizontal Dim. in North-South Direction (B or L) =	79.0 ft
V : Basic Wind Speed	98.0	Horizontal Dim. in East-West Direction (B or L) =	39.0 ft
Kd : Directionality Factor	0.850 per ASCE 7-16 Table 26.6-1	h : Mean Roof height =	22.0 ft

Exposure Category per ASCE 7-16 Section 26.7

North : Exposure B — East : Exposure B
South : Exposure B — West : Exposure B

Topographic Factor per ASCE 7-16 Sec 26.8 & Figure 26.8-1

North :	K1 =	0.2650	K2 =	1.0	K3 =	1.0	Kzt =	1.600
South :	K1 =	0.2650	K2 =	1.0	K3 =	1.0	Kzt =	1.600
East :	K1 =	0.2650	K2 =	1.0	K3 =	1.0	Kzt =	1.600
West :	K1 =	0.2650	K2 =	1.0	K3 =	1.0	Kzt =	1.600

Building Period & Flexibility Category

User has specified the building frequency is >= 1 Hz, therefore considered RIGID for both North-South and East-West directions.

Building Story Data

Level Description	hi ft	Story Ht ft	E_R : X ft	E_R : X ft
Roof	22.00	11.00	0.000	0.000
1st	11.00	11.00	0.000	0.000

Gust Factor

For wind coming from direction indicated

North	=	0.850	South	=	0.850
East	=	0.850	West	=	0.850

Enclosure

Check if Building Qualifies as "Open"

	North Wall	South Wall	East Wall	West Wall	Roof	Total
Agross	1.0 ft^2	1.0 ft^2	1.0 ft^2	1.0 ft^2	1.0 ft^2	5.0 ft^2
Aopenings	0.0 ft^2	0.0 ft^2	0.0 ft^2	0.0 ft^2	0.0 ft^2	0.0 ft^2
Aopenings >= 0.8 * Agross ?	No	No	No	No		

All four Agross values must be non-zero — Building does NOT qualify as "Open"

User has specified the Building is to be considered Enclosed when NORTH elevation receives positive external pressure

User has specified the Building is to be considered Enclosed when SOUTH elevation receives positive external pressure

User has specified the Building is to be considered Enclosed when EAST elevation receives positive external pressure

User has specified the Building is to be considered Enclosed when WEST elevation receives positive external pressure

Velocity Pressures

When the following walls experience leeward or sidewall pressures, the value of Kh shall be (per Table 26.10-1) :

North Wall = 0.6412 psf — South Wall = 0.6412 psf — East Wall = 0.6412 psf — West Wall = 0.6412 psf

When the following walls experience leeward or sidewall pressures, the value of qh shall be (per Table 26.10-1) :

North Wall = 21.442 psf — South Wall = 21.442 psf — East Wall = 21.442 psf — West Wall = 21.442 psf

qz : Windward Wall Velocity Pressures at various heights per Eq. 26.10-1

Height Above Base (ft)	North Elevation Kz	North Elevation qz	South Elevation Kz	South Elevation qz	East Elevation Kz	East Elevation qz	West Elevation Kz	West Elevation qz
0.00	0.575	19.22	0.575	19.22	0.575	19.22	0.575	19.22
4.00	0.575	19.22	0.575	19.22	0.575	19.22	0.575	19.22
8.00	0.575	19.22	0.575	19.22	0.575	19.22	0.575	19.22
12.00	0.575	19.22	0.575	19.22	0.575	19.22	0.575	19.22

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16.00	0.585	19.58	0.585	19.58	0.585	19.58	0.585	19.58
20.00	0.624	20.87	0.624	20.87	0.624	20.87	0.624	20.87

Pressure Coefficients

GCpi Values when elevation receives positive external pressure

GCpi : Internal pressure coefficient, per sec. 26.13 and Table 26.13-1

North	South	East	West
+/- 0.180	+/- 0.180	+/- 0.180	+/- 0.180

Specify Cp Values from Figure 27.3-1 for Windward, Leeward & Side Walls

Cp Values when elevation receives positive external pressure

	North	South	East	West
Windward Wall	0.80	0.80	0.80	0.80
Leeward Wall	-0.50	-0.50	-0.50	-0.50
Side Walls	-0.70	-0.70	-0.70	-0.70

Wind Pressures

Wind Pressures when NORTH Elevation receives positive external wind pressure

	Positive Internal	Negative Internal
Leeward Wall Pressures	-12.973 psf	-5.253 psf
Side Wall Pressures	-16.618 psf	-8.899 psf

Windward Wall Pressures . . . Height Above Base (ft)	Positive Internal Pressure (psf)	Negative Internal Pressure (psf)
0.00	9.21	16.93
4.00	9.21	16.93
8.00	9.21	16.93
12.00	9.21	16.93
16.00	9.45	17.17
20.00	10.33	18.05

Wind Pressures when SOUTH Elevation receives positive external wind pressure

	Positive Internal	Negative Internal
Leeward Wall Pressures	-12.973 psf	-5.253 psf
Side Wall Pressures	-16.618 psf	-8.899 psf

Windward Wall Pressures . . . Height Above Base (ft)	Positive Internal Pressure (psf)	Negative Internal Pressure (psf)
0.00	9.21	16.93
4.00	9.21	16.93
8.00	9.21	16.93
12.00	9.21	16.93
16.00	9.45	17.17
20.00	10.33	18.05

Wind Pressures when EAST Elevation receives positive external wind pressure

	Positive Internal	Negative Internal
Leeward Wall Pressures	-12.973 psf	-5.253 psf
Side Wall Pressures	-16.618 psf	-8.899 psf

Windward Wall Pressures . . . Height Above Base (ft)	Positive Internal Pressure (psf)	Negative Internal Pressure (psf)
0.00	9.21	16.93
4.00	9.21	16.93
8.00	9.21	16.93

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12.00	9.21	16.93
16.00	9.45	17.17
20.00	10.33	18.05

Wind Pressures when WEST Elevation receives positive external wind pressure

	Positive Internal	Negative Internal
Leeward Wall Pressures	-12.973 psf	-5.253 psf
Side Wall Pressures	-16.618 psf	-8.899 psf

Windward Wall Pressures . . . Height Above Base (ft)	Positive Internal Pressure (psf)	Negative Internal Pressure (psf)
0.00	9.21	16.93
4.00	9.21	16.93
8.00	9.21	16.93
12.00	9.21	16.93
16.00	9.45	17.17
20.00	10.33	18.05

Story Forces for Design Wind Load Cases

Values below are calculated based on a building with dimensions B x L x h as defined on the "Basic Values" tab.

Load Case	Windward Wall	Building level	Ht. Range	Trib. Height	Wind Shear Components (k) In "Y" Direction	In "X" Direction	Eccentricity for (ft) "Y" Shear	"X" Shear	Mt, (ft-k)
CASE 1	North	Level 2	16.50' -> 22.00'	5.50	-4.96	---	---	---	---
CASE 1	North	Level 1	5.50' -> 16.50'	11.00	-9.53	---	---	---	---
CASE 1	South	Level 2	16.50' -> 22.00'	5.50	4.96	---	---	---	---
CASE 1	South	Level 1	5.50' -> 16.50'	11.00	9.53	---	---	---	---
CASE 1	East	Level 2	16.50' -> 22.00'	5.50	---	-10.05	---	---	---
CASE 1	East	Level 1	5.50' -> 16.50'	11.00	---	-19.30	---	---	---
CASE 1	West	Level 2	16.50' -> 22.00'	5.50	---	10.05	---	---	---
CASE 1	West	Level 1	5.50' -> 16.50'	11.00	---	19.30	---	---	---
CASE 2	North	Level 2	16.50' -> 22.00'	5.50	-3.72	---	---	5.85 +/-	21.8
CASE 2	North	Level 1	5.50' -> 16.50'	11.00	-7.15	---	---	5.85 +/-	41.8
CASE 2	South	Level 2	16.50' -> 22.00'	5.50	3.72	---	---	5.85 +/-	21.8
CASE 2	South	Level 1	5.50' -> 16.50'	11.00	7.15	---	---	5.85 +/-	41.8
CASE 2	East	Level 2	16.50' -> 22.00'	5.50	---	-7.54	11.52	--- +/-	86.9
CASE 2	East	Level 1	5.50' -> 16.50'	11.00	---	-14.47	11.52	--- +/-	166.8
CASE 2	West	Level 2	16.50' -> 22.00'	5.50	---	7.54	11.52	--- +/-	86.9
CASE 2	West	Level 1	5.50' -> 16.50'	11.00	---	14.47	11.52	--- +/-	166.8
CASE 3	North & East	Level 2	16.50' -> 22.00'	5.50	-3.72	-7.54	---	---	---
CASE 3	North & East	Level 1	5.50' -> 16.50'	11.00	-7.15	-14.47	---	---	---
CASE 3	North & West	Level 2	16.50' -> 22.00'	5.50	-3.72	7.54	---	---	---
CASE 3	North & West	Level 1	5.50' -> 16.50'	11.00	-7.15	14.47	---	---	---
CASE 3	South & West	Level 2	16.50' -> 22.00'	5.50	3.72	7.54	---	---	---
CASE 3	South & West	Level 1	5.50' -> 16.50'	11.00	7.15	14.47	---	---	---
CASE 3	South & East	Level 2	16.50' -> 22.00'	5.50	3.72	-7.54	---	---	---
CASE 3	South & East	Level 1	5.50' -> 16.50'	11.00	7.15	-14.47	---	---	---
CASE 4	North & East	Level 2	16.50' -> 22.00'	5.50	-2.79	-5.66	11.52	5.85 +/-	81.6

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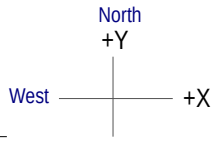
CASE 4	North & East	Level 1	5.50' ->	16.50'	11.00	-5.36	-10.86	11.52	5.85 +/-	156.6
CASE 4	North & West	Level 2	16.50' ->	22.00'	5.50	-2.79	5.66	11.52	5.85 +/-	81.6
CASE 4	North & West	Level 1	5.50' ->	16.50'	11.00	-5.36	10.86	11.52	5.85 +/-	156.6
CASE 4	South & West	Level 2	16.50' ->	22.00'	5.50	2.79	5.66	11.52	5.85 +/-	81.6
CASE 4	South & West	Level 1	5.50' ->	16.50'	11.00	5.36	10.86	11.52	5.85 +/-	156.6
CASE 4	South & East	Level 2	16.50' ->	22.00'	5.50	2.79	-5.66	11.52	5.85 +/-	81.6
CASE 4	South & East	Level 1	5.50' ->	16.50'	11.00	5.36	-10.86	11.52	5.85 +/-	156.6
Min per ASCE 27.1.5	North	Level 2	16.50' ->	22.00'	5.50	-3.43	---	---	---	---
Min per ASCE 27.1.5	North	Level 1	5.50' ->	16.50'	11.00	-6.86	---	---	---	---
Min per ASCE 27.1.5	South	Level 2	16.50' ->	22.00'	5.50	3.43	---	---	---	---
Min per ASCE 27.1.5	South	Level 1	5.50' ->	16.50'	11.00	6.86	---	---	---	---
Min per ASCE 27.1.5	East	Level 2	16.50' ->	22.00'	5.50	---	-6.95	---	---	---
Min per ASCE 27.1.5	East	Level 1	5.50' ->	16.50'	11.00	---	-13.90	---	---	---
Min per ASCE 27.1.5	West	Level 2	16.50' ->	22.00'	5.50	---	6.95	---	---	---
Min per ASCE 27.1.5	West	Level 1	5.50' ->	16.50'	11.00	---	13.90	---	---	---

Base Shear for Design Wind Load Cases

Values below are calculated based on a building with dimensions B x L x h as defined on the "General" tab.



Load Case	Windward Wall	Leeward Wall	Wind Base Shear Components (k) In "Y" Direction	In "X" Direction		Mt, (ft-k)
Case 1	North	South	-14.49	---		---
Case 1	South	North	14.49	---		---
Case 1	East	West	---	-29.35		---
Case 1	West	East	---	29.35		---
Case 2	North	South	-10.87	---	+/-	63.6
Case 2	South	North	10.87	---	+/-	63.6
Case 2	East	West	---	-22.01	+/-	253.7
Case 2	West	East	---	22.01	+/-	253.7
Case 3	North & East	South & West	-10.87	-22.01		---
Case 3	North & West	South & East	-10.87	22.01		---
Case 3	South & West	North & East	10.87	22.01		---
Case 3	South & East	North & West	10.87	-22.01		---
Case 4	North & East	South & West	-8.16	-16.52	+/-	238.1
Case 4	North & West	South & East	-8.16	16.52	+/-	238.1
Case 4	South & West	North & East	8.16	16.52	+/-	238.1
Case 4	South & East	North & West	8.16	-16.52	+/-	238.1
Min per ASCE 27.1.5	North	South	-10.30	---		---
Min per ASCE 27.1.5	South	North	10.30	---		---
Min per ASCE 27.1.5	East	West	---	-20.86		---
Min per ASCE 27.1.5	West	East	---	20.86		---

GOVERNING LATERAL LOAD IN MLFRS

SEISMIC

$$V_{SEISMIC} = \frac{25272^{\#}}{EL,ASD}$$

WIND

$$V_{WIND,MAX} = 0.6 \times 29350^{\#} = \frac{17610^{\#}}{WL,ASD}$$

$\rightarrow V_{SEISMIC} > V_{WIND,MAX}$

$\therefore$ SEISMIC GOVERNS MLFRS DESIGN

DEHAVEN
20025

10/1/20

ROOF FRAMING

RR1 DECK ROOF RAFTERS

BACKSPAN = 7'-0"
CANTILEVER = 3'-0"

W = 10 + 20 + 25 psf (DL, LL, SL)

USE 2x6 @ 24" o.c.

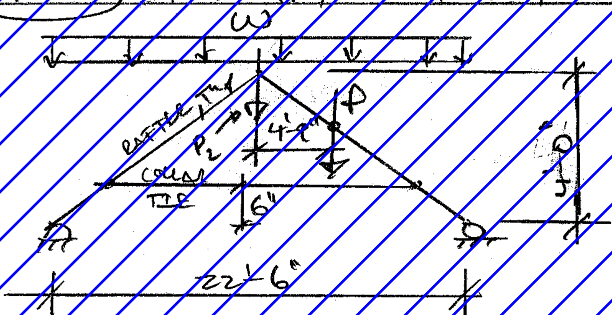
RR2 SECONDARY RAFTERS of VAULTED CEILING

SPAN = 11'-3"

W = 14 + 20 + 25 psf (DL, LL, SL)

USE DBL 2x6 @ 48" o.c.

RR3 PRIMARY RAFTERS of VAULTED CEILING



W = (14 + 20 + 25)(2') = 30 + 40 + 50 #/ft (DL, LL, SL)

(SOFFIT)
P_1 = (5 + 20)(1' + 7'/2)(4') = 90 + 36 # (DL, LL)

P_2 = (14 + 20 + 25)(2')(22'-6"/2) (DL, LL, SL)

= 320 + 450 + 560 # (DL, LL, SL)

USE DBL 2x10 RAFTERS @ 48" o.c.

USE (2) 3 1/16 x 3 COLLAR TIE
w/ (3) 1/2" Ø THRU-BOLTS EACH END

COLLAR TIE SAG = 5wL^4 / 384EI = (5)(19.4)(20)^4 / (384)(2000)(0.42)
= 0.38" = L/425 ok

RH4 ROOF HEADER

SPAN = 22'-6"

(ROOF) (SOFFIT)
W = (14 + 20 + 25)(30'/2) + (45 + 184 #)/2' x 6'-6"/22'-6" (DL, LL, SL) (DL, LL)

USE 3 1/2 x 16 PSL

= 220 + 300 + 380 + 30 #/ft (DL, LL, SL, LL)

RB5 Roof Deck Beam

BACK SPAN = 20'-6"
CANTILEVER = 3'-6" Each End

$w = \underset{DL}{(10} + \underset{RL}{20} + \underset{SL}{25)}\left(\frac{7'}{2} + 3\frac{1}{6}''\right) = \underset{DC}{70} + \underset{RL}{140} + \underset{SL}{180}$ #/ft

USE DBL C16x15.3

RH6 ROOF HEADER

SPAN = 6'-3" $w = \underset{DC}{(14} + \underset{RL}{20} + \underset{SL}{25)}\left(\frac{24'}{2}\right) = \underset{DL}{170} + \underset{RL}{240} + \underset{SL}{300}$ #/ft

USE (2) 1 3/4 x 7 1/4 LVL $P = \underset{DC}{(14} + \underset{RL}{20} + \underset{SL}{25)}\left(\frac{28'}{2}\right)\left(\frac{11'}{2}\right) = \underset{DC}{1400} + \underset{RL}{2000} + \underset{SL}{2500}$ # $e_x = 6''$

~~ISS~~ SUSPENDED ~~SOFFIT JOIST~~

BACK SPAN = 7'-0"
CANTILEVER = 1'-0"

$w = \underset{DL}{5} + \underset{LL}{20}$ psf USE 2x8 @ 16" o.c. MAX

UPPER FLOOR FRAMING

UFH1 UPPER FLOOR HEADER

SPAN = 8'-9"

$W_1 = \left(\underset{DL}{10} + \underset{SL}{25} + \underset{LL}{60}\right)_{DECK} \left(\frac{13'}{2}\right) = \underset{DL}{70} + \underset{RM}{160} + \underset{SL}{390}$ #/FT

USE (2) 1 3/4 x 11 7/8 LVL

$P = \underset{DL}{2670} + \underset{RM}{3320} + \underset{SL}{4280} + \underset{LL}{340}$ # (RXN @ RH4)

$+ 1.4 \times \frac{2.5'}{1.3} \times \frac{14660\ \#/FT}{5'} = 7900\#$ EL @ x = 4' (SW (3.2))

$W_2 = \left(\underset{DL}{220} + \underset{RM}{300} + \underset{SL}{380} + \underset{LL}{30}\ \#/FT\right)_{(ROOF, SIM TO RH4)} + \underset{DL}{(10)}_{(WALL)}(8')$

$= \underset{DL}{300} + \underset{RM}{300} + \underset{SL}{380} + \underset{LL}{30}$ #/FT FROM x = 4' TO 8'-9"

UFB2 UPPER FLOOR BEAM

BACKSPAN = 7'-0"
CANTILEVER = 8'-0"

$W_1 = \left(\underset{DL}{14} + \underset{LL}{40}\right)_{(UPPER FLR)} (16") = \underset{DL}{19} + \underset{LL}{53}$ #/FT

USE 1 3/4 x 11 7/8 LVL

$W_2 = \left(\underset{DL}{90} + \underset{LL}{60}\right)_{(PLANTER)} \left(\frac{4'6"}{2}\right) + \underset{DL}{(10)}_{(WALL)}(8') = \underset{DL}{280} + \underset{LL}{140}$ #/FT

FROM x = 7' TO 10'

PBX PLANTER BOX JOISTS

SPAN = 4'-6"

$W = \underset{DL}{90} + \underset{LL}{60}$ #/ft

USE 4x4 PT@16" o.c.

EUFB3 (E) UPPER FLOOR BEAM (WORST CASE SPAN)

SPAN = 19'-6"

$W = \left(\underset{DL}{10} + \underset{RM}{20} + \underset{SL}{25}\right)_{(DECK ROOF)} \left(\frac{7'}{2}\right) + \left(\underset{DL}{14} + \underset{LL}{40}\right)_{(UPPER FLR)} \left(\frac{16'}{2}\right) + \left(\underset{DL}{19} + \underset{SL}{25} + \underset{LL}{60}\right)_{(DECK)} \left(\frac{7'}{2}\right) + \underset{DL}{(10)}_{(WALL)}(11')$

USE (E) 6 3/4 x 18 GLB

$= \underset{DL}{320} + \underset{RM}{70} + \underset{SL}{180} + \underset{LL}{530}$ #/FT

DECK FRAMING

DJ1 DECK JOIST

SPAN = 12'-9" $w = \frac{19}{DL} + \frac{25}{SL} + \frac{60}{LL}$ plf USE 2x12 @ 16" O.C.

DB2 DECK BEAM

SPAN = 12'-9" $w_1 = \left(\frac{19}{DL} + \frac{60}{LL}\right)\left(\frac{4'-6"}{2}\right) = \frac{210}{DL} + \frac{140}{LL}$ #/FT (PLANTER) from x = 7'-6" to 10'-3"

USE 4x12 $w_2 = \left(\frac{14}{DL} + \frac{25}{SL} + \frac{60}{LL}\right)\left(\frac{15'}{2}\right) = \frac{84}{DL} + \frac{150}{SL} + \frac{450}{LL}$ #/FT (STAIR) from x = 14'-3" to 12'-9"

DB3 DECK BEAM

BACK SPAN = 15'-0"
CANTILEVER = 3'-6"

$w = \left(\frac{19}{DL} + \frac{25}{RLL} + \frac{60}{SL}\right)\left(\frac{13'}{2} + 1'\right) = \frac{140}{DL} + \frac{190}{SL} + \frac{430}{LL}$ #/FT Deck

USE 5 1/2 x 13 1/2 PT GLB

$P = \frac{610}{DL} + \frac{1280}{LL} + \frac{430}{SL}$ # Ex DB2 @ x = 18'-6"

DJ4 DECK JOIST

BACK SPAN = 6'-9"
CANTILEVER = 3'-6"

$w = \frac{14}{DC} + \frac{25}{SL} + \frac{60}{LL}$ plf

$P = \left(\frac{10}{DC}\right)\left(12'\right)\left(16"\right) = \frac{160}{DL}$ # (WALL) @ x = 1'-9"

USE 2x6 @ 16" O.C.

DH6 DECK HEADER

SPAN = 8'-3"

$w = \left(\frac{19}{DC} + \frac{25}{SL} + \frac{60}{LL}\right)\left(3'-6" + \frac{7'}{2}\right) = \frac{130}{DL} + \frac{180}{SL} + \frac{420}{LL}$ #/FT

USE 5 1/2 x 9 GLB

$P = 2\left(\frac{690}{DC} + \frac{180}{RLL} + \frac{1240}{SL}\right) = \frac{1380}{DC} + \frac{1460}{RLL} + \frac{2480}{SL}$ # Ex RB5 @ x = 2'

DH7 DECK HEADER

SPAN = 16'-3"

$w = \frac{130}{DL} + \frac{180}{SL} + \frac{420}{LL}$ #/FT (SIM TO DH6)

USE 5 1/2 x 12 GLB

DB 8 DECK BEAM (SW 4-3)

SPAN = 7'-0" $P = 1.4 \times \frac{2.5}{1.3} \times \frac{35655\#\cdot ft}{16'} = 6{,}000\#$ @ x = 1'-9"

(LRFD above 1.4; Ω/S beneath 2.5/1.3; OTM above 35655; L wall beneath 16'; E4 / LRFD beneath 6,000#)

USE DBL 1 3/4 x 7 1/4 LVL

POST

POST SUPPORTING DB3

H = 9'-0" $P = \left(\underset{DL}{19} + \underset{SL}{25} + \underset{LL}{60}\right)\left(\frac{14'}{2}\right)/15' = \underset{DL}{2040^{\#}} + \underset{SL}{2630^{\#}} + \underset{LL}{6300^{\#}}$

USE 6x6 PT

FOUNDATIONS

CONSERVATIVE TRIB LENGTH

(F1) EXTERIOR STRIP FOOTING

RXN (DH6)

$w = [(1630 + 1480 + 2620 + 1730^{\#}) + (1170 + 1460 + 3400^{\#})] / 6'$
(DL, RLL, SL, WL) (DL, SL, WL)

$= 470 + 250 + 680 + 860 \ ^{\#}/ft$ (DL, RLL, SL, WL) (UNFACTORED)

$W_{FACTORED} = 470 + 0.75(680 + 860) = 1630 \ ^{\#}/ft$

USE 15" WIDE STRIP FOOTING GOOD FOR $15/12 \times 2000 = 2500 \ ^{\#}/ft$ ok

(F2) DECK PIER w/ HELICAL PILE

$P = 2000 \quad 2630 \quad 6300^{\#}$ (DL, SL, WL) (UNFACTORED) SAME AS POST SUPPORTING DB2

$P_{FACTORED} = 2000 + 0.75(2630 + 6300) = 8700^{\#}$

$P_{all, PIER} = \frac{K_t \times T}{SF} = \frac{(9 ft^{-1})(T)}{2} > 8700^{\#}$

$\rightarrow T > 1930^{\#}$

USE 4000 ft# FINAL TORQUE ok

(E4) (E) INTERIOR PAD FOOTING

RXN (EUFB3)

$P = (320 + 70 + 180 + 530^{\#}/ft)(\frac{32'}{2}) = 5120 + 1120 + 2880 + 8480^{\#}$
(DL, RLL, SL, WL) (DL, RLL, SL, WL) (UNFACTORED)

$P_{FACTORED} = 5120 + 0.75(2880 + 8480) = 13640^{\#}$

USE (E) 3'-0" SQ. PAD FOOTING GOOD FOR $3^2 \times 2000 = 18000^{\#}$ ok

RETROFIT HELICAL PILES

(4PN RH4)

$P_{MAX} = \frac{2870}{DL} + \frac{3380}{RLL} + \frac{4280}{SL} + \frac{340^{\#}}{W}$ (UNFACTORED)

$P_{FACTORED} = 2870 + 4280 = 6950^{\#}$

USE 40,000# FINAL TORQUE

GOOD FOR $\frac{(9)(40,000)}{2} = 180,000^{\#}$ OK

Multiple Simple Beam

Lic. # : KW-06011183 — O.G. Engineering, PLLC

Description : Roof Framing

Wood Beam Design : RR1 - Deck Roof Rafters

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **2x6, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2018 Load Combinations, Major Axis Bending
Wood Species : Douglas Fir-Larch — Wood Grade : No.2

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.210 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

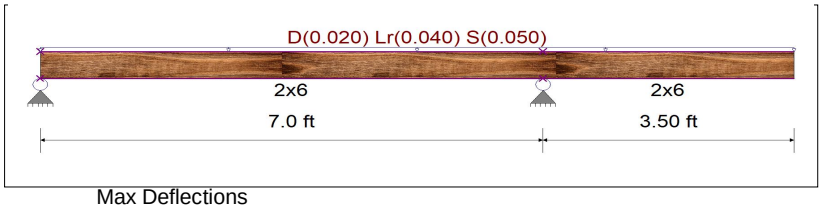
Unif Load: D = 0.010, Lr = 0.020, S = 0.0250 k/ft, Trib= 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.440** : 1
fb : Actual : 680.33 psi at 7.000 ft in Span # 1
Fb : Allowable : 1,547.33 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.241** : 1
fv : Actual : 49.89 psi at 6.545 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.05		0.14	0.13			
Right Support	0.16		0.32	0.39			



Max Deflections

Transient Downward	0.143 in	Total Downward	0.162 in
Ratio	588	Ratio	518
	Lr Only, LL Comb Run (*L		D+Lr+H, LL Comb Run (*L
Transient Upward	-0.104 in	Total Upward	-0.084 in
Ratio	808	Ratio	994
	Lr Only, LL Comb Run (L*		D+Lr+H, LL Comb Run (L*

Wood Beam Design : RR2 - Secondary Rafters over Vaulted Ceiling

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **2-2x6, Sawn, Fully Braced**
Using Allowable Stress Design with IBC 2018 Load Combinations, Major Axis Bending
Wood Species : Douglas Fir-Larch — Wood Grade : No.2

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.210 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

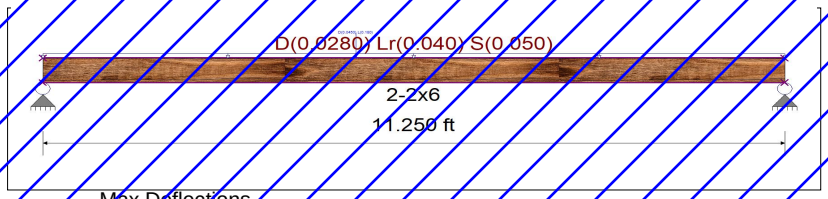
Unif Load: D = 0.0140, Lr = 0.020, S = 0.0250 k/ft, Trib= 2.0 ft
Point: D = 0.0480, L = 0.180 k @ 4.750 ft

Design Summary

Max fb/Fb Ratio = **0.772** : 1
fb : Actual : 1,193.98 psi at 4.763 ft in Span # 1
Fb : Allowable : 1,547.33 psi
Load Comb : +D+0.750L+0.750S+H

Max fv/FvRatio = **0.195** : 1
fv : Actual : 40.27 psi at 0.000 ft in Span # 1
Fv : Allowable : 207.00 psi
Load Comb : +D+0.750L+0.750S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.18	0.10	0.23	0.28			
Right Support	0.18	0.08	0.23	0.28			



Max Deflections

Transient Downward	0.272 in	Total Downward	0.491 in
Ratio	495	Ratio	274
	LC: S Only		C: +D+0.750L+0.750S+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

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Lic. # : KW-06011183 — O.G. Engineering, PLLC

Multiple Simple Beam

Wood Beam Design : RH4 - Roof Header

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **3.5x16.0, Parallam PSL, Fully Braced**
Using Allowable Stress Design with IBC 2018 Load Combinations, Major Axis Bending

Wood Species : iLevel Truss Joist — Wood Grade : Parallam PSL 2.2E

Fb - Tension	2,900.0 psi	Fc - Prll	2,900.0 psi	Fv	290.0 psi	Ebend- xx	2,200.0 ksi	Density	45.070 pcf
Fb - Compr	2,900.0 psi	Fc - Perp	750.0 psi	Ft	2,025.0 psi	Eminbend - xx	1,118.19 ksi		

Applied Loads

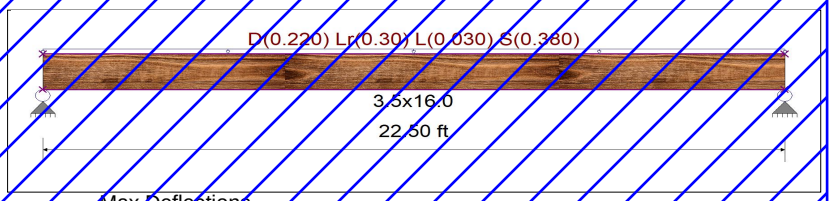
Beam self weight calculated and added to loads
Unif Load: D = 0.220, Lr = 0.30, L = 0.030, S = 0.380 k/ft, Trib= 1.0 ft

Design Summary

Max fb/Fb Ratio = **0.972** : 1
fb : Actual : 3,140.19 psi at 11.250 ft in Span # 1
Fb : Allowable : 3,230.19 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.495** : 1
fv : Actual : 165.00 psi at 21.225 ft in Span # 1
Fv : Allowable : 333.50 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	2.67	0.34	3.38	4.28			
Right Support	2.67	0.34	3.38	4.28			



Max Deflections

Transient Downward	0.838 in	Total Downward	1.362 in
Ratio	322	Ratio	198
	LC: S Only		LC: +D+S+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Steel Beam Design : RB5 - Roof Deck Beam (Each Channel takes 1/2 of Load)

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16

STEEL Section : **C10x15.3, Fully Braced**
Using Allowable Strength Design with IBC 2018 Load Combinations, Major Axis Bending

Fy = 36.0 ksi E = 29,000.0 ksi

Applied Loads

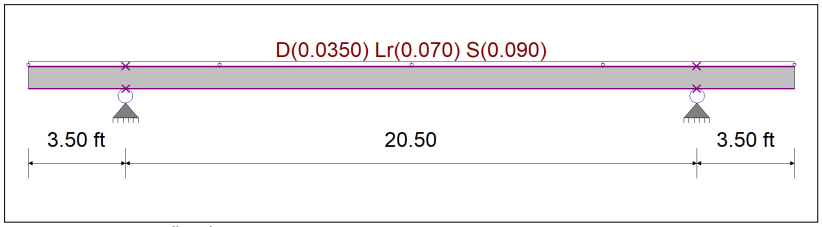
Beam self weight calculated and added to loads
Unif Load: D = 0.0350, Lr = 0.070, S = 0.090 k/ft, Trib= 1.0 ft

Design Summary

Max fb/Fb Ratio = **0.228** : 1
Mu : Applied 6.511 k-ft at 10.250 ft in Span # 2
Mn / Omega : Allow 28.563 k-ft
Load Comb : +D+S+H

Max fv/FvRatio = **0.046** : 1
Vu : Applied 1.438 k at 0.000 ft in Span # 2
Vn / Omega : Allow 31.042 k
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.69		0.98	1.24			
Right Support	0.69		0.98	1.24			



Max Deflections

Transient Downward	0.159 in	Total Downward	0.248 in
Ratio	1545	Ratio	991
	LC: S Only		LC: +D+S+H
Transient Upward	-0.081 in	Total Upward	-0.126 in
Ratio	1034	Ratio	664
	LC: S Only		LC: +D+S+H

Wood Beam Design : RH6 - Roof Header

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **2-1.75x7.25, Microllam LVL, Fully Braced**
Using Allowable Stress Design with IBC 2018 Load Combinations, Major Axis Bending

Wood Species : iLevel Truss Joist — Wood Grade : MicroLam LVL 2.0 E

Fb - Tension	2600 psi	Fc - Prll	2510 psi	Fv	285 psi	Ebend- xx	2000 ksi	Density	42.01 pcf
Fb - Compr	2600 psi	Fc - Perp	750 psi	Ft	1555 psi	Eminbend - xx	1016.535 ksi		

Applied Loads

Beam self weight calculated and added to loads
Unif Load: D = 0.170, Lr = 0.240, S = 0.30 k/ft, Trib= 1.0 ft
Point: D = 1.40, Lr = 2.0, S = 2.50 k @ 0.50 ft

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Multiple Simple Beam

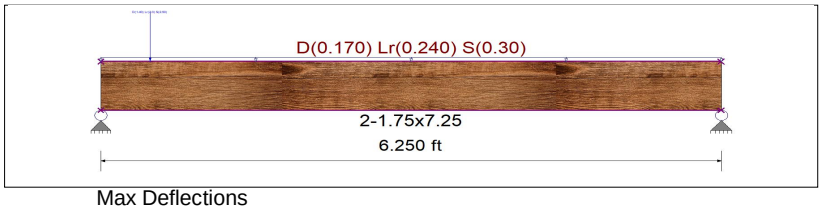
Lic. # : KW-06011183 — O.G. Engineering, PLLC

Design Summary

Max fb/Fb Ratio = **0.446** : 1
fb : Actual : 1,333.79 psi at 2.479 ft in Span # 1
Fb : Allowable : 2,990.00 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.916** : 1
fv : Actual : 300.29 psi at 0.000 ft in Span # 1
Fv : Allowable : 327.75 psi
Load Comb : +D+S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	1.84		2.59	3.24			
Right Support	0.67		0.91	1.14			



Max Deflections

Transient Downward	0.070 in	Total Downward	0.111 in
Ratio	1064	Ratio	673
	LC: S Only		LC: +D+S+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : SSB - Suspended Soffit Joists

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **2x8, Sawn, Fully Unbraced**
Using Allowable Stress Design with IBC 2018 Load Combinations, Major Axis Bending
Wood Species : Douglas Fir-Larch — Wood Grade : No.2

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.210 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

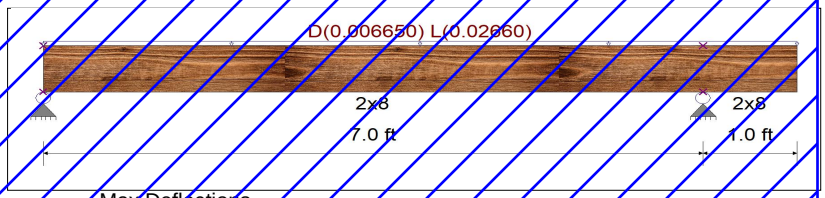
Unif Load: D = 0.0050, L = 0.020 k/ft, Trib= 1.330 ft

Design Summary

Max fb/Fb Ratio = **0.191** : 1
fb : Actual : 184.46 psi at 3.500 ft in Span # 1
Fb : Allowable : 963.38 psi
Load Comb : +D+L+H, LL Comb Run (L*)

Max fv/FvRatio = **0.076** : 1
fv : Actual : 13.65 psi at 6.405 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H, LL Comb Run (LL)

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.02	0.09					
Right Support	0.03	0.12					



Max Deflections

Transient Downward	0.019 in	Total Downward	0.024 in
Ratio	4419	Ratio	3570
	L Only, LL Comb Run (L*)		D+L+H, LL Comb Run (L*)
Transient Upward	-0.009 in	Total Upward	-0.011 in
Ratio	2764	Ratio	2268
	L Only, LL Comb Run (L*)		D+L+H, LL Comb Run (L*)

Multiple Simple Beam

Lic. # : KW-06011183 — O.G. Engineering, PLLC

Description : Upper Floor Framing

Wood Beam Design : UFH1 - Upper Floor Header

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **2-1.75x11.87, Microllam LVL, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending

Wood Species : iLevel Truss Joist — Wood Grade : MicroLam LVL 2.0 E

Fb - Tension	2,600.0 psi	Fc - Prll	2,510.0 psi	Fv	285.0 psi	Ebend- xx	2,000.0 ksi	Density	42.010 pcf
Fb - Compr	2,600.0 psi	Fc - Perp	750.0 psi	Ft	1,555.0 psi	Eminbend - xx	1,016.54 ksi		

Applied Loads

Beam self weight calculated and added to loads
Unif Load: D = 0.30, Lr = 0.30, L = 0.030, S = 0.380 k/ft, Trib= 1.0 ft
Point: D = 2.670, Lr = 3.380, L = 0.340, S = 4.280, E = 7.90 k @ 4.0 ft

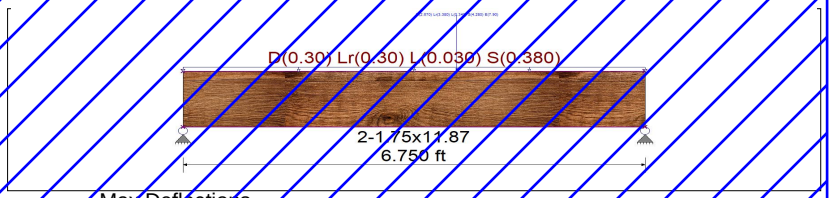
Design Summary

Max fb/Fb Ratio = **0.737** : 1
fb : Actual : 2,204.23 psi at 4.005 ft in Span # 1
Fb : Allowable : 2,990.00 psi
Load Comb : +D+S+H

Max fv/FvRatio = **0.637** : 1
fv : Actual : 208.78 psi at 5.783 ft in Span # 1
Fv : Allowable : 327.75 psi
Load Comb : +D+S+H

Max Reactions (k)

	D	L	Lr	S	W	E	H
Left Support	2.14	0.24	2.39	3.03		3.22	
Right Support	2.64	0.30	3.02	3.82		4.68	



Max Deflections

Transient Downward	0.086 in	Total Downward	0.142 in
Ratio	942	Ratio	572
	LC: E Only		+0.750L+0.750S+0.525OE
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : UFB2 - Upper Floor Beam

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **1.75x11.87, Microllam LVL, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending

Wood Species : iLevel Truss Joist — Wood Grade : MicroLam LVL 2.0 E

Fb - Tension	2,600.0 psi	Fc - Prll	2,510.0 psi	Fv	285.0 psi	Ebend- xx	2,000.0 ksi	Density	42.010 pcf
Fb - Compr	2,600.0 psi	Fc - Perp	750.0 psi	Ft	1,555.0 psi	Eminbend - xx	1,016.54 ksi		

Applied Loads

Beam self weight calculated and added to loads
Unif Load: D = 0.0190, L = 0.0530 k/ft, Trib= 1.0 ft
Unif Load: D = 0.280, L = 0.140 k/ft, 7.0 to 10.0 ft, Trib= 1.0 ft

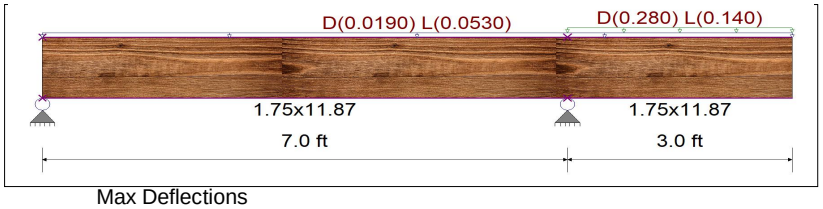
Design Summary

Max fb/Fb Ratio = **0.252** : 1
fb : Actual : 653.92 psi at 7.000 ft in Span # 1
Fb : Allowable : 2,600.00 psi
Load Comb : +D+L+H, LL Comb Run (LL)

Max fv/FvRatio = **0.255** : 1
fv : Actual : 72.80 psi at 7.000 ft in Span # 1
Fv : Allowable : 285.00 psi
Load Comb : +D+L+H, LL Comb Run (LL)

Max Reactions (k)

	D	L	Lr	S	W	E	H
Left Support	-0.11	0.19					
Right Support	1.20	0.89					



Max Deflections

Transient Downward	0.028 in	Total Downward	0.069 in
Ratio	2534	Ratio	1036
	L Only, LL Comb Run (*L)		D+L+H, LL Comb Run (*L)
Transient Upward	-0.010 in	Total Upward	-0.022 in
Ratio	8640	Ratio	3752
	L Only, LL Comb Run (*L)		D+L+H, LL Comb Run (*L)

Multiple Simple Beam

Lic. # : KW-06011183 — O.G. Engineering, PLLC

Wood Beam Design : PBX - Planter Box Joists

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **4x4, Sawn, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending
Wood Species : Hem-Fir — Wood Grade : No.2

Fb - Tension	850 psi	Fc - Prll	1300 psi	Fv	150 psi	Ebend- xx	1300 ksi	Density	26.84 pcf
Fb - Compr	850 psi	Fc - Perp	405 psi	Ft	525 psi	Eminbend - xx	470 ksi		

Applied Loads

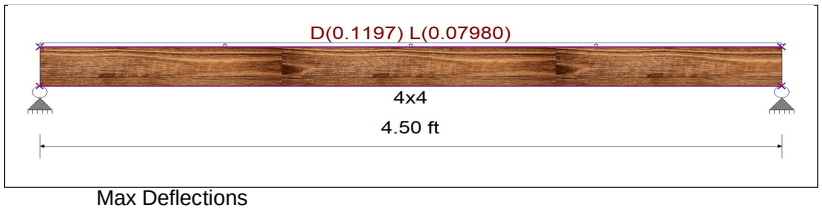
Unif Load: D = 0.090, L = 0.060 k/ft, Trib= 1.330 ft

Design Summary

Max fb/Fb Ratio = **0.723** : 1
fb : Actual : 848.02 psi at 2.250 ft in Span # 1
Fb : Allowable : 1,173.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.412** : 1
fv : Actual : 48.00 psi at 0.000 ft in Span # 1
Fv : Allowable : 116.40 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.27	0.18					
Right Support	0.27	0.18					



Max Deflections

Transient Downward	0.051 in	Total Downward	0.126 in
Ratio	1067	Ratio	426
	LC: L Only		LC: +D+L+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : EUFB3 - (E) Upper Floor Beam

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **6.75x18, GLB, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending
Wood Species : DF/DF — Wood Grade : 24F-V4

Fb - Tension	2400 psi	Fc - Prll	1650 psi	Fv	265 psi	Ebend- xx	1800 ksi	Density	31.21 pcf
Fb - Compr	1850 psi	Fc - Perp	650 psi	Ft	1100 psi	Eminbend - xx	950 ksi		

Applied Loads

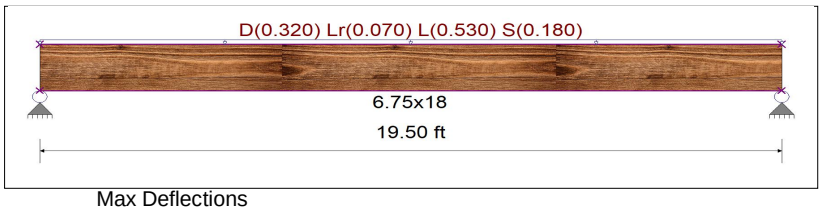
Beam self weight calculated and added to loads
Unif Load: D = 0.320, Lr = 0.070, L = 0.530, S = 0.180 k/ft, Trib= 1.0 ft

Design Summary

Max fb/Fb Ratio = **0.607** : 1
fb : Actual : 1,371.30 psi at 9.750 ft in Span # 1
Fb : Allowable : 2,258.71 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.337** : 1
fv : Actual : 89.31 psi at 18.005 ft in Span # 1
Fv : Allowable : 265.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	3.38	5.17	0.68	1.76			
Right Support	3.38	5.17	0.68	1.76			



Max Deflections

Transient Downward	0.294 in	Total Downward	0.487 in
Ratio	797	Ratio	480
	LC: L Only		.C: +D+0.750L+0.750S+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Multiple Simple Beam

Lic. # : KW-06011183 — O.G. Engineering, PLLC

Description : Deck Framing

Wood Beam Design : DJ1 - Deck Joists

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **2x12, Sawn, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending
Wood Species : Douglas Fir-Larch — Wood Grade : No.2

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.210 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

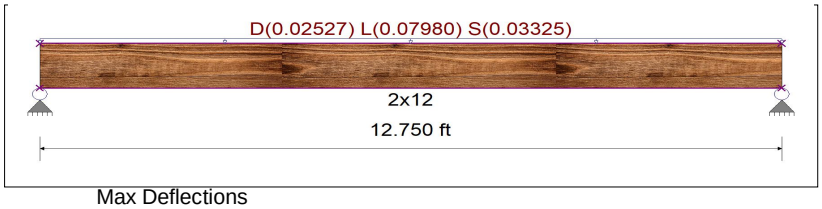
Unif Load: D = 0.0190, L = 0.060, S = 0.0250 k/ft, Trib= 1.330 ft

Design Summary

Max fb/Fb Ratio = **0.782** : 1
fb : Actual : 809.74 psi at 6.375 ft in Span # 1
Fb : Allowable : 1,035.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.282** : 1
fv : Actual : 50.81 psi at 11.815 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.16	0.51		0.21			
Right Support	0.16	0.51		0.21			



Max Deflections

Transient Downward	0.168 in	Total Downward	0.231 in
Ratio	913	Ratio	662
	LC: L Only		.C: +D+0.750L+0.750S+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : DB3 - Deck Beam

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **5.5x13.5, GLB, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending
Wood Species : DF/DF — Wood Grade : 24F-V8

Fb - Tension	2,400.0 psi	Fc - Prll	1,650.0 psi	Fv	265.0 psi	Ebend- xx	1,800.0 ksi	Density	31.210 pcf
Fb - Compr	2,400.0 psi	Fc - Perp	650.0 psi	Ft	1,100.0 psi	Eminbend - xx	950.0 ksi		

Applied Loads

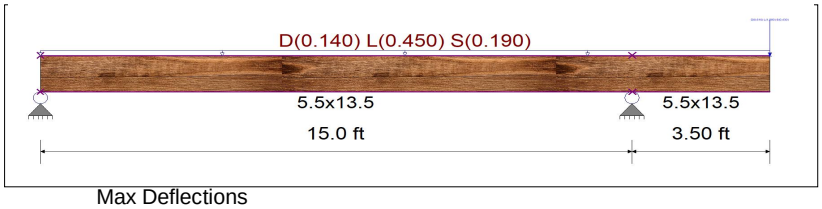
Beam self weight calculated and added to loads
Unif Load: D = 0.140, L = 0.450, S = 0.190 k/ft, Trib= 1.0 ft
Point: D = 0.610, L = 1.280, S = 0.430 k @ 18.50 ft

Design Summary

Max fb/Fb Ratio = **0.465** : 1
fb : Actual : 1,115.91 psi at 7.125 ft in Span # 1
Fb : Allowable : 2,400.00 psi
Load Comb : +D+L+H, LL Comb Run (L*)

Max fv/FvRatio = **0.351** : 1
fv : Actual : 92.88 psi at 13.950 ft in Span # 1
Fv : Allowable : 265.00 psi
Load Comb : +D+L+H, LL Comb Run (LL)

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.96	3.38		1.25			
Right Support	2.53	6.71		2.70			



Max Deflections

Transient Downward	0.255 in	Total Downward	0.306 in
Ratio	642	Ratio	588
	L Only, LL Comb Run (*L)		)+L+H, LL Comb Run (L*)
Transient Upward	-0.189 in	Total Upward	-0.198 in
Ratio	444	Ratio	424
	L Only, LL Comb Run (L*)		)+L+H, LL Comb Run (L*)

Multiple Simple Beam

Wood Beam Design : DJ4 - Deck Joists

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **2x8, Sawn, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending
Wood Species : Hem-Fir Wood Grade : No.2

Fb - Tension	850.0 psi	Fc - Prll	1,300.0 psi	Fv	150.0 psi	Ebend- xx	1,300.0 ksi	Density	26.840 pcf
Fb - Compr	850.0 psi	Fc - Perp	405.0 psi	Ft	525.0 psi	Eminbend - xx	470.0 ksi		

Applied Loads

Unif Load: D = 0.0190, L = 0.060, S = 0.0250 k/ft, Trib= 1.330 ft
Point: D = 0.160 k @ 1.750 ft

Design Summary

Max fb/Fb Ratio = **0.662** : 1
fb : Actual : 621.67 psi at 2.768 ft in Span # 1
Fb : Allowable : 938.40 psi
Load Comb : +D+L+H, LL Comb Run (L*)

Max fv/FvRatio = **0.582** : 1
fv : Actual : 67.78 psi at 6.750 ft in Span # 1
Fv : Allowable : 116.40 psi
Load Comb : +D+L+H, LL Comb Run (LL)

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.18	0.27		0.08			
Right Support	0.24	0.62		0.26			

Max Deflections

Transient Downward	0.166 in	Total Downward	0.151 in
Ratio	506	Ratio	556
	L Only, LL Comb Run (*L)		D+L+H, LL Comb Run (*L)
Transient Upward	-0.111 in	Total Upward	-0.126 in
Ratio	756	Ratio	668
	L Only, LL Comb Run (L*)		D+L+H, LL Comb Run (L*)

Wood Beam Design : DH6 - Deck Header

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **5.5x9, GLB, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending
Wood Species : DF/DF Wood Grade : 24F-V8

Fb - Tension	2,400.0 psi	Fc - Prll	1,650.0 psi	Fv	265.0 psi	Ebend- xx	1,800.0 ksi	Density	31.210 pcf
Fb - Compr	2,400.0 psi	Fc - Perp	650.0 psi	Ft	1,100.0 psi	Eminbend - xx	950.0 ksi		

Applied Loads

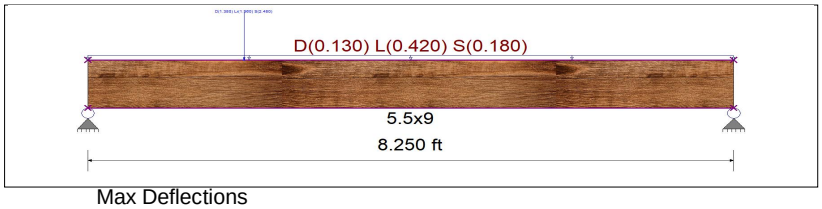
Beam self weight calculated and added to loads
Unif Load: D = 0.130, L = 0.420, S = 0.180 k/ft, Trib= 1.0 ft
Point: D = 1.380, Lr = 1.960, S = 2.480 k @ 2.0 ft

Design Summary

Max fb/Fb Ratio = **0.515** : 1
fb : Actual : 1,420.28 psi at 2.805 ft in Span # 1
Fb : Allowable : 2,760.00 psi
Load Comb : +D+0.750L+0.750S+H

Max fv/FvRatio = **0.443** : 1
fv : Actual : 134.93 psi at 0.000 ft in Span # 1
Fv : Allowable : 304.75 psi
Load Comb : +D+0.750L+0.750S+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	1.63	1.73	1.48	2.62			
Right Support	0.92	1.73	0.48	1.34			



Max Deflections

Transient Downward	0.088 in	Total Downward	0.177 in
Ratio	1122	Ratio	559
	LC: S Only		.C: +D+0.750L+0.750S+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Multiple Simple Beam

Lic. # : KW-06011183 — O.G. Engineering, PLLC

Wood Beam Design : DH7 - Deck Header

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **5.5x12, GLB, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending
Wood Species : DF/DF — Wood Grade : 24F-V8

Fb - Tension	2,400.0 psi	Fc - Prll	1,650.0 psi	Fv	265.0 psi	Ebend- xx	1,800.0 ksi	Density	31.210 pcf
Fb - Compr	2,400.0 psi	Fc - Perp	650.0 psi	Ft	1,100.0 psi	Eminbend - xx	950.0 ksi		

Applied Loads

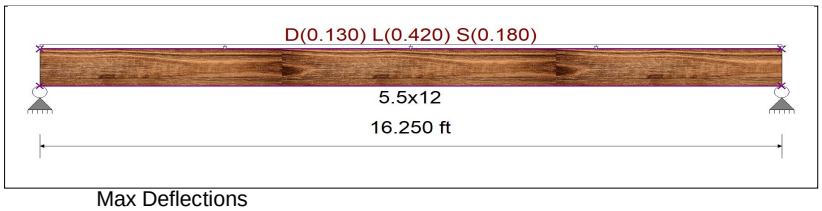
Beam self weight calculated and added to loads
Unif Load: D = 0.130, L = 0.420, S = 0.180 k/ft, Trib= 1.0 ft

Design Summary

Max fb/Fb Ratio = **0.706** : 1
fb : Actual : 1,693.31 psi at 8.125 ft in Span # 1
Fb : Allowable : 2,400.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.346** : 1
fv : Actual : 91.70 psi at 15.275 ft in Span # 1
Fv : Allowable : 265.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	1.17	3.41		1.46			
Right Support	1.17	3.41		1.46			



Max Deflections

Transient Downward	0.465 in	Total Downward	0.658 in
Ratio	419	Ratio	296
	LC: L Only		.C: +D+0.750L+0.750S+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Wood Beam Design : DB8 - Deck Beam

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **2-1.75x7.25, Microllam LVL, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending
Wood Species : iLevel Truss Joist — Wood Grade : MicroLam LVL 2.0 E

Fb - Tension	2,600.0 psi	Fc - Prll	2,510.0 psi	Fv	285.0 psi	Ebend- xx	2,000.0 ksi	Density	42.010 pcf
Fb - Compr	2,600.0 psi	Fc - Perp	750.0 psi	Ft	1,555.0 psi	Eminbend - xx	1,016.54 ksi		

Applied Loads

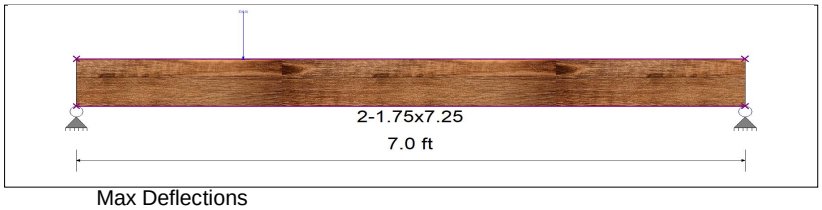
Beam self weight calculated and added to loads
Point: E = 6.0 k @ 1.750 ft

Design Summary

Max fb/Fb Ratio = **0.522** : 1
fb : Actual : 2,170.74 psi at 1.750 ft in Span # 1
Fb : Allowable : 4,160.00 psi
Load Comb : +D+0.70E+H

Max fv/FvRatio = **0.411** : 1
fv : Actual : 187.48 psi at 0.000 ft in Span # 1
Fv : Allowable : 456.00 psi
Load Comb : +D+0.70E+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.03					4.50	
Right Support	0.03					1.50	



Max Deflections

Transient Downward	0.234 in	Total Downward	0.166 in
Ratio	358	Ratio	506
	LC: E Only		LC: +D+0.70E+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Multiple Simple Beam

Wood Beam Design : DB2 - Deck Beam

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16

BEAM Size : **4x12, Sawn, Fully Braced**
Using Allowable Stress Design with ASCE 7-10 Load Combinations, Major Axis Bending

Wood Species : Douglas Fir-Larch
Wood Grade : No.2

Fb - Tension	900.0 psi	Fc - Prll	1,350.0 psi	Fv	180.0 psi	Ebend- xx	1,600.0 ksi	Density	31.210 pcf
Fb - Compr	900.0 psi	Fc - Perp	625.0 psi	Ft	575.0 psi	Eminbend - xx	580.0 ksi		

Applied Loads

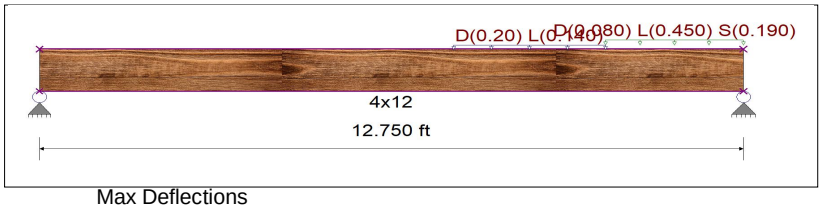
Beam self weight calculated and added to loads
Unif Load: D = 0.20, L = 0.140 k/ft, 7.50 ft to 10.250 ft, Trib= 1.0 ft
Unif Load: D = 0.080, L = 0.450, S = 0.190 k/ft, 10.250 to 12.750 ft, Trib= 1.0 ft

Design Summary

Max fb/Fb Ratio = **0.576** : 1
fb : Actual : 570.22 psi at 8.670 ft in Span # 1
Fb : Allowable : 990.00 psi
Load Comb : +D+L+H

Max fv/FvRatio = **0.296** : 1
fv : Actual : 53.21 psi at 11.815 ft in Span # 1
Fv : Allowable : 180.00 psi
Load Comb : +D+L+H

Max Reactions (k)	D	L	Lr	S	W	E	H
Left Support	0.24	0.23		0.05			
Right Support	0.62	1.28		0.43			



Max Deflections

Transient Downward	0.072 in	Total Downward	0.135 in
Ratio	2136	Ratio	1133
	LC: L Only		LC: +D+L+H
Transient Upward	0.000 in	Total Upward	0.000 in
Ratio	9999	Ratio	9999
	LC:		LC:

Printed: 27 APR 2021, 12:05PM

Wood Column

Lic. # : KW-06011183 — O.G. Engineering, PLLC

DESCRIPTION: Posts Supporting DB3

Code References

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : ASCE 7-10

General Information

Analysis Method :	Allowable Stress Design		
End Fixities	Top & Bottom Pinned		
Overall Column Height	9 ft		
(Used for non-slender calculations)			
Wood Species	Hem-Fir		
Wood Grade	No.2		
Fb +	575.0 psi	Fv	140.0 psi
Fb -	575.0 psi	Ft	375.0 psi
Fc - Prll	575.0 psi	Density	26.840 pcf
Fc - Perp	405.0 psi		

E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial
Basic	1,100.0	1,100.0	1,100.0 ksi
Minimum	400.0	400.0	

Wood Section Name	**6x6**		
Wood Grading/Manuf.	Graded Lumber		
Wood Member Type	Sawn		
Exact Width	**5.50** in	Allow Stress Modification Factors	
Exact Depth	**5.50** in	Cf or Cv for Bending	1.0
Area	30.250 in^2	Cf or Cv for Compression	1.0
Ix	76.255 in^4	Cf or Cv for Tension	1.0
Iy	76.255 in^4	Cm : Wet Use Factor	0.850
Incising Factors :		Ct : Temperature Factor	1.0
for Bending	0.80	Cfu : Flat Use Factor	1.0
for Elastic Modulus	0.95	Kf : Built-up columns	1.0 *NDS 15.3.2*
		Use Cr : Repetitive ?	No

Brace condition for deflection (buckling) along columns :
X-X (width) axis : Unbraced Length for buckling ABOUT Y-Y Axis = 9 ft, K = 1.0
Y-Y (depth) axis : Unbraced Length for buckling ABOUT X-X Axis = 9 ft, K = 1.0

Applied Loads

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

Column self weight included : 50.744 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 9.0 ft, D = 2.0, L = 6.30, S = 2.630 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.8584** : 1
Load Combination +D+L
Governing NDS Forumla Comp Only, fc/Fc'
Location of max.above base 0.0 ft
At maximum location values are . . .
Applied Axial 8.351 k
Applied Mx 0.0 k-ft
Applied My 0.0 k-ft
Fc : Allowable 321.604 psi

PASS Maximum Shear Stress Ratio = **0.0** : 1
Load Combination +0.60D
Location of max.above base 9.0 ft
Applied Design Shear 0.0 psi
Allowable Shear 173.824 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.0 k	Bottom along Y-Y	0.0 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .
Along Y-Y 0.0 in at 0.0 ft above base
for load combination : n/a
Along X-X 0.0 in at 0.0 ft above base
for load combination : n/a

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension

Date: 4/27/2021
Job # 20025

Plywood Shear Wall Design

Refer to Shear Wall Key Plans

Story Forces	
Floor	F_x (psf)
Roof	5.1
Upper	3.6

ASD

Plywood Grade
CD-X

Struct 1 or CD-X

15/32" Plywood, w/ 10d nails, min. 1-1/2" penetration into framing members

R_d (Dead Load Resistance Factor) = 0.6-0.14S_{ds} = 0.44

Wall Mark Capacity (Grade Struct 1)		
Wall Mark	Edge Nailing	Capacity (plf)
1	6"o.c.	340
2	4"o.c.	510
3	3"o.c.	665
4	2"o.c.	870
Dbl 2	4"o.c. Both Sides	1020
Dbl 3	3"o.c. Both Sides	1330
Dbl 4	2"o.c. Both Sides	1740

Wall Mark Capacity (Grade CD-X)		
Wall Mark	Edge Nailing	Capacity (plf)
1	6"o.c.	310
2	4"o.c.	460
3	3"o.c.	600
4	2"o.c.	770
Dbl 2	4"o.c. Both Sides	920
Dbl 3	3"o.c. Both Sides	1200
Dbl 4	2"o.c. Both Sides	1540

Holdown Schedule	
Holdown	Capacity (lb)
HDU2	3075
HDU4	4565
HDU5	5645
HDU8	6970
MSTC28	1540
MSTC40	3080
MSTC52	4620

Notes

1) $Wall_{abv}$ = Shear wall on story above that adds shear to subject wall
2) V_{abv} = Shear demand from wall on story above
3) V_{cur} = Shear demand from current story = A_T x F_x
4) V = Total shear demand in wall = V_{abv} + V_{cur}
5) v = unit shear demand = V / L
6) Allowable shear reduction multiplier of 2xL/h for walls w/ h>2L (=1 if h<2L)
7) OTM = Wall overturning moment = V x h
8) w_{DL} = Distributed resisting dead load on top of wall
9) $P_{DL,END}$ = Minimum resisting point dead load on end of wall
10) RM = Resisting Moment from w_{DL} & $P_{DL,END}$, mulitplied by R_d above
11) T_{end} = Tension at end of wall from current story shear = (OTM - RM) / L
12) T_{abv} = Tension from wall holdown on story above
13) T = T_{end} + T_{abv}

Roof Diaphragm

Walls in North-South Direction												
Wall	L (ft)	h (ft)	A_T (sf)	$Wall_{abv}$[1]	V_{abv}[2] (lbs)	V_{cur}[3] (lbs)	V[4] (lb)	v[5] (plf)	Wall Mark	h>2L?	2xL/h[6]	Capacity (plf)
4-3	16	9	790	none	0	4068	4068	254	1	no	1	310

Holdowns for Walls in North-South Direction									
Wall	OTM[7] (lb-ft)	w_{DL}[8] (plf)	$P_{DL,END}$[9] (lb)	RM[10] (lb-ft)	T_{end}[11] (lb)	T_{abv}[12] (lb)	T[13] (lb)	Holdown	Capacity
4-3	36612	140	0	7930	1793		1793	MSTC48B3	3380

Upper Floor Diaphragm

Walls in North-South Direction												
Wall	L (ft)	h (ft)	A_T (sf)	$Wall_{abv}$[1]	V_{abv}[2] (lbs)	V_{cur}[3] (lbs)	V[4] (lb)	v[5] (plf)	Wall Mark	h>2L?	2xL/h[6]	Capacity (plf)
5.1	2.58	8	160	4-3	1049	584	1633	633	DBL 3	yes	0.65	774
5.2	2.33	8	150	4-3	947	547	1494	641	DBL 3	yes	0.58	699
5.3	2.92	8	190	4-3	1187	693	1880	644	DBL 3	yes	0.73	876

Holdowns for Walls in North-South Direction									
Wall	OTM[7] (lb-ft)	w_{DL}[8] (plf)	$P_{DL,END}$[9] (lb)	RM[10] (lb-ft)	T_{end}[11] (lb)	T_{abv}[12] (lb)	T[13] (lb)	Holdown	Capacity
5.1	13061	100	0	147	5005		5005	HDU5	5645
5.2	11956	100	0	120	5080		5080	HDU5	5645
5.3	15042	100	0	189	5087		5087	HDU5	5645