CK Engineering LLC.

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Lake Forest Park, WA 98155

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STRUCTURAL CALCULATIONS

Lateral & Gravity Design
22-007

3/2/2022

ANDERSON RESIDENCE
14 WEMBLEY LANE
MERCER ISLAND, WA 98040
March 2, 2022

Hazards by Location

Search Information

Address: 14 Wembley Ln, Mercer Island, WA 98040, USA

Coordinates: 47.5632714, -122.2254072

Elevation: 306 ft

Timestamp: 2022-02-24T11:38:32.485Z

Hazard Type: Wind

ASCE 7-16

MRI 10-Year	67 mph
MRI 25-Year	73 mph
MRI 50-Year	78 mph
MRI 100-Year	83 mph
Risk Category I	92 mph
Risk Category II	97 mph
Risk Category III	104 mph
Risk Category IV	108 mph

ASCE 7-10

MRI 10-Year	72 mph
MRI 25-Year	79 mph
MRI 50-Year	85 mph
MRI 100-Year	91 mph
Risk Category I	100 mph
Risk Category II	110 mph
Risk Category III-IV	115 mph

ASCE 7-05

ASCE 7-05 Wind Speed	85 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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Hazards by Location

Search Information

Address:	14 Wembley Ln, Mercer Island, WA 98040, USA
Coordinates:	47.5632714, -122.2254072
Elevation:	306 ft
Timestamp:	2022-02-24T11:40:09.933Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	I
Site Class:	D-default

Basic Parameters

Name	Value	Description
S_S	1.434	MCE_R ground motion (period=0.2s)
S_1	0.498	MCE_R ground motion (period=1.0s)
S_{MS}	1.721	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.147	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	0.898	Coefficient of risk (1.0s)
PGA	0.614	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.737	Site modified peak ground acceleration

T_L	6	Long-period transition period (s)
SsRT	1.434	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.59	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	3.893	Factored deterministic acceleration value (0.2s)
S1RT	0.498	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.555	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	1.532	Factored deterministic acceleration value (1.0s)
PGAd	1.314	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

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Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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Design Criteria

Scope of Work:	Lateral & Gravity Design		
Site Address:	14 WEMBLEY LANE MERCER ISLAND, WA 98040		
Number of Stories:	2	Engineer:	PK

Roof Loading

Roofing	Composition	3.0
Sheathing	5/8" Plywood	1.8
Insulation	Roll/Batt	3.0
Ceiling	5/8" GWB	2.8
Framing	Trusses	2.2
Miscellaneous	fixtures, mechanical, electrical, etc.	2.2
	TOTAL DEAD LOAD:	15.0 psf
	ROOF SNOW LOAD:	25.0 psf

Upper Floor Loading

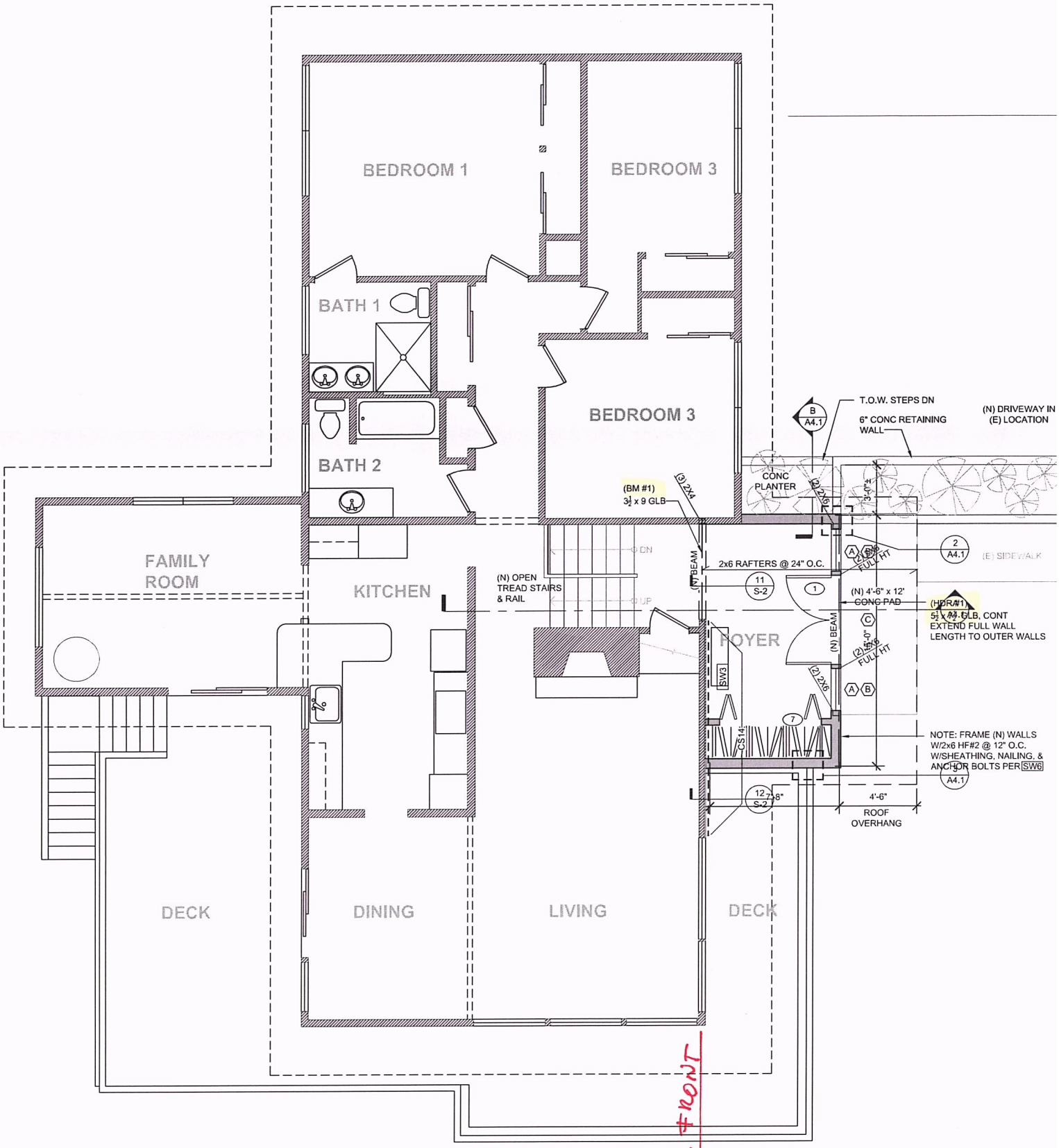
Floor Covering	Carpet/Hardwood/Tile	3.0
Sheathing	3/4" T&G	2.3
Ceiling	1/2" GWB	2.2
Joists	Solid Sawn @ 16" o/c	3.3
Beams		2.8
Miscellaneous	fixtures, mechanical, electrical, etc.	1.4
	TOTAL DEAD LOAD:	15.0 psf
	FLOOR LIVE LOAD:	40.0 psf

Main Floor Loading

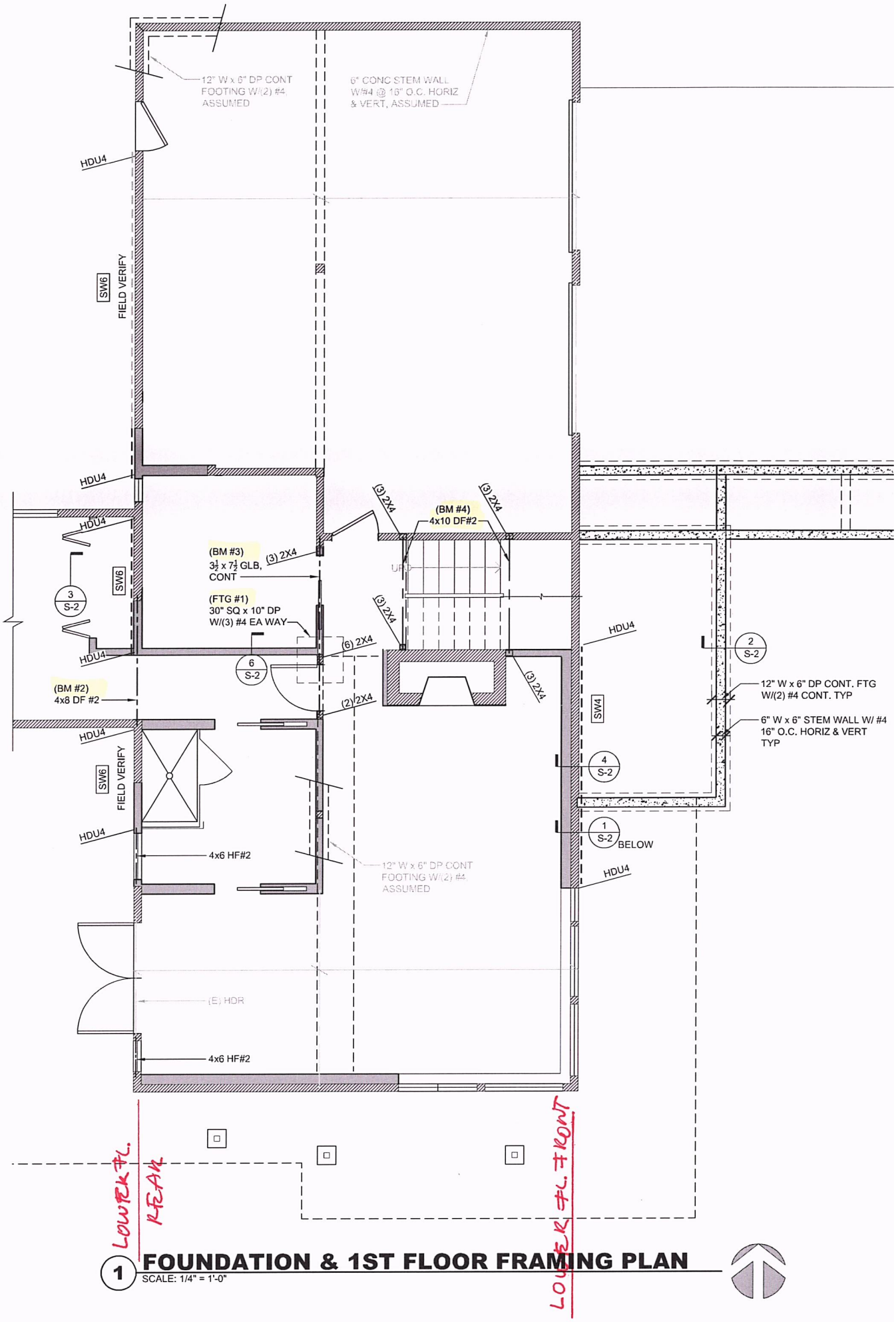
Floor Covering	Carpet/Hardwood/Tile	3.0
Sheathing	3/4" T&G	2.3
Ceiling	5/8" GWB	2.8
Joists	I-Joists	2.1
Beams		4.2
Miscellaneous	fixtures, mechanical, electrical, etc.	0.6
	TOTAL DEAD LOAD:	15.0 psf
	FLOOR LIVE LOAD:	40.0 psf

Soil Bearing Capacity:	1500 psf
Frost Depth:	18 in

KEY PLANS



2 FIRST FLOOR PLAN
SCALE: 1/4" = 1'-0"



1 FOUNDATION & 1ST FLOOR FRAMING PLAN

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

Type of construction:	Addition	Location:	14 WEMBLEY LANE
Applicable Building Codes:	IBC 2018, ASCE 7/SEI 7-16		MERCER ISLAND, WA 98040

Work performed : **Lateral & Gravity Design**

WIND DESIGN:

$P_s = \lambda I_w P_{s30} K_{zt}$

Exposure :	C	Wind Exposure Category as set forth in Section 26.7 of ASCE 7-16
Wind Speed =	85 MPH	Basic Wind Speed (LRFD) as used in Figure 28.5 of ASCE 7-16 and converted to (ASD)
P_{s30} =		Simplified design wind pressure for Exposure B, at h = 30 feet and for I = 1.0, from Figure 28.5-1
I_w =	1	Importance factor as defined in Table 1.5-2 of ASCE 7-16
λ =	1.21	Adjustment factor for building height and exposure from Figure 28.5-1 of ASCE 7-16
K_{ZT} =	1.00	Adjustment factor for increased wind speed due to a hill or escarpment from Section 26.8 of ASCE 7-16

Roof slope :

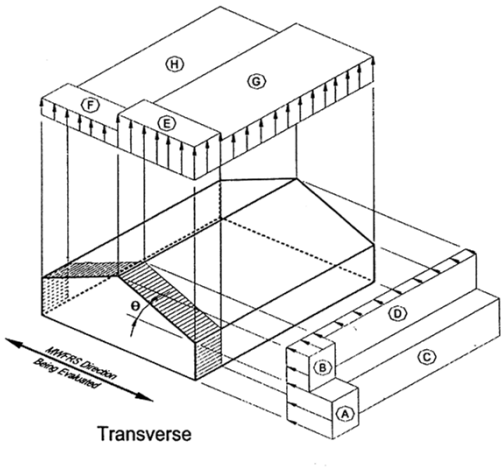
		rise		run			
Front/Rear	$\tan^{-1}$ (	2	/	12	)	= 9.5 degrees	Number of floors: 2
Left/Right	$\tan^{-1}$ (	2	/	12	)	= 9.5 degrees	
		14 ft	Mean Elevation				

0

Average uplift (F/R)=	-9.7 psf	Based on wind zones 'G' and 'H'
Average uplift (R/L)=	-9.7 psf	Based on wind zones 'G' and 'H'

	End zone of wall		End zone of roof	
		Front/Rear / Left/Right	Front/Rear	Left/Right
P_{s30} =	A =	12.7 psf / 12.7 psf	B = -5.5 psf	-5.5 psf
P_s =		15.4 psf / 15.4 psf	-6.6 psf	-6.6 psf

	Interior zone of wall		Interior zone of roof	
	Front/Rear	Left/Right	Front/Rear	Left/Right
P_{s30} =	C = 8.5 psf	8.5 psf	D = -3.1 psf	-3.1 psf
P_s =	10.3 psf	10.3 psf	-3.8 psf	-3.8 psf



WIND LOAD CALCULATIONS

FRONT ⟶ REAR

ΣV 2ND FLOOR = N.A.

WIND ZONE												
AVE. HEIGHT												
AVE. WIDTH												
Ps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0 lbs											

ΣV 1ST FLOOR =

WIND ZONE												
AVE. HEIGHT												
AVE. WIDTH												
Ps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0 lbs											

NOT USED

WIND ZONE												
AVE. HEIGHT												
AVE. WIDTH												
Ps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0 lbs											

WIND LOAD CALCULATIONS

LEFT ⟶ **RIGHT**

ΣV 2ND FLOOR =

WIND ZONE	A	C	A	C								
AVE. HEIGHT	2	2	4	4								
AVE. WIDTH	8	4	8	16								
Ps	15.43	10.28	15.43	10.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	247	82	494	658	0	0	0	0	0	0	0	0
TOTAL	1,480 lbs											

ΣV 1ST FLOOR =

WIND ZONE	A	C										
AVE. HEIGHT	9	9										
AVE. WIDTH	8	16										
Ps	15.43	10.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	1111	1480	0	0	0	0	0	0	0	0	0	0
TOTAL	2,590 lbs											

NOT USED

WIND ZONE												
AVE. HEIGHT												
AVE. WIDTH												
Ps	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0 lbs											

ρ CALCS:

2ND FLOOR CALCULATIONS:

Plate Height:	8.00 ft
Total length of Shearwall in Shortest Line:	13.00 ft
Length of Shortest Segment within Shear Line:	5.00 ft
Length of Longest Segment in Shear Line:	3.00 ft

Tributary Area: 1.0
Total Area: 2.0

ρ = 1.00
ASCE 7-16 12.3.4.2 b

MAIN FLOOR CALCULATIONS:

Plate Height:	8.00 ft
Total length of Shearwall in Shortest Line:	8.00 ft
Length of Shortest Shearwall within Shear Line:	3.00 ft
Length of Longest Wall in Shear Line:	5.00 ft

Tributary Area: 1.0
Total Area: 2.0

ρ = 1.00
ASCE 7-16 12.3.4.2 b

NOT USED:

Plate Height:	10.00 ft
Total length of Shearwall in Shortest Line:	8.00 ft
Length of Shortest Shearwall within Shear Line:	3.00 ft
Length of Longest Wall in Shear Line:	5.00 ft

Tributary Area: 1.0
Total Area: 2.0

ρ = NA

All loads in pounds per square foot

WALL DEAD LOAD =	10 psf	ROOF DEAD LOAD =	15.0 psf
FLAT ROOF SNOW LOAD =	25 psf	UPPER FLOOR D.L. =	15.0 psf
RED. S.L. (20%*S.L.) =	0	LOWER FLOOR D.L. =	15.0 psf
		FLOOR LIVE LOAD =	40.0 psf

SEISMIC DESIGN:

$E = E_h + E_v$

$E = \rho Q_{E+.2S_{DS}D}$ $\quad Q_E = V = C_sW$

ρ =	1.00						
Site Class =	D	Geotech Report	No	20% Seismic Load Increase			
I_E =	1	Importance factor as defined in Table 11.5-1					
R =	6.5						
h_n =	15	Total height of structure					

$V = 0.7S_{DS}I_EW / R$	$S_{DS} = 2/3\ S_{MS}$	Ss =	143.4%	S_{MS} = 172.1%	V =	0.124	W
$V_{max} = S_{D1}I_EW / T_aR$	$S_{MS} = (Fa)(Ss)$	Fa =	1.20	S_{DS} = 114.7%	E =	0.124	W
$T_a = 0.02h_n^{0.75}$	$S_{D1} = 2/3\ S_{M1}$	S_1 =	49.8%	S_{M1} = 74.7%			
T_a = 0.15 s	$S_{M1} = (Fv)(S_1)$	Fv =	1.50	S_{D1} = 49.8%	Cs =	0.124	

2ND FLOOR DIAPHRAGM LOADING:

W (ROOF) =

LENGTH	WIDTH	LOAD	TOTAL
64	30	15.0	28800
16	16	15.0	3840
17	9	15.0	2295
		15.0	0
		15.0	0

Area = 2329 Sub-Total= 34935

W (FLOOR) =

LENGTH	WIDTH	LOAD	TOTAL
		15.0	0
		15.0	0
		15.0	0
		15.0	0
		15.0	0

Area = 0 Sub-Total= 0

W (WALL) =

LENGTH	TRIB. HT.	LOAD	TOTAL
150	4	10.0	6000
60	4	10.0	2400
		10.0	0
		10.0	0
		10.0	0

Area = 840 Sub-Total= 8400

TOTAL = 43335 lb

1ST FLOOR DIAPHRAGM LOADING:

W (ROOF) =

LENGTH	WIDTH	LOAD	TOTAL
		15.0	0
		15.0	0
		15.0	0
		15.0	0
		15.0	0

Area = 0 Sub-Total= 0

W (FLOOR) =

LENGTH	WIDTH	LOAD	TOTAL
57	26	15.0	22230
16	12	15.0	2880
15	8	15.0	1800
		15.0	0
		15.0	0

Area = 1794 Sub-Total= 26910

W (WALL) =

LENGTH	TRIB. HT.	LOAD	TOTAL
150	6	10.0	9000
60	6	10.0	3600
		10.0	0
		10.0	0
		10.0	0

Area = 1260 Sub-Total= 12600

TOTAL = 39510 lb

NOT APPLICABLE

W (ROOF) =

LENGTH	WIDTH	LOAD	TOTAL
		15.0	0
		15.0	0
		15.0	0
		15.0	0
		15.0	0

Area = 0 Sub-Total= 0

W (FLOOR) =

LENGTH	WIDTH	LOAD	TOTAL
		15.0	0
		15.0	0
		15.0	0
		15.0	0
		15.0	0

Area = 0 Sub-Total= 0

W (WALL) =

LENGTH	TRIB. HT.	LOAD	TOTAL
		10.0	0
		10.0	0
		10.0	0
		10.0	0
		10.0	0

Area = 0 Sub-Total= 0

TOTAL = lb

V (2ND FLOOR) = .124 x 43335 lb = 5354 lbs

V (1ST FLOOR) = .124 x 39510 lb = 4881 lbs

V ( ) = .124 x lb = lbs

REDISTRIBUTE:

ΣV x ρ	height	ΣV x height
5354 lb	12.5	66923
4881 lb	3.5	17084
lb		0
TOTAL = 10235 lb		TOTAL = 84007

$$E\ (2ND) = \frac{\Sigma V \times height \times \Sigma V\ TOTAL}{\Sigma V \times height\ TOTAL} = 8154 \text{ lbs}$$

$$E\ (1ST) = \frac{\Sigma V \times height \times \Sigma V\ TOTAL}{\Sigma V \times height\ TOTAL} = 2081 \text{ lbs}$$

$$E\ () = \frac{\text{NOT USED}}{} = 0 \text{ lbs}$$

SUMMARY:

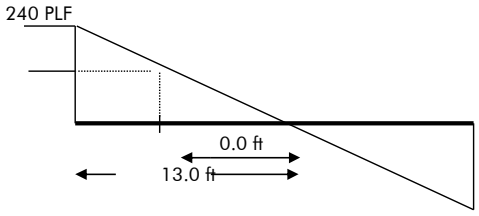
	WIND (front-rear)	WIND (left-right)	SEISMIC
ΣV (2ND) =	lbs	1480 lbs	9784 lbs
ΣV (MAIN) =	0 lbs	2590 lbs	2498 lbs
NOT APPLICABLE	0 lbs	0 lbs	0 lbs
TOTAL =	lbs	4071 lbs	12282 lbs

DIAPHRAGM SHEAR:

Total diaphragm length = 57.0 ft Sub-diaphragm length = 57.0 ft
Diaphragm width = 26.0 ft ΣV (2ND) = 9,784 lbs

$$v = \frac{\Sigma V(roof)}{(2)(width)} = \frac{9784\ lb}{52\ ft} = 188\ PLF$$

IBC Table 2306.3.1 ⟶ 240 PLF



USE 15/32 CDX ROOF SHEATHING OR 3/4 T&G CDX SUBFLOORING w/8d AT 6 in o/c(PANEL EDGE), END 8d AT 12in o/c(PANEL FIELD)

CHORD:

Sub-diaphragm length = 57.0 ft Total-diaphragm length = 57.0 ft
Sub-diaphragm width = 26.0 ft

$$T = \frac{M}{B} = \frac{\Sigma V \times (diaphragm\ length)}{8 \times (diaphragm\ width)} = \frac{9784 \times 57\ ft}{8 \times 26\ ft} = 2681\ lbs$$

Top Plate Size: 2x4 Species/Grade: HF #2

Area = 5.25 in^2 F_t = 525 psi
Load duration (C_D) = 1.33 $T_{allowable}$ = Area x C_D x F_t = 3,666 lbs

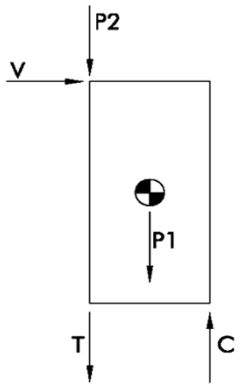
Since T allowable is greater than T applied, OK.

SHEAR CAPACITY OF 10d COMMON NAIL = 102 lbs 102 x Cd x p = 136 lbs 2018 NDS

$$\#\ OF\ NAILS\ PER\ 4\ FT\ SPLICE = \frac{2681\ lbs}{136\ lbs} = 20$$

USE 2x4 HF #2 TOP PLATE W/ (2) 10d NAILS @ 5 in O/C.

Lateral Calculation Key



V = Shear, plf
H = Height of shearwall
L = Length of shearwall
P1 = Weight of shearwall and connected framing
P2 = Weight of adjacent wall

T = V x H - 0.5P1 - P2 = Tension reaction to be resisted by holdown
C = V x H + 0.5P1 = Compression reaction

ASD Basic Load Combinations

For calculation of tension and compression forces in compliance with ASCE 7-16 2.4.1

Tension Equations (Uplift)

7. 0.6D + W
8. $(0.6 - 0.14S_{DS})D + E$ → 0.44 D + E

*8. $(0.6 - 0.14S_{DS})D + 2.5\ E$ → 0.44 D + 2.5 E

Compression Equations

5. D + W
5. $(1 + 0.14S_{DS})D + E$ → 1.16 D + E
6. D + 0.75W + 0.75L + 0.75S
6. $(1.0 + 0.105S_{DS})D + 0.75E + 0.75L + 0.75S$ → 1.12 D + 0.75 E + 0.75 L + 0.75 S

*5. $(1 + 0.14S_{DS})D + 2.5E$ → 1.16 D + 2.5 E
*6. $(1.0 + 0.105S_{DS})D + 1.875E + 0.75L + 0.75S$ → 1.12 D +1.875 E + 0.75 L + 0.75 S

** Equations include overstrength factor.*

Note: The 0.7 factor for Earthquake loading has already been incorporated into the calculation of the lateral design force E_h, but not E_v. Therefore this factor has been omitted from equations 5, 6 and 8 where appropriate.

MAIN FL. FRONT (LIVING RM)

SHEARWALL | WIND | SEISMIC

Floor Info

Upper	Floor Level, e.g. Upper, Main, Lower			Tributary Width (Upper Floor)		Tributary Area (Upper Floor)	
Lt-Rt	Load Direction, e.g. Left-Right, Front-Rear			1.0	tributary width	1.0	tributary area
	(For Left Wall, Use Front-Rear Load Direction)			2.0	total width	2.0	total area
CDX	Sheathing type			Tributary Width (Main Floor)		Tributary Area (Main Floor)	
	Values in accordance with AF&PA SDPWS-2015			1.0	tributary width	1.0	tributary area
Roof	Resisting Dead Load			2.0	total width	2.0	total area
	(e.g. Roof, Upper Floor, Main Floor)			Not Used		Not Used	
13.00 ft	Total Length of Shearwalls			1.0	tributary width	1.0	tributary area
				2.0	total width	2.0	total area

V(from upper)=	1480 lb	9784 lb		Height of Shearwall =	8.0 ft	Weight of Shearwall =	10.0 lbs
V(from main)=	0 lb	0 lb		Length of Shearwall =	13.0 ft	Tributary width for dead load =	6.0 ft
V(from lower)=	0 lb	0 lb		Aspect Ratio OK		Length of adjoining wall =	2.0 ft
Σ (Wind) =	1,480 lb	Σ (Smc) =	9,784 lb	Use alternate R factor for seismic?	No		
v =	57 PLF	v =	376 PLF				

3x framing required per IBC

SDPWS, Table 4.3A → 0.93 x 456 = 424 PLF → USE SW3

Seismic controls shearwall design

C_{TOTAL} =	(floor above) + (this floor) =		+ 2107 lbs	= 2107 lbs	Seismic controls	
T_{TOTAL} =	(floor above) + (this floor) =		+ 2376 lbs	= 2376 lbs	Load case 8 controls - Seismic	

Seismic controls holdown design

Where overstrength factor is applicable, use this value for E in equations 5, 6, and 8: E= 3011 lbs

USE SIMPSON DESIGNED HOLDOWN: CS14

OR AT FOUNDATION / INTERIOR WALLS USE: STHD10/RJ

LOWER FL. FRONT (REC. RM)

SHEARWALL | WIND | SEISMIC

Floor Info

Main	Floor Level, e.g. Upper, Main, Lower			Tributary Width (Upper Floor)		Tributary Area (Upper Floor)	
Lt-Rt	Load Direction, e.g. Left-Right, Front-Rear			1.0	tributary width	1.0	tributary area
	(For Left Wall, Use Front-Rear Load Direction)			2.0	total width	2.0	total area
CDX	Sheathing type			Tributary Width (Main Floor)		Tributary Area (Main Floor)	
	Values in accordance with AF&PA SDPWS-2015			1.0	tributary width	1.0	tributary area
U/FL	Resisting Dead Load			2.0	total width	2.0	total area
	(e.g. Roof, Upper Floor, Main Floor)			Not Used		Not Used	
20.00 ft	Total Length of Shearwalls			1.0	tributary width	1.0	tributary area
				2.0	total width	2.0	total area

V(from upper)=	1480 lb	9784 lb		Height of Shearwall =	4.0 ft	Weight of Shearwall =	10.0 lbs
V(from main)=	2590 lb	2498 lb		Length of Shearwall =	20.0 ft	Tributary width for dead load =	5.0 ft
V(from lower)=	0 lb	0 lb		Aspect Ratio OK		Length of adjoining wall =	2.0 ft
Σ (Wind) =	4,071 lb	Σ (Smc) =	12,282 lb	Use alternate R factor for seismic?	No		
v =	102 PLF	v =	307 PLF				

SDPWS, Table 4.3A → 0.93 x 353 = 328 PLF → USE SW4

Seismic controls shearwall design

C_{TOTAL} =	(floor above) + (this floor) =	2107	+ 860 lbs	= 2967 lbs	Seismic controls	
T_{TOTAL} =	(floor above) + (this floor) =	2376	+ 622 lbs	= 2998 lbs	Load case 8 controls - Seismic	

Seismic controls holdown design

HDU4

Where overstrength factor is applicable, use this value for E in equations 5, 6, and 8: E= 1228 lbs

USE SIMPSON DESIGNED HOLDOWN: MST48

OR AT FOUNDATION / INTERIOR WALLS USE: STHD14/RJ

LOWER FL. REAR (BATH, LAUNDRY, GARAGE)

SHEARWALL | WIND | SEISMIC

Floor Info

Main	Floor Level, e.g. Upper, Main, Lower			Tributary Width (Upper Floor)		Tributary Area (Upper Floor)	
Lt-Rt	Load Direction, e.g. Left-Right, Front-Rear			1.0	tributary width	1.0	tributary area
	(For Left Wall, Use Front-Rear Load Direction)			2.0	total width	2.0	total area
CDX	Sheathing type			Tributary Width (Main Floor)		Tributary Area (Main Floor)	
	Values in accordance with AF&PA SDPWS-2015			1.0	tributary width	1.0	tributary area
Roof	Resisting Dead Load			2.0	total width	2.0	total area
	(e.g. Roof, Upper Floor, Main Floor)			Not Used		Not Used	
29.00 ft	Total Length of Shearwalls			1.0	tributary width	1.0	tributary area
				2.0	total width	2.0	total area

V(from upper)=	1480 lb	9784 lb		Height of Shearwall =	8.0 ft	Weight of Shearwall =	10.0 lbs
V(from main)=	2590 lb	2498 lb		Length of Shearwall =	6.0 ft	Tributary width for dead load =	6.0 ft
V(from lower)=	0 lb	0 lb		Aspect Ratio OK		Length of adjoining wall =	1.0 ft
Σ (Wind) =	4,071 lb	Σ (Smc) =	12,282 lb	Use alternate R factor for seismic?	No		
v =	70 PLF	v =	212 PLF				

SDPWS, Table 4.3A → 0.93 x 242 = 225 PLF → USE SW6

Seismic controls shearwall design

C_{TOTAL} =	(floor above) + (this floor) =		+ 1186 lbs	= 1186 lbs	Seismic controls	
T_{TOTAL} =	(floor above) + (this floor) =		+ 1395 lbs	= 1395 lbs	Load case 8 controls - Seismic	

Seismic controls holdown design

HDU4

Where overstrength factor is applicable, use this value for E in equations 5, 6, and 8: E= 1694 lbs

USE SIMPSON DESIGNED HOLDOWN: CS14

OR AT FOUNDATION / INTERIOR WALLS USE: LSTHD8/RJ

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

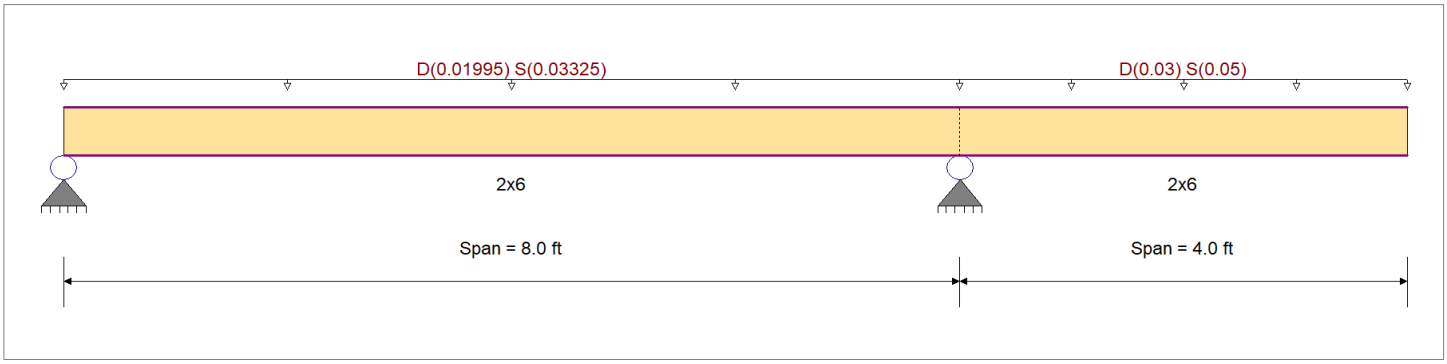
DESCRIPTION: RAFTERS

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	675 psi	*E : Modulus of Elasticity*	
Load Combination	ASCE 7-16	Fb -	675 psi	Ebend- xx	1100 ksi
		Fc - Prll	500 psi	Eminbend - xx	400 ksi
Wood Species :	Hem-Fir	Fc - Perp	405 psi		
Wood Grade :	No.2	Fv	140 psi		
		Ft	350 psi	Density	26.84 pcf
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling			Repetitive Member Stress Increase	



Applied Loads

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

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 1.330 ft, (ROOF)
Load for Span Number 2
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 2.0 ft, (ROOF)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.875 : 1	Maximum Shear Stress Ratio	=	0.321 : 1
Section used for this span		2x6	Section used for this span		2x6
fb: Actual	=	1,015.54 psi	fv: Actual	=	51.68 psi
Fb: Allowable	=	1,160.49 psi	Fv: Allowable	=	161.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	8.000 ft	Location of maximum on span	=	8.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.228 in	Ratio =	420 >=360	Span: 2 : S Only
Max Upward Transient Deflection	-0.014 in	Ratio =	6812 >=360	Span: 1 : S Only
Max Downward Total Deflection	0.365 in	Ratio =	262 >=240	Span: 2 : +D+S
Max Upward Total Deflection	-0.023 in	Ratio =	4257 >=240	Span: 1 : +D+S

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.419	0.154	0.90	1.300	1.00	1.15	1.00	1.00	1.00	0.24	380.83	908.21	0.11	19.38	126.00
Length = 4.0 ft	2	0.419	0.154	0.90	1.300	1.00	1.15	1.00	1.00	1.00	0.24	380.83	908.21	0.11	19.38	126.00
+D+S					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.875	0.321	1.15	1.300	1.00	1.15	1.00	1.00	1.00	0.64	1,015.54	1160.49	0.28	51.68	161.00
Length = 4.0 ft	2	0.875	0.321	1.15	1.300	1.00	1.15	1.00	1.00	1.00	0.64	1,015.54	1160.49	0.28	51.68	161.00
+D+0.750S					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 8.0 ft	1	0.738	0.271	1.15	1.300	1.00	1.15	1.00	1.00	1.00	0.54	856.86	1160.49	0.24	43.61	161.00
Length = 4.0 ft	2	0.738	0.271	1.15	1.300	1.00	1.15	1.00	1.00	1.00	0.54	856.86	1160.49	0.24	43.61	161.00
+0.60D					1.300	1.00	1.15	1.00	1.00	1.00			0.00	0.00	0.00	0.00

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

DESCRIPTION: RAFTERS

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
Length = 8.0 ft	**1**	0.142	0.052	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.14	228.50	1614.60	0.06	11.63	224.00
Length = 4.0 ft	**2**	0.142	0.052	1.60	1.300	1.00	1.15	1.00	1.00	1.00	0.14	228.50	1614.60	0.06	11.63	224.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0341	2.547	+D+S	-0.0225	6.838
+D+S	2	0.3654	4.000		0.0000	6.838

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	0.133	0.613	
Overall MINimum	0.083	0.383	
D Only	0.050	0.230	
+D+S	0.133	0.613	
+D+0.750S	0.112	0.517	
+0.60D	0.030	0.138	
S Only	0.083	0.383	

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

LIC# : KW-06016495, Build:20.22.2.9 CK Engineering LLC (c) ENERCALC INC 1983-2022

DESCRIPTION: BM#1

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

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

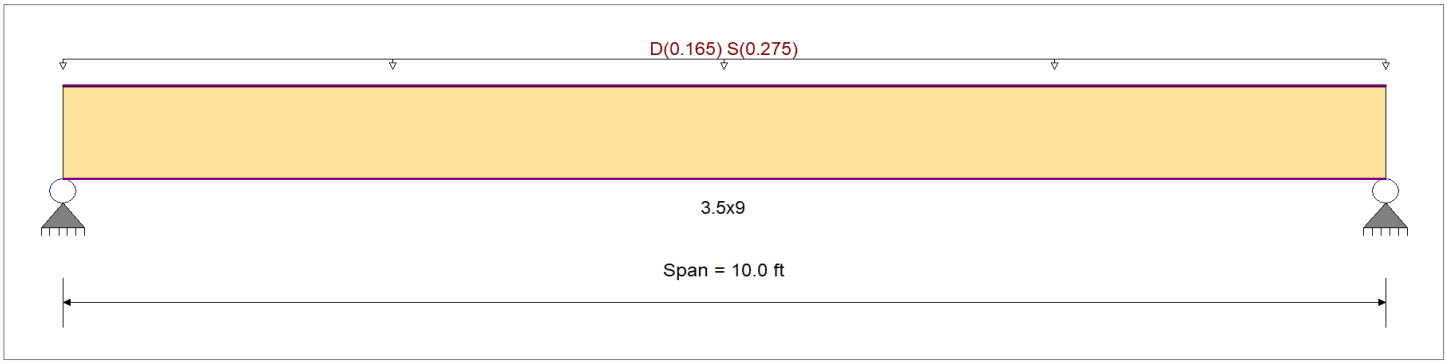
Wood Species : DF/DF
Wood Grade : 24F-V4

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

Fb +	2,400.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	950.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	850.0 ksi
Density	31.210 pcf



Applied Loads

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

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

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.506 : 1	Maximum Shear Stress Ratio	=	0.294 : 1
Section used for this span		3.5x9	Section used for this span		3.5x9
fb: Actual	=	1,396.83 psi	fv: Actual	=	89.47 psi
Fb: Allowable	=	2,760.00 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	5.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.163 in	Ratio =	737 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.260 in	Ratio =	461 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 10.0 ft	1	0.243	0.141	0.90	1.000	1.00	1.00	1.00	1.00	1.00	2.06	523.81	2160.00	0.70	33.55	238.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.0 ft	1	0.506	0.294	1.15	1.000	1.00	1.00	1.00	1.00	1.00	5.50	1,396.83	2760.00	1.88	89.47	304.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.0 ft	1	0.427	0.248	1.15	1.000	1.00	1.00	1.00	1.00	1.00	4.64	1,178.57	2760.00	1.59	75.49	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 10.0 ft	1	0.082	0.047	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.24	314.29	3840.00	0.42	20.13	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.2602	5.036		0.0000	0.000

Wood Beam

DESCRIPTION: BM#1

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.200	2.200
Overall MINimum	1.375	1.375
D Only	0.825	0.825
+D+S	2.200	2.200
+D+0.750S	1.856	1.856
+0.60D	0.495	0.495
S Only	1.375	1.375

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

LIC# : KW-06016495, Build:20.22.2.9 CK Engineering LLC (c) ENERCALC INC 1983-2022

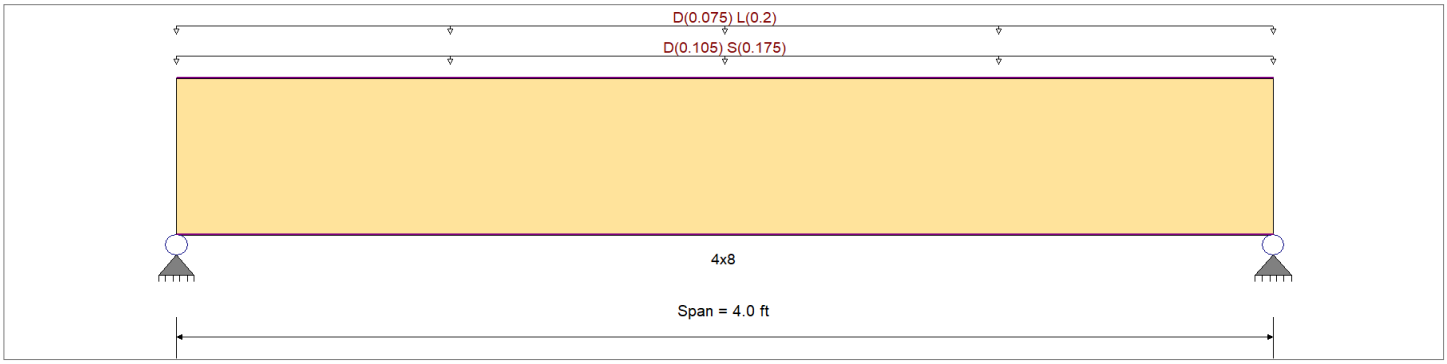
DESCRIPTION: BM#2

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875 psi	*E : Modulus of Elasticity*	
Load Combination	ASCE 7-16	Fb -	875 psi	Ebend- xx	1300 ksi
		Fc - Prll	600 psi	Eminbend - xx	470 ksi
Wood Species	: Douglas Fir-Larch (North)	Fc - Perp	625 psi		
Wood Grade	: No.2	Fv	170 psi		
		Ft	425 psi	Density	30.59 pcf
Beam Bracing	: Beam is Fully Braced against lateral-torsional buckling				



Applied Loads

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

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 7.0 ft, (ROOF)
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 5.0 ft, (FLOOR)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.276 : 1	Maximum Shear Stress Ratio	=	0.195 : 1
Section used for this span		4x8	Section used for this span		4x8
fb: Actual	=	361.04 psi	fv: Actual	=	38.21 psi
Fb: Allowable	=	1,308.13 psi	Fv: Allowable	=	195.50 psi
Load Combination		+D+0.750L+0.750S	Load Combination		+D+0.750L+0.750S
Location of maximum on span	=	2.000 ft	Location of maximum on span	=	3.401 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.008 in	Ratio =	5985 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.018 in	Ratio =	2595 >=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.138	0.097	0.90	1.300	1.00	1.00	1.00	1.00	1.00	0.36	140.89	1023.75	0.25	14.91	153.00
+D+L					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.261	0.185	1.00	1.300	1.00	1.00	1.00	1.00	1.00	0.76	297.44	1137.50	0.53	31.48	170.00
+D+S					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.212	0.150	1.15	1.300	1.00	1.00	1.00	1.00	1.00	0.71	277.87	1308.13	0.50	29.41	195.50
+D+0.750L					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.182	0.129	1.25	1.300	1.00	1.00	1.00	1.00	1.00	0.66	258.30	1421.88	0.46	27.34	212.50
+D+0.750L+0.750S					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.276	0.195	1.15	1.300	1.00	1.00	1.00	1.00	1.00	0.92	361.04	1308.13	0.65	38.21	195.50
+0.60D					1.300	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 4.0 ft	1	0.046	0.033	1.60	1.300	1.00	1.00	1.00	1.00	1.00	0.22	84.54	1820.00	0.15	8.95	272.00

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

DESCRIPTION: BM#2

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0185	2.015		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.923	0.923
Overall MINimum	0.350	0.350
D Only	0.360	0.360
+D+L	0.760	0.760
+D+S	0.710	0.710
+D+0.750L	0.660	0.660
+D+0.750L+0.750S	0.923	0.923
+0.60D	0.216	0.216
L Only	0.400	0.400
S Only	0.350	0.350

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

DESCRIPTION: BM#3

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-16

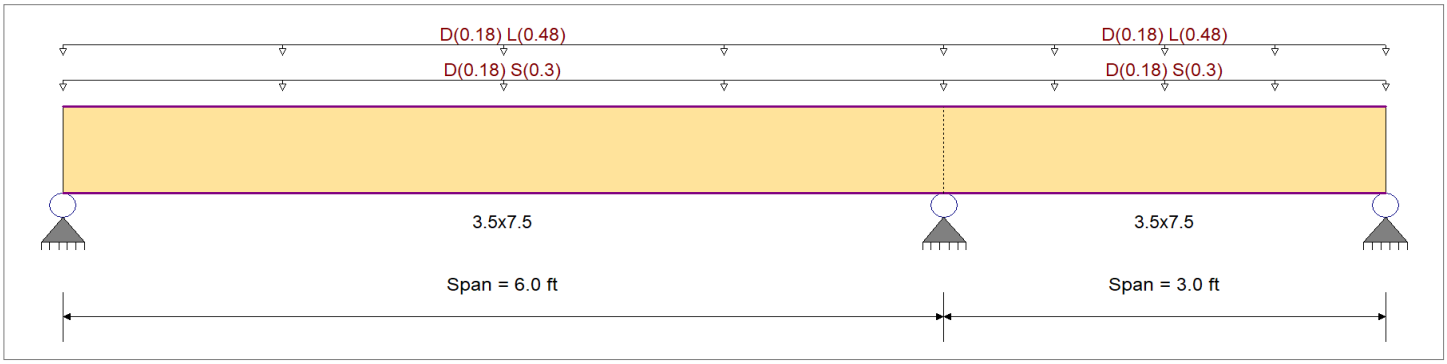
Material Properties

Analysis Method :	Allowable Stress Design
Load Combination	ASCE 7-16
Wood Species	: DF/DF
Wood Grade	: 24F-V4
Beam Bracing	: Beam is Fully Braced against lateral-torsional buckling

Fb +	2,400.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	950.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	850.0 ksi
Density	31.210 pcf



Applied Loads

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

Beam self weight NOT internally calculated and added
Load for Span Number 1
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 12.0 ft, (ROOF)
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 12.0 ft, (FLOOR)
Load for Span Number 2
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 12.0 ft, (ROOF)
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 12.0 ft, (FLOOR)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.560 : 1	Maximum Shear Stress Ratio	=	0.536 : 1
Section used for this span		3.5x7.5	Section used for this span		3.5x7.5
fb: Actual	=	1,036.80 psi	fv: Actual	=	142.04 psi
Fb: Allowable	=	1,850.00 psi	Fv: Allowable	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	6.000 ft	Location of maximum on span	=	5.397 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.036 in	Ratio =	2023	>=360	Span: 1 : L Only
Max Upward Transient Deflection	-0.004 in	Ratio =	9834	>=360	Span: 2 : L Only
Max Downward Total Deflection	0.070 in	Ratio =	1027	>=240	Span: 1 : +D+0.750L+0.750S
Max Upward Total Deflection	-0.007 in	Ratio =	4995	>=240	Span: 2 : +D+0.750L+0.750S

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 6.0 ft	1	0.267	0.255	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.21	444.34	1665.00	1.07	60.87	238.50
Length = 3.0 ft	2	0.267	0.255	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.21	444.34	1665.00	0.72	60.87	238.50
+D+L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.0 ft	1	0.560	0.536	1.00	1.000	1.00	1.00	1.00	1.00	1.00	2.83	1,036.80	1850.00	2.49	142.04	265.00
Length = 3.0 ft	2	0.560	0.536	1.00	1.000	1.00	1.00	1.00	1.00	1.00	2.83	1,036.80	1850.00	1.68	142.04	265.00
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.0 ft	1	0.383	0.366	1.15	1.000	1.00	1.00	1.00	1.00	1.00	2.23	814.63	2127.50	1.95	111.60	304.75

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

LIC# : KW-06016495, Build:20.22.2.9 CK Engineering LLC (c) ENERCALC INC 1983-2022

DESCRIPTION: BM#3

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
Length = 3.0 ft	**2**	0.383	0.366	1.15	1.000	1.00	1.00	1.00	1.00	1.00	2.23	814.63	2127.50	1.32	111.60	304.75
+D+0.750L					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.0 ft	**1**	0.384	0.368	1.25	1.000	1.00	1.00	1.00	1.00	1.00	2.43	888.69	2312.50	2.13	121.75	331.25
Length = 3.0 ft	**2**	0.384	0.368	1.25	1.000	1.00	1.00	1.00	1.00	1.00	2.43	888.69	2312.50	1.44	121.75	331.25
+D+0.750L+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.0 ft	**1**	0.548	0.524	1.15	1.000	1.00	1.00	1.00	1.00	1.00	3.19	1,166.40	2127.50	2.80	159.79	304.75
Length = 3.0 ft	**2**	0.548	0.524	1.15	1.000	1.00	1.00	1.00	1.00	1.00	3.19	1,166.40	2127.50	1.89	159.79	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.0 ft	**1**	0.090	0.086	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.73	266.61	2960.00	0.64	36.52	424.00
Length = 3.0 ft	**2**	0.090	0.086	1.60	1.000	1.00	1.00	1.00	1.00	1.00	0.73	266.61	2960.00	0.43	36.52	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0700	2.715		0.0000	0.000
	2	0.0000	2.715	+D+0.750L+0.750S	-0.0072	1.022

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Overall MAXimum	2.303	5.847	0.354
Overall MINimum	0.731	1.856	0.113
D Only	0.878	2.227	0.135
+D+L	2.048	5.197	0.315
+D+S	1.609	4.084	0.248
+D+0.750L	1.755	4.455	0.270
+D+0.750L+0.750S	2.303	5.847	0.354
+0.60D	0.527	1.336	0.081
L Only	1.170	2.970	0.180
S Only	0.731	1.856	0.113

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

LIC# : KW-06016495, Build:20.22.2.9 CK Engineering LLC (c) ENERCALC INC 1983-2022

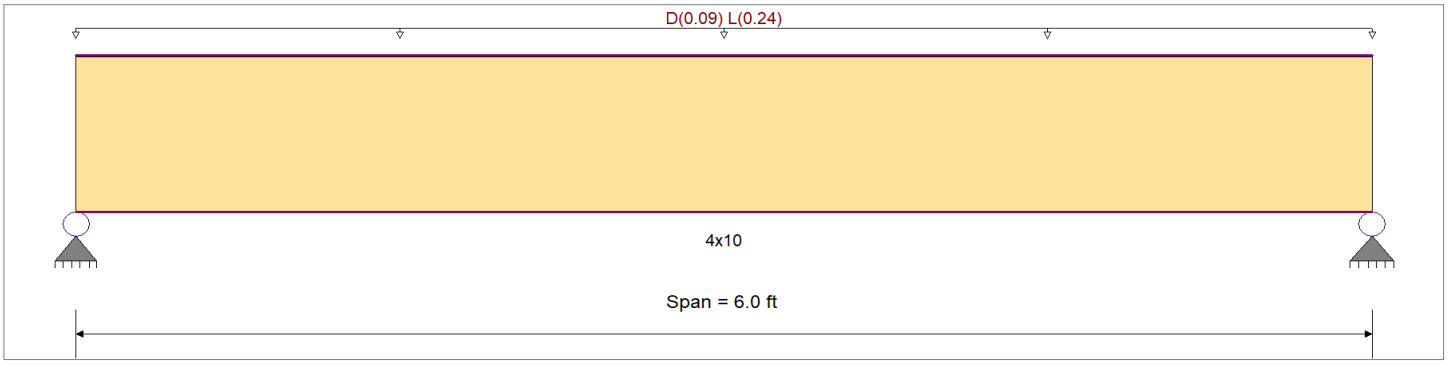
DESCRIPTION: BM#4

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	875 psi	*E : Modulus of Elasticity*	
Load Combination	ASCE 7-16	Fb -	875 psi	Ebend- xx	1300 ksi
		Fc - Prll	600 psi	Eminbend - xx	470 ksi
Wood Species :	Douglas Fir-Larch (North)	Fc - Perp	625 psi		
Wood Grade :	No.2	Fv	170 psi		
		Ft	425 psi	Density	30.59 pcf
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling				



Applied Loads

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

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 6.0 ft, (FLOOR)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.340 : 1	Maximum Shear Stress Ratio	=	0.201 : 1
Section used for this span		4x10	Section used for this span		4x10
fb: Actual	=	357.03 psi	fv: Actual	=	34.15 psi
Fb: Allowable	=	1,050.00 psi	Fv: Allowable	=	170.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	3.000 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.023 in	Ratio =	3069 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.032 in	Ratio =	2232 >=240	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 6.0 ft	1	0.103	0.061	0.90	1.200	1.00	1.00	1.00	1.00	1.00	0.41	97.37	945.00	0.20	9.31	153.00
+D+L					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.0 ft	1	0.340	0.201	1.00	1.200	1.00	1.00	1.00	1.00	1.00	1.49	357.03	1050.00	0.74	34.15	170.00
+D+0.750L					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.0 ft	1	0.223	0.131	1.25	1.200	1.00	1.00	1.00	1.00	1.00	1.22	292.12	1312.50	0.60	27.94	212.50
+0.60D					1.200	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 6.0 ft	1	0.035	0.021	1.60	1.200	1.00	1.00	1.00	1.00	1.00	0.24	58.42	1680.00	0.12	5.59	272.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0323	3.022		0.0000	0.000

Wood Beam

DESCRIPTION: BM#4

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.990	0.990
Overall MINimum	0.720	0.720
D Only	0.270	0.270
+D+L	0.990	0.990
+D+0.750L	0.810	0.810
+0.60D	0.162	0.162
L Only	0.720	0.720

Project Title:
Engineer:
Project ID:
Project Descr:

Wood Beam

Project File: 22-007.ec6

LIC# : KW-06016495, Build:20.22.2.9 CK Engineering LLC (c) ENERCALC INC 1983-2022

DESCRIPTION: HDR#1

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

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

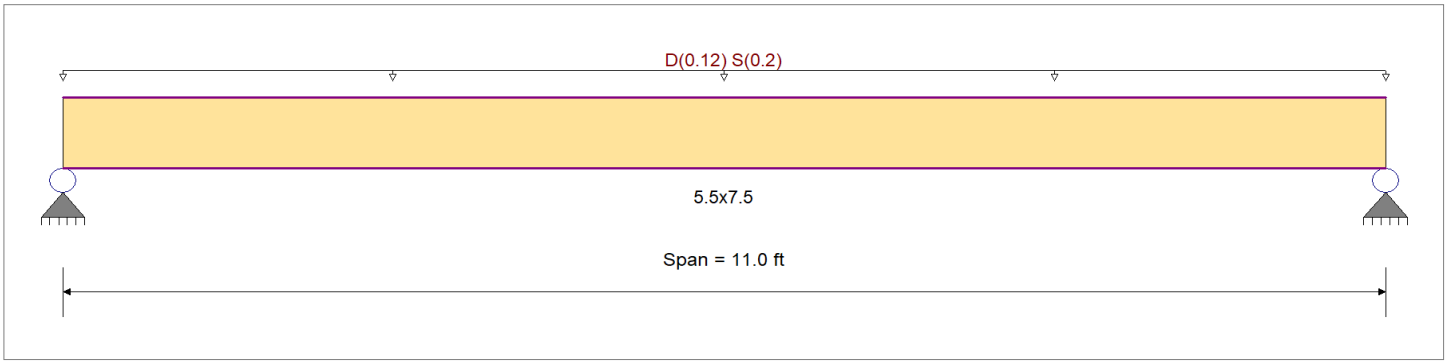
Wood Species : DF/DF
Wood Grade : 24F-V4

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

Fb +	2,400.0 psi
Fb -	1,850.0 psi
Fc - Prll	1,650.0 psi
Fc - Perp	650.0 psi
Fv	265.0 psi
Ft	1,100.0 psi

E : Modulus of Elasticity

Ebend- xx	1,800.0 ksi
Eminbend - xx	950.0 ksi
Ebend- yy	1,600.0 ksi
Eminbend - yy	850.0 ksi
Density	31.210 pcf



Applied Loads

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

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.0150, S = 0.0250 ksf, Tributary Width = 8.0 ft, (ROOF)

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.408 : 1	Maximum Shear Stress Ratio	=	0.187 : 1
Section used for this span		5.5x7.5	Section used for this span		5.5x7.5
fb: Actual	=	1,126.40 psi	fv: Actual	=	56.99 psi
Fb: Allowable	=	2,760.00 psi	Fv: Allowable	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	5.500 ft	Location of maximum on span	=	10.398 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.190 in	Ratio =	693 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.305 in	Ratio =	433 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios									Moment Values			Shear Values		
Segment Length	Span #	M	V	C_d	$C_{F/V}$	C_i	C_r	C_m	C_t	C_L	M	fb	F'b	V	fv	F'v
D Only													0.00	0.00	0.00	0.00
Length = 11.0 ft	1	0.196	0.090	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.82	422.40	2160.00	0.59	21.37	238.50
+D+S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	1	0.408	0.187	1.15	1.000	1.00	1.00	1.00	1.00	1.00	4.84	1,126.40	2760.00	1.57	56.99	304.75
+D+0.750S					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	1	0.344	0.158	1.15	1.000	1.00	1.00	1.00	1.00	1.00	4.08	950.40	2760.00	1.32	48.09	304.75
+0.60D					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00
Length = 11.0 ft	1	0.066	0.030	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.09	253.44	3840.00	0.35	12.82	424.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.3046	5.540		0.0000	0.000

Wood Beam

DESCRIPTION: HDR#1

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.760	1.760
Overall MINimum	1.100	1.100
D Only	0.660	0.660
+D+S	1.760	1.760
+D+0.750S	1.485	1.485
+0.60D	0.396	0.396
S Only	1.100	1.100

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: 22-007.ec6

LIC# : KW-06016495, Build:20.22.2.9 CK Engineering LLC (c) ENERCALC INC 1983-2022

DESCRIPTION: FTNG#1

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
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)	=	150.0	pcf
Soil/Concrete Friction Coeff.	=	0.250	

Increases based on footing Depth

Footing base depth below soil surface	=	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

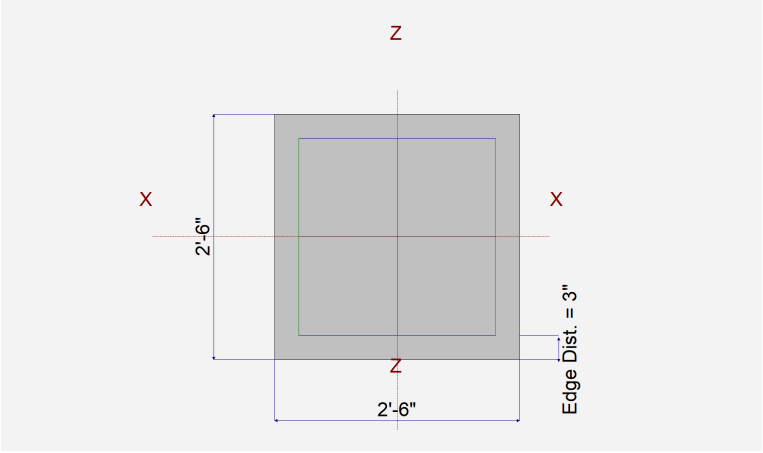
Width parallel to X-X Axis	=	2.50 ft
Length parallel to Z-Z Axis	=	2.50 ft
Footing Thickness	=	10.0 in

Pedestal dimensions...

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

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0 in

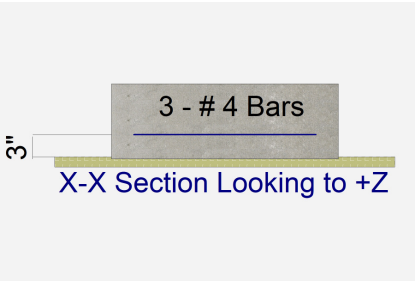


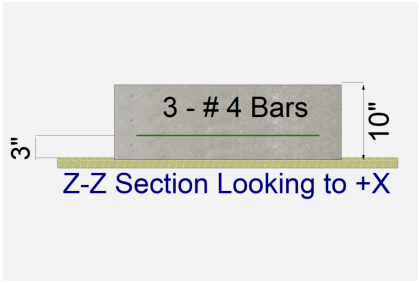
Reinforcing

Bars parallel to X-X Axis			
Number of Bars	=		3
Reinforcing Bar Size	=	#	4
Bars parallel to Z-Z Axis			
Number of Bars	=		3.0
Reinforcing Bar Size	=	#	4

Bandwidth Distribution Check (ACI 15.4.4.2)

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





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	2.230		2.970	1.860				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

Project File: 22-007.ec6

LIC# : KW-06016495, Build:20.22.2.9 CK Engineering LLC (c) ENERCALC INC 1983-2022

DESCRIPTION: FTNG#1

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.7047	Soil Bearing	1.057 ksf	1.50 ksf	+D+0.750L+0.750S 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	0.2197	Z Flexure (+X)	1.078 k-ft/ft	4.904 k-ft/ft	+1.20D+L+1.60S
PASS	0.2197	Z Flexure (-X)	1.078 k-ft/ft	4.904 k-ft/ft	+1.20D+L+1.60S
PASS	0.2197	X Flexure (+Z)	1.078 k-ft/ft	4.904 k-ft/ft	+1.20D+L+1.60S
PASS	0.2197	X Flexure (-Z)	1.078 k-ft/ft	4.904 k-ft/ft	+1.20D+L+1.60S
PASS	0.1478	1-way Shear (+X)	11.085 psi	75.0 psi	+1.20D+L+1.60S
PASS	0.1478	1-way Shear (-X)	11.085 psi	75.0 psi	+1.20D+L+1.60S
PASS	0.1478	1-way Shear (+Z)	11.085 psi	75.0 psi	+1.20D+L+1.60S
PASS	0.1478	1-way Shear (-Z)	11.085 psi	75.0 psi	+1.20D+L+1.60S
PASS	0.2764	2-way Punching	41.456 psi	150.0 psi	+1.20D+L+1.60S

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	0.4776	0.4776	n/a	n/a	0.318
X-X, +D+L	1.50	n/a	0.0	0.9528	0.9528	n/a	n/a	0.635
X-X, +D+S	1.50	n/a	0.0	0.7752	0.7752	n/a	n/a	0.517
X-X, +D+0.750L	1.50	n/a	0.0	0.8340	0.8340	n/a	n/a	0.556
X-X, +D+0.750L+0.750S	1.50	n/a	0.0	1.057	1.057	n/a	n/a	0.705
X-X, +0.60D	1.50	n/a	0.0	0.2866	0.2866	n/a	n/a	0.191
Z-Z, D Only	1.50	0.0	n/a	n/a	n/a	0.4776	0.4776	0.318
Z-Z, +D+L	1.50	0.0	n/a	n/a	n/a	0.9528	0.9528	0.635
Z-Z, +D+S	1.50	0.0	n/a	n/a	n/a	0.7752	0.7752	0.517
Z-Z, +D+0.750L	1.50	0.0	n/a	n/a	n/a	0.8340	0.8340	0.556
Z-Z, +D+0.750L+0.750S	1.50	0.0	n/a	n/a	n/a	1.057	1.057	0.705
Z-Z, +0.60D	1.50	0.0	n/a	n/a	n/a	0.2866	0.2866	0.191

Overturning Stability

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

All units k

Sliding Stability

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

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.3903	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.40D	0.3903	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+1.60L	0.9285	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+1.60L	0.9285	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+1.60L+0.50S	1.045	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+1.60L+0.50S	1.045	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+L	0.7058	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+L	0.7058	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D	0.3345	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D	0.3345	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+L+1.60S	1.078	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+L+1.60S	1.078	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+1.60S	0.7065	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK

Project Title:
Engineer:
Project ID:
Project Descr:

General Footing

Project File: 22-007.ec6

DESCRIPTION: FTNG#1

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, +1.20D+1.60S	0.7065	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+L+0.50S	0.8220	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+L+0.50S	0.8220	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +0.90D	0.2509	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +0.90D	0.2509	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+L+0.20S	0.7523	+Z	Bottom	0.2160	AsMin	0.240	4.904	OK
X-X, +1.20D+L+0.20S	0.7523	-Z	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.40D	0.3903	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.40D	0.3903	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+1.60L	0.9285	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+1.60L	0.9285	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+1.60L+0.50S	1.045	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+1.60L+0.50S	1.045	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+L	0.7058	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+L	0.7058	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D	0.3345	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D	0.3345	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+L+1.60S	1.078	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+L+1.60S	1.078	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+1.60S	0.7065	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+1.60S	0.7065	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+L+0.50S	0.8220	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+L+0.50S	0.8220	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +0.90D	0.2509	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +0.90D	0.2509	+X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+L+0.20S	0.7523	-X	Bottom	0.2160	AsMin	0.240	4.904	OK
Z-Z, +1.20D+L+0.20S	0.7523	+X	Bottom	0.2160	AsMin	0.240	4.904	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	4.01 psi	4.01 psi	4.01 psi	4.01 psi	4.01 psi	75.00 psi	0.05	OK
+1.20D+1.60L	9.55 psi	9.55 psi	9.55 psi	9.55 psi	9.55 psi	75.00 psi	0.13	OK
+1.20D+1.60L+0.50S	10.75 psi	10.75 psi	10.75 psi	10.75 psi	10.75 psi	75.00 psi	0.14	OK
+1.20D+L	7.26 psi	7.26 psi	7.26 psi	7.26 psi	7.26 psi	75.00 psi	0.10	OK
+1.20D	3.44 psi	3.44 psi	3.44 psi	3.44 psi	3.44 psi	75.00 psi	0.05	OK
+1.20D+L+1.60S	11.09 psi	11.09 psi	11.09 psi	11.09 psi	11.09 psi	75.00 psi	0.15	OK
+1.20D+1.60S	7.27 psi	7.27 psi	7.27 psi	7.27 psi	7.27 psi	75.00 psi	0.10	OK
+1.20D+L+0.50S	8.46 psi	8.46 psi	8.46 psi	8.46 psi	8.46 psi	75.00 psi	0.11	OK
+0.90D	2.58 psi	2.58 psi	2.58 psi	2.58 psi	2.58 psi	75.00 psi	0.03	OK
+1.20D+L+0.20S	7.74 psi	7.74 psi	7.74 psi	7.74 psi	7.74 psi	75.00 psi	0.10	OK

Two-Way "Punching" Shear

All units k

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	15.01 psi	150.00 psi	0.1001	OK
+1.20D+1.60L	35.72 psi	150.00 psi	0.2381	OK
+1.20D+1.60L+0.50S	40.19 psi	150.00 psi	0.2679	OK
+1.20D+L	27.15 psi	150.00 psi	0.181	OK
+1.20D	12.87 psi	150.00 psi	0.08578	OK
+1.20D+L+1.60S	41.46 psi	150.00 psi	0.2764	OK
+1.20D+1.60S	27.18 psi	150.00 psi	0.1812	OK
+1.20D+L+0.50S	31.62 psi	150.00 psi	0.2108	OK
+0.90D	9.65 psi	150.00 psi	0.06433	OK
+1.20D+L+0.20S	28.94 psi	150.00 psi	0.1929	OK

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Cantilevered Retaining Wall

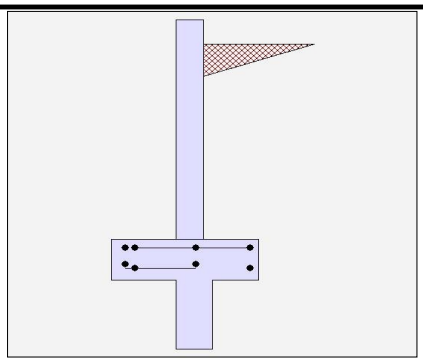
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	4.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	7.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	33.833
Total Seismic Force	=	163.528

Stem Weight Seismic Load

F_p / W_p Weight Multiplier = 0.200 g

Added seismic base force 47.3 lbs

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Design Summary

Wall Stability Ratios

Overturning	=	1.93	OK
Sliding	=	1.54	OK
Total Bearing Load	=	1,253 lbs	
...resultant ecc.	=	6.35 in	
Soil Pressure @ Toe	=	1,038 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,453 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	7.3 psi	OK
Footing Shear @ Heel	=	5.3 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	570.5 lbs	
less 100% Passive Force	= -	379.7 lbs	
less 100% Friction Force	= -	501.0 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

		Bottom
		Stem OK
Design Height Above Ftg	ft =	0.00
Wall Material Above "Ht"	=	Concrete
Design Method	=	LRFD
Thickness	=	6.00
Rebar Size	=	# 4
Rebar Spacing	=	12.00
Rebar Placed at	=	Edge
Design Data		
fb/FB + fa/Fa	=	**0.414**
Total Force @ Section		
Service Level	lbs =	
Strength Level	lbs =	650.8
Moment....Actual		
Service Level	ft-# =	
Strength Level	ft-# =	1,019.9
Moment.....Allowable	=	2,455.6
Shear.....Actual		
Service Level	psi =	
Strength Level	psi =	12.8
Shear.....Allowable	psi =	75.0
Anet (Masonry)	in2 =	
Rebar Depth 'd'	in =	4.25
Masonry Data		
f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Wall Weight	psf =	75.0
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD
Concrete Data		
f'c	psi =	2,500.0
Fy	psi =	40,000.0

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Cantilevered Retaining Wall

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Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.0865 in2/ft	
(4/3) * As :	0.1153 in2/ft	Min Stem T&S Reinf Area 0.648 in2
200bd/fy : 200(12)(4.25)/40000 :	0.255 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.1296 in2/ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.2 in2/ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.8636 in2/ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	1.17 ft
Heel Width	=	1.50
Total Footing Width	=	2.67
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	17.00 in
Key Distance from Toe	=	1.17 ft

f'c = 2,500 psi Fy = 40,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,453	0	psf
Mu' : Upward	=	9,959	502	ft-#
Mu' : Downward	=	1,226	4,068	ft-#
Mu: Design	=	346	10	ft-#
Actual 1-Way Shear	=	7.26	5.31	psi
Allow 1-Way Shear	=	40.00	40.00	psi

Toe Reinforcing = # 4 @ 11.11 in
Heel Reinforcing = # 4 @ 11.11 in
Key Reinforcing = None Spec'd
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm

Min footing T&S reinf Area 0.58 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)		408.8	1.61	658.7	Soil Over HL (ab. water tbl)	440.0	2.17	953.5
HL Act Pres (be water tbl)					Soil Over HL (bel. water tbl)		2.17	953.5
Hydrostatic Force					Watre Table			
Buoyant Force	=				Sloped Soil Over Heel	=		
Surcharge over Heel	=				Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=		
Seismic Earth Load	=	114.5	2.42	276.6	Surcharge Over Toe	=		
Seismic Stem Self Wt	=	47.3	3.08	145.7	Stem Weight(s)	=	337.5	1.42	478.2
					Earth @ Stem Transitions	=			
					Footing Weight	=	333.4	1.33	444.6
					Key Weight	=	141.7	1.50	212.5
					Vert. Component	=			
Total	=	570.5	**O.T.M.** =	1,081.0	**Total =**		1,252.5 lbs	**R.M.=**	2,088.8

Resisting/Overturning Ratio = **1.93**
Vertical Loads used for Soil Pressure = 1,252.5 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,
because the wall would then tend to rotate into the retained soil.

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Cantilevered Retaining Wall

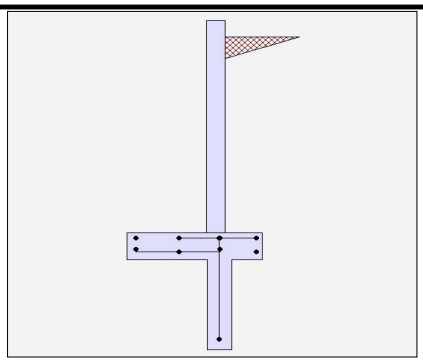
Code: IBC 2018,ACI 318-14,TMS 402-16

Criteria

Retained Height	=	6.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	1,500.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	35.0 psf/ft
	=	
Passive Pressure	=	150.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing||Soil Friction	=	0.400
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0
Used for Sliding & Overturning		

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
Load Type	=	Wind (W) (Service Level)
Wind on Exposed Stem (Service Level)	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Method : Uniform

Multiplier Used	=	7.000
(Multiplier used on soil density)		
Uniform Seismic Force	=	47.833
Total Seismic Force	=	326.861

Stem Weight Seismic Load

F_p / W_p Weight Multiplier = 0.200 g

Added seismic base force 68.3 lbs

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Cantilevered Retaining Wall

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Design Summary

Wall Stability Ratios

Overturning	=	1.64	OK
Sliding	=	1.54	OK
Total Bearing Load	=	1,881 lbs	
...resultant ecc.	=	10.04 in	
Soil Pressure @ Toe	=	1,258 psf	OK
Soil Pressure @ Heel	=	0 psf	OK
Allowable	=	1,500 psf	
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	1,761 psf	
ACI Factored @ Heel	=	0 psf	
Footing Shear @ Toe	=	23.6 psi	OK
Footing Shear @ Heel	=	9.5 psi	OK
Allowable	=	75.0 psi	

Sliding Calcs

Lateral Sliding Force	=	1,114.2 lbs	
less 100% Passive Force	= -	963.0 lbs	
less 100% Friction Force	= -	752.4 lbs	
Added Force Req'd	=	0.0 lbs	OK
....for 1.5 Stability	=	0.0 lbs	OK

Vertical component of active lateral soil pressure IS NOT considered in the calculation of soil bearing

Load Factors

Building Code	IBC 2018,ACI
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.000
Seismic, E	1.000

Stem Construction

Bottom

Stem OK

Design Height Above Ftg	ft =	0.00	
Wall Material Above "Ht"	=	Concrete	
Design Method	=	LRFD	
Thickness	=	6.00	
Rebar Size	=	# 4	
Rebar Spacing	=	8.00	
Rebar Placed at	=	Edge	
Design Data			
fb/FB + fa/Fa	=	**0.883**	
Total Force @ Section			
Service Level	lbs =		
Strength Level	lbs =	1,392.5	
Moment....Actual			
Service Level	ft-# =		
Strength Level	ft-# =	3,193.9	
Moment.....Allowable	=	3,612.6	
Shear.....Actual			
Service Level	psi =		
Strength Level	psi =	27.3	
Shear.....Allowable	psi =	75.0	
Anet (Masonry)	in2 =		
Rebar Depth 'd'	in =	4.25	
Masonry Data			
f'm	psi =		
Fs	psi =		
Solid Grouting	=		
Modular Ratio 'n'	=		
Wall Weight	psf =	75.0	
Short Term Factor	=		
Equiv. Solid Thick.	=		
Masonry Block Type	=	Medium Weight	
Masonry Design Method	=	ASD	
Concrete Data			
f'c	psi =	2,500.0	
Fy	psi =	40,000.0	

Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Concrete Stem Rebar Area Details

Bottom Stem	Vertical Reinforcing	Horizontal Reinforcing
As (based on applied moment) :	0.2708 in2/ft	
(4/3) * As :	0.3611 in2/ft	Min Stem T&S Reinf Area 0.936 in2
200bd/fy : 200(12)(4.25)/40000 :	0.255 in2/ft	Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft
0.0018bh : 0.0018(12)(6) :	0.1296 in2/ft	Horizontal Reinforcing Options :
	==========	One layer of : Two layers of :
Required Area :	0.2708 in2/ft	#4@ 16.67 in #4@ 33.33 in
Provided Area :	0.3 in2/ft	#5@ 25.83 in #5@ 51.67 in
Maximum Area :	0.8636 in2/ft	#6@ 36.67 in #6@ 73.33 in

Footing Data

Toe Width	=	2.17 ft
Heel Width	=	1.50
Total Footing Width	=	3.67
Footing Thickness	=	10.00 in
Key Width	=	8.00 in
Key Depth	=	33.00 in
Key Distance from Toe	=	2.17 ft

f'c = 2,500 psi Fy = 40,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel	
Factored Pressure	=	1,761	0	psf
Mu' : Upward	=	37,635	40	ft-#
Mu' : Downward	=	4,226	5,652	ft-#
Mu: Design	=	1,334	112	ft-#
Actual 1-Way Shear	=	23.60	9.49	psi
Allow 1-Way Shear	=	75.00	40.00	psi

Toe Reinforcing = # 4 @ 10.00 in
Heel Reinforcing = # 4 @ 18.00 in
Key Reinforcing = # 4 @ 8.00 in
Footing Torsion, Tu = 0.00 ft-lbs
Footing Allow. Torsion, phi Tu = 0.00 ft-lbs

If torsion exceeds allowable, provide supplemental design for footing torsion.

Other Acceptable Sizes & Spacings

Toe: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: #4@ 8.13 in, #5@ 12.6 in, #6@ 17.89 in, #7@ 18 in, #8@

Min footing T&S reinf Area 0.79 in2
Min footing T&S reinf Area per foot 0.22 in2 /ft

If one layer of horizontal bars:	If two layers of horizontal bars:
#4@ 11.11 in	#4@ 22.22 in
#5@ 17.22 in	#5@ 34.44 in
#6@ 24.44 in	#6@ 48.89 in

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Cantilevered Retaining Wall

Code: IBC 2018,ACI 318-14,TMS 402-16

Summary of Overturning & Resisting Forces & Moments

Item	.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#	.....RESISTING..... Force lbs	Distance ft	Moment ft-#
HL Act Pres (ab water tbl)	817.2	2.28	1,861.3			
HL Act Pres (be water tbl)						
Hydrostatic Force						
Buoyant Force =						
Surcharge over Heel =						
Surcharge Over Toe =						
Adjacent Footing Load =						
Added Lateral Load =						
Load @ Stem Above Soil =						
Seismic Earth Load =	228.8	3.42	781.7			
Seismic Stem Self Wt =	68.3	4.08	278.7			
Soil Over HL (ab. water tbl)				660.0	3.17	2,090.2
Soil Over HL (bel. water tbl)					3.17	2,090.2
Watre Table						
Sloped Soil Over Heel =						
Surcharge Over Heel =						
Adjacent Footing Load =						
Axial Dead Load on Stem =						
* Axial Live Load on Stem =						
Soil Over Toe =						
Surcharge Over Toe =						
Stem Weight(s) =				487.5	2.42	1,178.3
Earth @ Stem Transitions =						
Footing Weight =				458.4	1.83	840.4
Key Weight =				275.0	2.50	687.6
Vert. Component =						
Total =	1,114.2	**O.T.M.** =	2,921.7	**Total =** 1,880.9 lbs	**R.M.=**	4,796.5

Resisting/Overturning Ratio = **1.64**
Vertical Loads used for Soil Pressure = 1,880.9 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

If seismic is included, the OTM and sliding ratios
be 1.1 per section 1807.2.3 of IBC 2009 or IBC 201

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Sliding Resistance.

Vertical component of active lateral soil pressure IS NOT considered in the calculation of Overturning Resistance.

Tilt

Horizontal Deflection at Top of Wall due to settlement of soil

(Deflection due to wall bending not considered)

Soil Spring Reaction Modulus	250.0	pci
Horizontal Defl @ Top of Wall (approximate only)	0.000	in

The above calculation is not valid if the heel soil bearing pressure exceeds that of the toe,
because the wall would then tend to rotate into the retained soil.