



STRUCTURAL CALCULATIONS

Cheshire Upper Lot Residence

PROJECT LOCATION

7615 E Mercer Way
Mercer Island, WA

BY
KEVIN J. HAIAR, P.E.

MERRELL DESIGN SERVICES PLLC
SPOKANE, WA



REV 1: 3/28/25
CLARIFIED SEISMIC
CRITERIA & LATERAL
DESIGN

DATE
12/15/24

**TABLE R301.2(1)
CLIMATIC AND GEOGRAPHIC DESIGN
CRITERIA**

ROOF SNOW LOAD ^a (psf)	WIND DESIGN				SEISMIC DESIGN CATEGORY	SUBJECT TO DAMAGE FROM			OUTDOOR DESIGN TEMP (F) - Heat/Cool	ICE BARRIER UNDERLAYMENT REQUIRED	FLOOD HAZARD ^o	AIR FREEZING INDEX	MEAN ANNUAL TEMP
	Speed ^b (mph)	Topographic effects ^c	Special wind region	Windborne debris zone		Weathering ^d	Frost line depth	Termite					
25	110	Yes	No	No	D2	Moderate	12"	Slight to Moderate	83/24	No	N.A.	113	53
MANUAL J DESIGN CRITERIA													
Elevation		Latitude	Winter heating	Summer cooling	Altitude correction factor	Indoor design temperature	Design temperature cooling	Heating temperature difference					
338 feet		47°34'39"	72°F max	75°F min	0.99	72°F	75°F	48°F					
Cooling temperature difference		Wind velocity heating	Wind velocity cooling	Coincident wet bulb	Daily range	Winter humidity	Summer humidity						
8°F		N.A.	N.A.	66	Medium	75%	68%						

- a. This is the minimum roof snow load. When using this snow load it will be left to the engineer's judgment whether to consider drift or sliding snow. However, rain on snow surcharge of 5 psf must be considered for roof slopes less than 5 degrees.
- b. The 110 mph Ultimate Design Wind Speed (3-second gust) as adopted by the 2018 IRC/ASCE 7-10 (or if using the IBC for structural design, the 98 mph Basic Design Wind Speed as adopted by the 2018 IBC/ASCE 7-16 may be used).
- c. Wind exposure category and Topographic effects (Wind Speed-up Kzt factor) shall be determined on a site-specific basis by the Engineer of Record (components and cladding need not consider topographic effects unless otherwise determined by the engineer of record).
- d. Weathering may require a higher strength concrete or grade of masonry than necessary to satisfy the structural requirements of this code. The grade of masonry units shall be determined from ASTM C 34, C 55, C 62, C 73, C 90, C 129, C 145, C 216 or C 652.
- e. The City of Mercer Island participates in the National Flood Insurance Program (NFIP); Regular Program (No Special Flood Hazard Area). Further NFIP participation information: CID 530083, Initial FHBM Identified 06/28/74, Initial FIRM Identified 05/16/95, Current Effective Map Date (NSFHA), Reg-Emer Date 06/30/97, 53033C0654G effective 8/19/2020.

WIND EXPOSURE CATEGORIES & WIND SPEED-UP FACTORS (ICC Section 1609 & ASCE 7-05 Chapter 6)

It is the responsibility of the Owner (or their Design Professional) to review site conditions and determine the K_{zt} factor to be utilized for each specific project. The K_{zt} factors and wind exposure categories indicated on this map are the minimum values accepted by the City of Mercer Island without requiring the design professional to submit additional calculations and supporting topographic documentation (to verify the values utilized in their wind load determination).

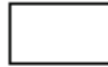
Please note – The K_{zt} values indicated on this map are approximations based upon periodic calculations of representative samplings around Mercer Island. These values are intended for City of Mercer Island’s plan review purposes only.

WIND EXPOSURE CATEGORIES:

Wind Exposure
Category



Exposure 'C' (1500 feet from Lake)



Exposure 'B' (all other areas)

WIND SPEED-UP (TOPOGRAPHIC EFFECT) - K_{zt} Factor :

K_{zt} Factor



$K_{zt} = 1.0$



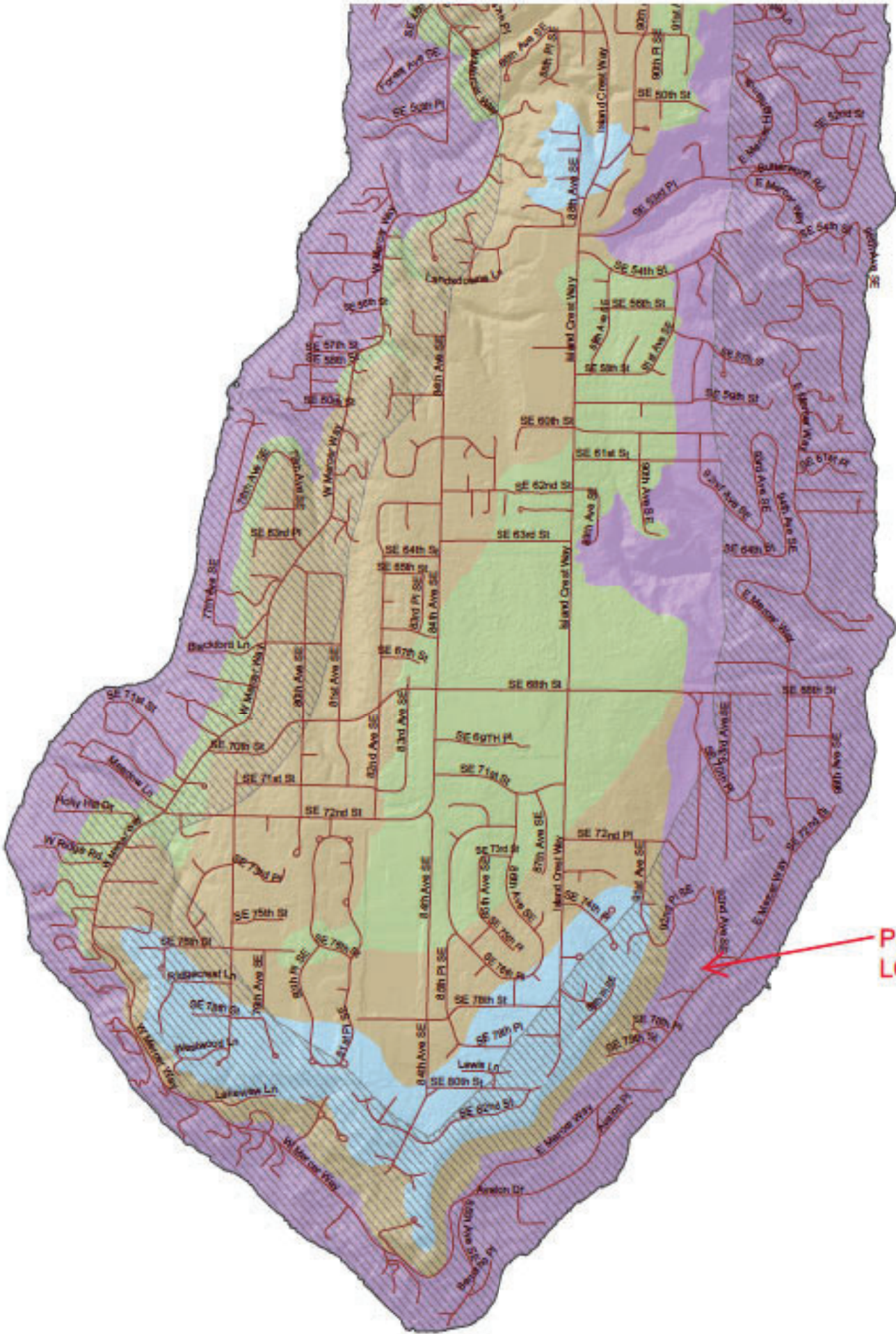
$K_{zt} = 1.3$



$K_{zt} = 1.6$



$K_{zt} = 1.9$



PROJECT
LOCATION

Summary

The project involves a new custom two-story home with attached garage located on Mercer Island, WA. The footprint is about 74 ft x 50 ft and includes single slope roofs with large overhangs. The framing will consist of conventional wood framing with concrete footings based on a geotech recommendations.

Design Codes

2021 International Building Code
ASCE/SEI 7-22
ACI 318 Concrete 2019
2024 NDS Wood

REV 1

Design Criteria

Roof Snow + 5psf Rain on Snow Load: 30 psf
 Wind Speed: 110 mph
 Wind Exposure: C
 Seismic Design Category: D
 Seismic S_s: 1.63
 Seismic S₁: 0.62
 Allowable Soil Bearing: 2000 psf
 (Earth Solutions NW
 Geotech Report)

REPORT SUMMARY

Site Information

Address:	7615 E Mercer Way, Mercer Island, Washington, 98040
Elevation:	147 ft (NAVD 88)
Lat:	47.534526
Long:	-122.216267
Standard:	ASCE/SEI 7-22
Risk Category:	II
Soil Class:	DE

Seismic Data

S _s	1.63
S ₁	0.62
S _{MS}	1.67
S _{M1}	1.61
S _{DS}	1.11
S _{D1}	1.07
T _L	6
PGA _M	0.7
V _{S30}	185
Seismic Design Category	D

Gravity Loads

<u>Roof Dead Loads:</u>	<u>Weight (psf)</u>
Roofing	1.0
Decking	2.0
Roof Joists/Trusses	3.0
Insulation	1.0
Gyp Ceiling	2.5
Mech/Elec	3.5
Misc.	2.0

Total Roof Dead Load **15.0**

<u>Roof Live Loads:</u>	<u>Weight (psf)</u>
Roof Live Load	20.0
Snow Load + Rain	30.0

<u>Ext. Wall Dead Loads:</u>	<u>Weight (psf)</u>
6" studs	1.8
Sheathing, 15/32"	1.5
Insulation	1.2
Ext finish (siding)	5
Misc	2.5

Total Wall Load **12**

<u>Floor Dead Loads:</u>	<u>Weight (psf)</u>
Flooring	1.5
Gypcrete/overlay (1.5")	0.0
Joists	3.0
Gyp Ceiling	2.5
Mech/Elec	3.5
Misc.	4.5

Total Floor Dead Load **15.0**

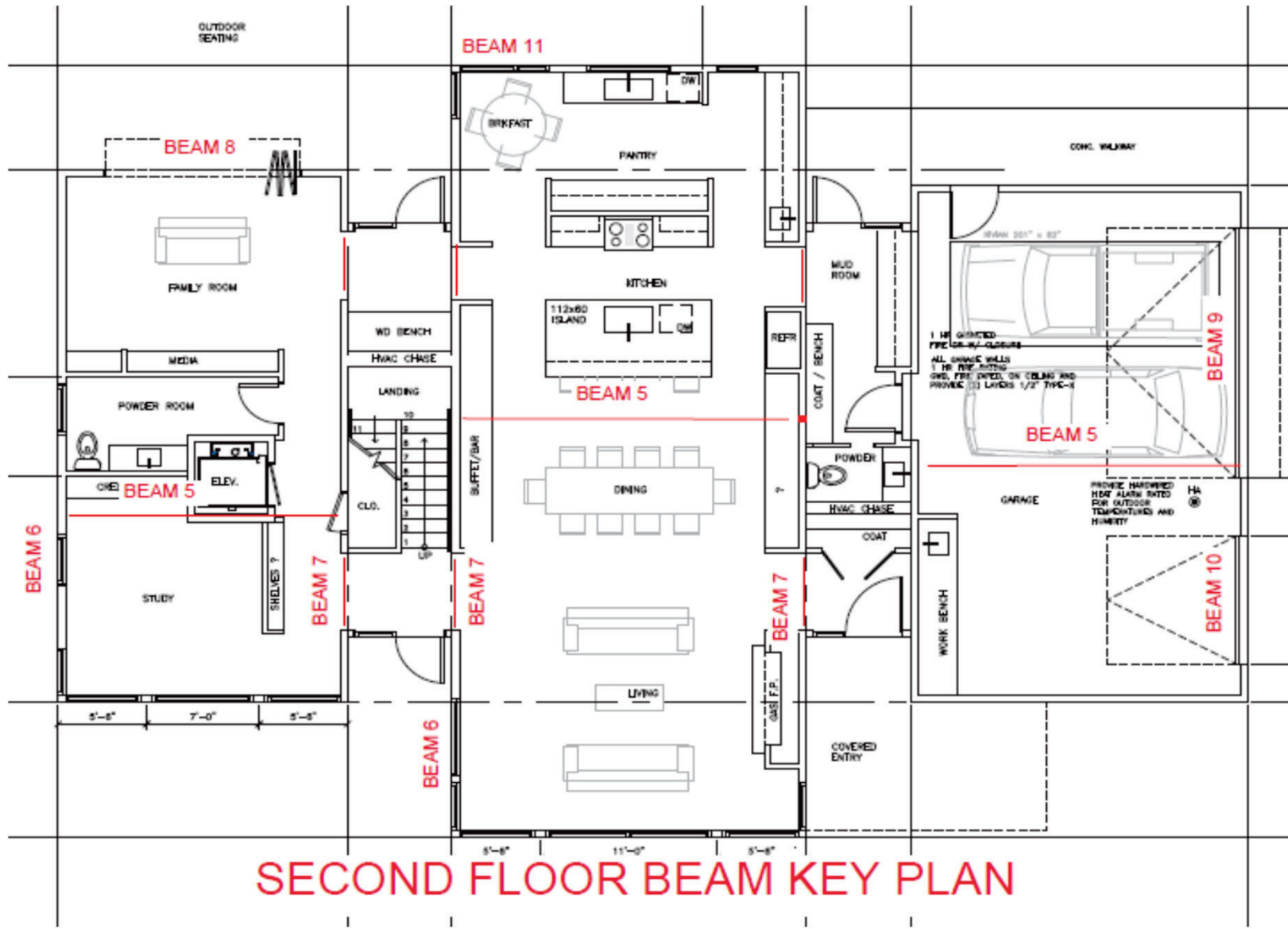
<u>Floor Live Loads:</u>	<u>Weight (psf)</u>
Residential	40

Interior Strip Footings - 15ft trib	Load (PLF)
Dead	450
Live	600
Snow	450

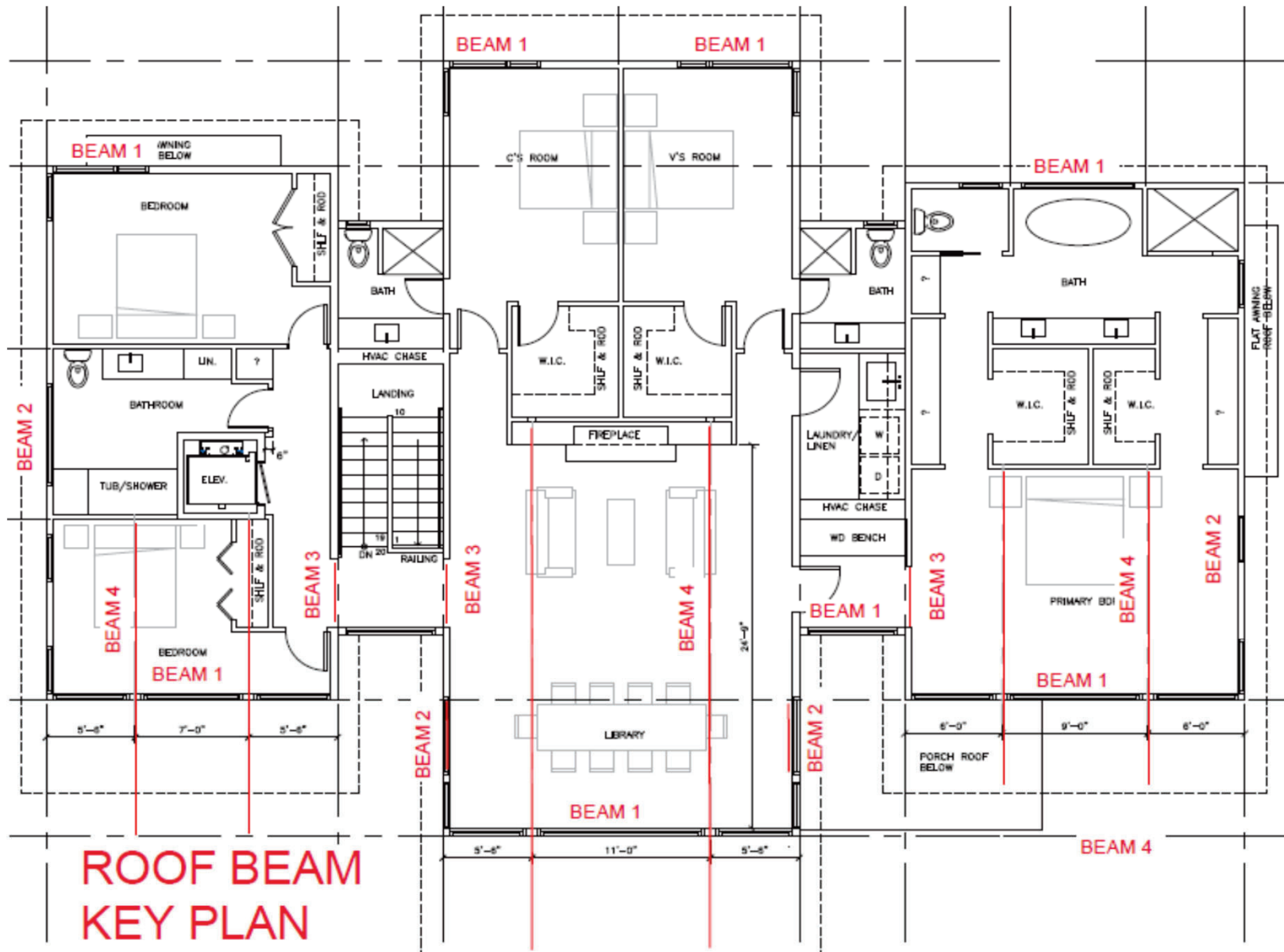
Allowable Bearing, 2000 psf **2000**

Minimum footing width, ft **1**

USE MINIMUM 1'-4" WIDE BY 12" DEEP CONT FTG AT INTERIOR AND EXTERIOR STRIP FOOTINGS



SECOND FLOOR BEAM KEY PLAN



**ROOF BEAM
KEY PLAN**

Roof & Second Floor Framing Beams

BM #	Description	location	Span	Roof Trib	R DL	Roof S	Roof Live	Floor Trib	FL Live	FL Dead	FL Live	Beam Size
			ft	ft	PLF	PLF	PLF	ft	PSF	PLF	PLF	
BM 1	Rf Ext Non Brg Hdr	Roof	6	2	30	60	40	0	0	0	0	(2) 2x10 DFL #2
Bm 2	Rf Ext Brg Hdr	Roof	7	12	180	360	240	0	0	0	0	(2) 2x10 DFL #2
BM 3	Int Brg Hdr	Roof	5	14.5	217.5	435	290	0	0	0	0	(2) 2x10 DFL #2
BM 4	Roof Girders	Roof	27	8.5	127.5	255	170		40	0	0	GL 6.75x24
BM 5	Second Flr Tfr Bms	2nd Floor	22	Conc	1.7k	3.3k	2.2k	1.33	40	20	53	GL 6.75x15
BM 6	Ext Brg Hdr	2nd Floor	6	9	135	270	180	9	40	135	360	(2) 2x10 DFL #2
BM 7	Int Brg Hdr	2nd Floor	6	14	210	420	280	14	40	210	560	(2) 2x10 DFL #2
BM 8	Folding Door hdr	2nd Floor	12	2	30	60	40	2	40	30	80	GL 5.5x10.5
BM 9	Large Gar Hdr	2nd Floor	16.5	12	180	360	240	10.5	40	158	420	GL 5.5x13.5
BM 10	Short Gar Hdr	2nd Floor	8.5	12	180	360	240	10.5	40	158	420	GL 5.5x9
BM 11	Ext Non Brg Hdr	2nd Floor	5	5	75	150	100	5	40	75	200	(2) 2x10 DFL #2

BM #	Description	location	BM Reaction (left)				BM Reaction (right)				Post Size	Ftg Size (2000psf) (ft)
			DL	FL LL	Snow	Total	DL	FL LL	Snow	Total		
			k	k	k	k	k	k	k	k		
BM 1	Rf Ext Non Brg Hdr	Roof	0.5	0.0	0.5	1.0	0.5	0.0	0.5	1.0	(2) studs	0.7
Bm 2	Rf Ext Brg Hdr	Roof	0.6		1.3	1.9	0.6	0.0	1.3	1.9	(2) studs	1.0
BM 3	Int Brg Hdr	Roof	0.5		1.1	1.6	0.5	0.0	1.1	1.6	(2) studs	0.9
BM 4	Roof Girders	Roof	1.7		3.3	5.0	3.0		6.1	9.1	(3) studs	1.3
BM 5	Second Flr Tfr Bms	2nd Floor	1.7		3.3	5.0	1.7	0.0	3.3	5.0	(2) studs	1.3
BM 6	Ext Brg Hdr	2nd Floor	0.4	1.0	0.8	1.8	0.4	1.0	0.8	1.8	(2) studs	0.9
BM 7	Int Brg Hdr	2nd Floor	0.5	1.7	1.3	2.8	0.5	2.0	1.3	2.8	(2) studs	1.2
BM 8	Folding Door hdr	2nd Floor	0.2	1.0	0.4	1.3	0.2	2.0	0.4	1.3	(2) studs	0.8
BM 9	Large Gar Hdr	2nd Floor	2.8	3.5	3.0	7.7	2.8	2.0	3.0	7.7	(2) studs	1.3
BM 10	Short Gar Hdr	2nd Floor	1.5	1.8	1.5	4.0	1.5	3.0	1.5	4.0	(2) studs	1.3
BM 11	Ext Non Brg Hdr	2nd Floor	0.4	0.5	0.4	1.1	0.4	3.0	0.4	1.1	(2) studs	0.7

NOTES:

1. SEE ENERCALC OUTPUT SHEETS FOR BEAM DESIGNS
2. TOTAL LOAD INCLUDES LOAD CASES D+L, $D=0.75*L+0.75*S$

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 1 Rf non brg hdr

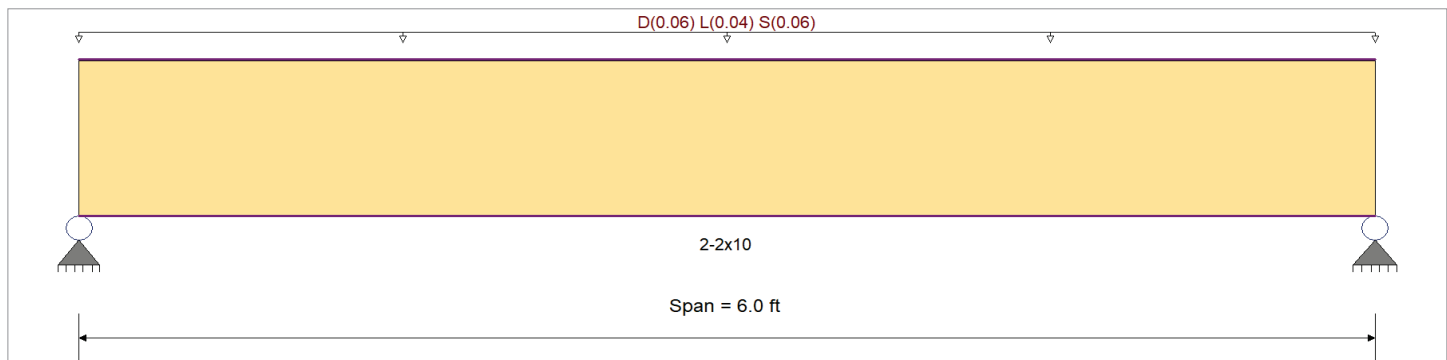
CODE REFERENCES

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

Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design	Fb +	900 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : IBC 2021	Fb -	900 psi	Ebend- xx	1600ksi
	Fc - Prll	1350 psi	Eminbend - xx	580ksi
Wood Species : Douglas Fir-Larch	Fc - Perp	625 psi		
Wood Grade : No.2	Fv	180 psi		
	Ft	575 psi	Density	31.21pcf
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 calculated and added to loading

Uniform Load : D = 0.030, L = 0.020, S = 0.030 ksf, Tributary Width = 2.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.156 1	Maximum Shear Stress Ratio =	0.082 : 1
Section used for this span	2-2x10	Section used for this span	2-2x10
fb: Actual =	177.99psi	fv: Actual =	17.03 psi
F'b =	1,138.50psi	F'v =	207.00 psi
Load Combination	+D+0.750L+0.750S	Load Combination	+D+0.750L+0.750S
Location of maximum on span	= 3.000ft	Location of maximum on span	= 0.000ft
Span # where maximum occurs	= Span # 1	Span # where maximum occurs	= Span # 1
Maximum Deflection			
Max Downward Transient Deflection	0.006 in Ratio = 12952 >=360	Span: 1 : S Only	
Max Upward Transient Deflection	0 in Ratio = 0 <360	n/a	
Max Downward Total Deflection	0.013 in Ratio = 5511 >=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	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 6.0 ft	1	0.094	0.049	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.30	83.3	891.0	0.0	0.00	0.0	0.0
+D+L	Length = 6.0 ft	1	0.135	0.071	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.48	133.8	990.0	0.0	0.00	0.0	0.0
+D+S	Length = 6.0 ft	1	0.140	0.073	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.57	159.1	1,138.5	0.0	0.00	0.0	0.0
+D+0.750L	Length = 6.0 ft	1	0.098	0.052	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.43	121.2	1,237.5	0.0	0.00	0.0	0.0
+D+0.750L+0.750S	Length = 6.0 ft	1	0.156	0.082	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.63	178.0	1,138.5	0.0	0.00	0.0	0.0



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 1 Rf non brg hdr

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
+0.60D						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1		0.032	0.017	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.18	50.0	1,584.0	0.09	4.8	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0131	3.022		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.423	0.423
Max Upward from Load Combinations	0.423	0.423
Max Upward from Load Cases	0.198	0.198
D Only	0.198	0.198
+D+L	0.318	0.318
+D+S	0.378	0.378
+D+0.750L	0.288	0.288
+D+0.750L+0.750S	0.423	0.423
+0.60D	0.119	0.119
L Only	0.120	0.120
S Only	0.180	0.180

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 2 Roof Ext Brg Hdr

CODE REFERENCES

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

Load Combination Set : IBC 2021

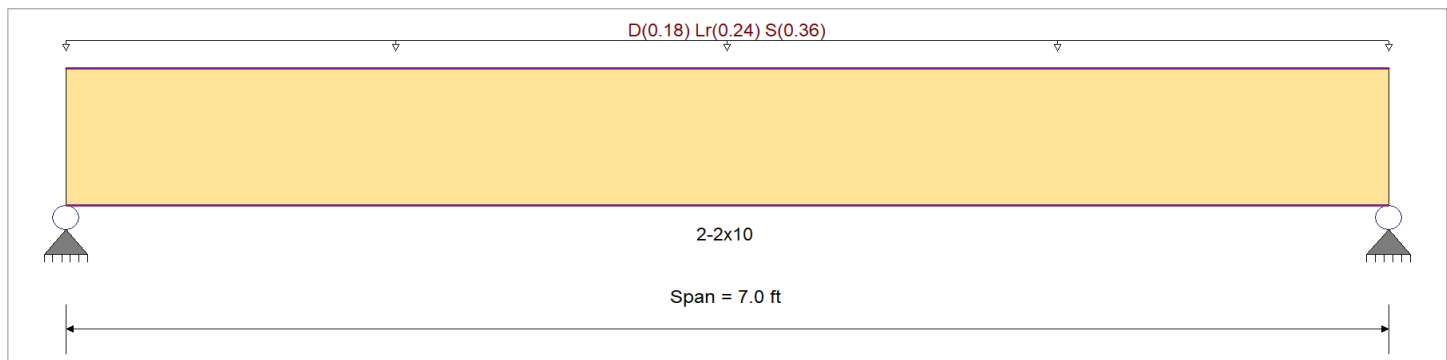
Material Properties

Analysis Method : Allowable Stress Design
 Load Combination : IBC 2021

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

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

Fb +	900.0 psi	E : Modulus of Elasticity	
Fb -	900.0 psi	Ebend- xx	1,600.0ksi
Fc - Prll	1,350.0 psi	Eminbend - xx	580.0ksi
Fc - Perp	625.0 psi		
Fv	180.0 psi		
Ft	575.0 psi	Density	31.210pcf



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, Lr = 0.020, S = 0.030 ksf, Tributary Width = 12.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.815 : 1	Maximum Shear Stress Ratio	=	0.385 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	927.74psi	fv: Actual	=	79.79 psi
F'b	=	1,138.50psi	F'v	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	3.500ft	Location of maximum on span	=	6.234 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.062 in	Ratio =	1359 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.093 in	Ratio =	906 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 7.0 ft	1	0.347	0.164	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.10	309.2	891.0	0.0	0.00	0.0	0.0
+D+Lr	Length = 7.0 ft	1	0.583	0.276	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.57	721.6	1,237.5	0.0	0.00	0.0	0.0
+D+S	Length = 7.0 ft	1	0.815	0.385	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	3.31	927.7	1,138.5	0.0	0.00	0.0	0.0
+D+0.750Lr	Length = 7.0 ft	1	0.500	0.236	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.21	618.5	1,237.5	0.0	0.00	0.0	0.0
+D+0.750S	Length = 7.0 ft	1	0.679	0.321	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.76	773.1	1,138.5	0.0	0.00	0.0	0.0



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Beam 2 Roof Ext Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
+0.60D						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 7.0 ft	1		0.117	0.055	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.66	185.5	1,584.0	0.30	16.0	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0927	3.526		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.890	1.890
Max Upward from Load Combinations	1.890	1.890
Max Upward from Load Cases	1.260	1.260
D Only	0.630	0.630
+D+Lr	1.470	1.470
+D+S	1.890	1.890
+D+0.750Lr	1.260	1.260
+D+0.750S	1.575	1.575
+0.60D	0.378	0.378
Lr Only	0.840	0.840
S Only	1.260	1.260

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

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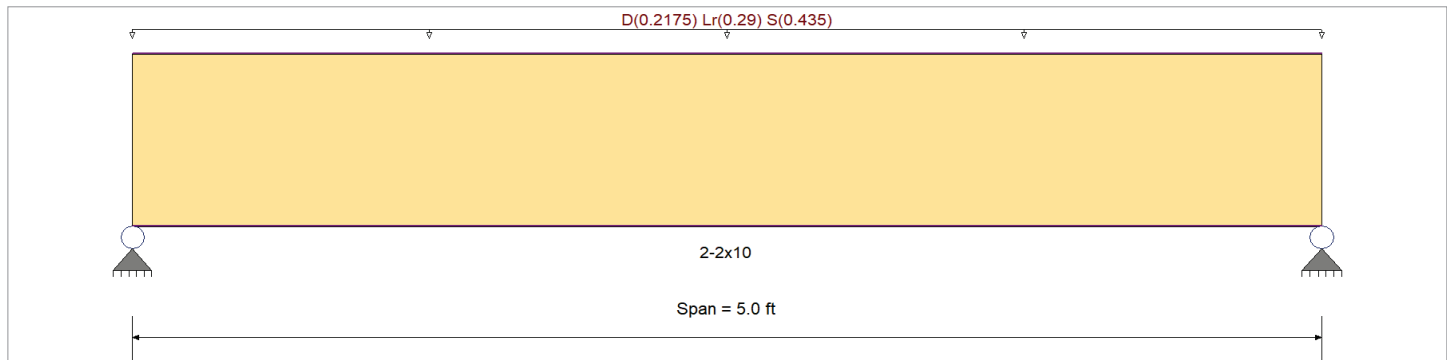
DESCRIPTION: Beam 3 Int Brg Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design	Fb +	900 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : IBC 2021	Fb -	900 psi	Ebend- xx	1600ksi
	Fc - Prll	1350 psi	Eminbend - xx	580ksi
Wood Species : Douglas Fir-Larch	Fc - Perp	625 psi		
Wood Grade : No.2	Fv	180 psi		
	Ft	575 psi	Density	31.21pcf
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, Lr = 0.020, S = 0.030 ksf, Tributary Width = 14.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.502 1	Maximum Shear Stress Ratio =	0.295 : 1
Section used for this span	2-2x10	Section used for this span	2-2x10
fb: Actual =	571.95psi	fv: Actual =	61.14 psi
F'b =	1,138.50psi	F'v =	207.00 psi
Load Combination	+D+S	Load Combination	+D+S
Location of maximum on span =	2.500ft	Location of maximum on span =	0.000ft
Span # where maximum occurs =	Span # 1	Span # where maximum occurs =	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.019 in	Ratio =	3087 >=360	Span: 1 : S Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.029 in	Ratio =	2058 >=240	Span: 1 : +D+S
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 5.0 ft	1	0.214	0.126	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.68	190.7	891.0	0.0	0.00	0.0	0.0
+D+Lr	Length = 5.0 ft	1	0.359	0.211	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.59	444.9	1,237.5	0.0	0.00	0.0	0.0
+D+S	Length = 5.0 ft	1	0.502	0.295	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.04	572.0	1,138.5	0.0	0.00	0.0	0.0
+D+0.750Lr	Length = 5.0 ft	1	0.308	0.181	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.36	381.3	1,237.5	0.0	0.00	0.0	0.0
+D+0.750S	Length = 5.0 ft	1	0.419	0.246	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.70	476.6	1,138.5	0.0	0.00	0.0	0.0



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Beam 3 Int Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
+0.60D						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1		0.072	0.042	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.41	114.4	1,584.0	0.23	12.2	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0292	2.518		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.631	1.631
Max Upward from Load Combinations	1.631	1.631
Max Upward from Load Cases	1.088	1.088
D Only	0.544	0.544
+D+Lr	1.269	1.269
+D+S	1.631	1.631
+D+0.750Lr	1.088	1.088
+D+0.750S	1.359	1.359
+0.60D	0.326	0.326
Lr Only	0.725	0.725
S Only	1.088	1.088

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC#: KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 4 Roof Grdrs

CODE REFERENCES

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

Load Combination Set : IBC 2021

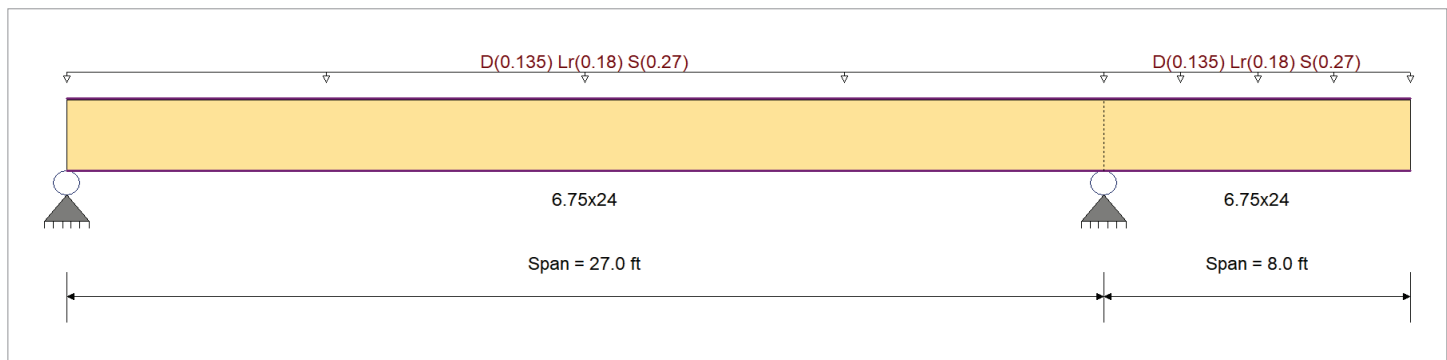
Material Properties

Analysis Method : Allowable Stress Design
 Load Combination : IBC 2021

Wood Species : DF/DF
 Wood Grade : 24F-V8

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

Fb +	2,400.0 psi	<i>E : Modulus of Elasticity</i>	
Fb -	2,400.0 psi	Ebend- xx	1,800.0ksi
Fc - Prll	1,650.0 psi	Eminbend - xx	950.0ksi
Fc - Perp	650.0 psi	Ebend- yy	1,600.0ksi
Fv	265.0 psi	Eminbend - yy	850.0ksi
Ft	1,100.0 psi	Density	31.210pcf



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, Lr = 0.020, S = 0.030 ksf, Tributary Width = 9.0 ft

Load for Span Number 2

Uniform Load : D = 0.0150, Lr = 0.020, S = 0.030 ksf, Tributary Width = 9.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.233 : 1	Maximum Shear Stress Ratio	=	0.157 : 1
Section used for this span		6.75x24	Section used for this span		6.75x24
fb: Actual	=	568.69psi	fv: Actual	=	47.72 psi
F'b	=	2,443.04psi	F'v	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	12.369ft	Location of maximum on span	=	25.039 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection		0.184 in	Ratio =	1760 >=360	Span: 1 : S Only
Max Upward Transient Deflection		-0.125 in	Ratio =	1536 >=360	Span: 2 : S Only
Max Downward Total Deflection		0.276 in	Ratio =	1173 >=240	Span: 1 : +D+S
Max Upward Total Deflection		-0.187 in	Ratio =	1024 >=240	Span: 2 : +D+S

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only																			
	Length = 27.0 ft	1	0.099	0.067	0.90	1.00	1.00	1.00	0.885	1.00	1.00	1.00	10.24	189.6	1,911.9	0.0	0.00	0.0	238.5
	Length = 8.0 ft	2	0.037	0.067	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	4.32	80.0	2,159.2	0.81	15.9	238.5	
+D+Lr																			
	Length = 27.0 ft	1	0.167	0.112	1.25	1.00	1.00	1.00	0.885	1.00	1.00	1.00	23.89	442.3	2,655.5	4.01	37.1	331.3	
	Length = 8.0 ft	2	0.062	0.112	1.25	1.00	1.00	1.00	1.000	1.00	1.00	1.00	10.08	186.7	2,999.0	1.90	37.1	331.3	
+D+S																			
	Length = 27.0 ft	1	0.233	0.157	1.15	1.00	1.00	1.00	0.885	1.00	1.00	1.00	30.71	568.7	2,443.0	5.15	47.7	304.8	

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Beam 4 Roof Grdrs

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
+D+0.750Lr	Length = 8.0 ft	2	0.087	0.157	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	12.96	240.0	2,759.0	2.44	47.7	304.8
															0.0	0.00	0.0	0.0
+D+0.750S	Length = 27.0 ft	1	0.143	0.096	1.25	1.00	1.00	1.00	0.885	1.00	1.00	1.00	20.47	379.1	2,655.5	3.44	31.8	331.3
	Length = 8.0 ft	2	0.053	0.096	1.25	1.00	1.00	1.00	1.000	1.00	1.00	1.00	8.64	160.0	2,999.0	1.63	31.8	331.3
+0.60D															0.0	0.00	0.0	0.0
	Length = 27.0 ft	1	0.194	0.130	1.15	1.00	1.00	1.00	0.885	1.00	1.00	1.00	25.59	473.9	2,443.0	4.29	39.8	304.8
	Length = 8.0 ft	2	0.072	0.130	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	10.80	200.0	2,759.0	2.04	39.8	304.8
															0.0	0.00	0.0	0.0
	Length = 27.0 ft	1	0.033	0.023	1.60	1.00	1.00	1.00	0.885	1.00	1.00	1.00	6.14	113.7	3,399.0	1.03	9.5	424.0
	Length = 8.0 ft	2	0.013	0.023	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	2.59	48.0	3,838.7	0.49	9.5	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.2761	13.123	+D+S	0.0000	0.000
	2	0.0000	13.123		-0.1873	8.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2	Support 3
Max Upward from all Load Conditions	4.988	9.188	
Max Upward from Load Combinations	4.988	9.188	
Max Upward from Load Cases	3.325	6.125	
D Only	1.663	3.063	
+D+Lr	3.879	7.146	
+D+S	4.988	9.188	
+D+0.750Lr	3.325	6.125	
+D+0.750S	4.156	7.656	
+0.60D	0.998	1.838	
Lr Only	2.217	4.083	
S Only	3.325	6.125	

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC#: KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 5 2nd Flr Tfr Bms

CODE REFERENCES

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

Load Combination Set : IBC 2021

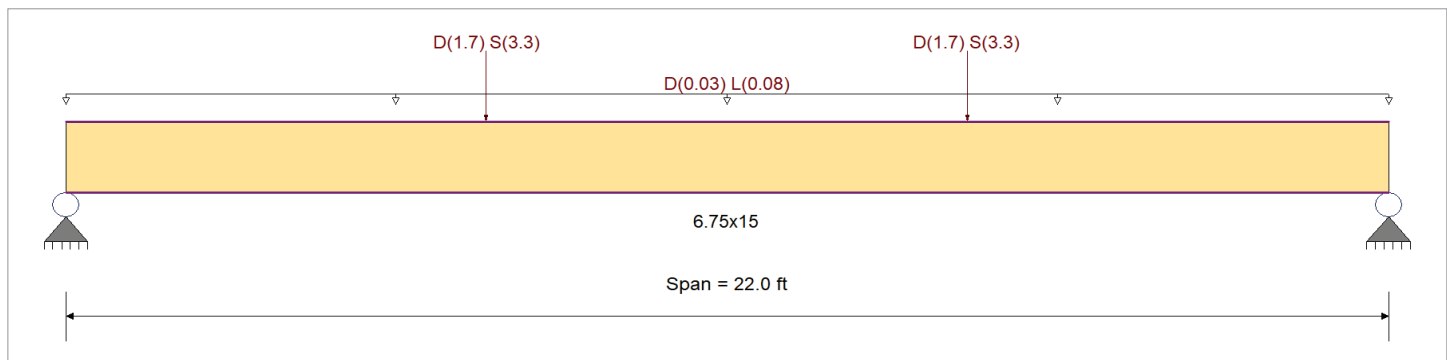
Material Properties

Analysis Method : Allowable Stress Design
 Load Combination : IBC 2021

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

Fb +	2,400.0 psi	<i>E : Modulus of Elasticity</i>	
Fb -	1,850.0 psi	Ebend- xx	1,800.0ksi
Fc - Prll	1,650.0 psi	Eminbend - xx	950.0ksi
Fc - Perp	650.0 psi	Ebend- yy	1,600.0ksi
Fv	265.0 psi	Eminbend - yy	850.0ksi
Ft	1,100.0 psi	Density	31.210pcf

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

Point Load : D = 1.70, S = 3.30 k @ 7.0 ft

Point Load : D = 1.70, S = 3.30 k @ 15.0 ft

Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 2.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.668 < 1	Maximum Shear Stress Ratio	=	0.257 < 1
Section used for this span		6.75x15	Section used for this span		6.75x15
fb: Actual	=	1,745.30psi	fv: Actual	=	78.43 psi
F'b	=	2,613.59psi	F'v	=	304.75 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	11.000ft	Location of maximum on span	=	20.796 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection		0.615 in	Ratio =	429 >=360	Span: 1 : S Only
Max Upward Transient Deflection		0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection		0.978 in	Ratio =	269 >=240	Span: 1 : +D+S
Max Upward Total Deflection		0 in	Ratio =	0 <240	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values						
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v				
D Only																						
Length = 22.0 ft	1		0.318	0.124	0.90	1.00	1.00	1.00	0.947	1.00	1.00	1.00	13.72	650.2	2,045.4	0.0	0.00	0.0	0.0	1.99	29.5	238.5
+D+L																						
Length = 22.0 ft	1		0.387	0.155	1.00	1.00	1.00	1.00	0.947	1.00	1.00	1.00	18.56	879.6	2,272.7	0.0	0.00	0.0	0.0	2.78	41.1	265.0
+D+S																						
Length = 22.0 ft	1		0.668	0.257	1.15	1.00	1.00	1.00	0.947	1.00	1.00	1.00	36.82	1,745.3	2,613.6	0.0	0.00	0.0	0.0	5.29	78.4	304.8
+D+0.750L																						
Length = 22.0 ft	1		0.289	0.115	1.25	1.00	1.00	1.00	0.947	1.00	1.00	1.00	17.35	822.3	2,840.9	0.0	0.00	0.0	0.0	2.58	38.2	331.3
+D+0.750L+0.750S																						
Length = 22.0 ft	1					1.00	1.00	1.00	0.947	1.00	1.00	1.00				0.0	0.00	0.0	0.0			



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 5 2nd Flr Tfr Bms

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
Length = 22.0 ft	1	0.629	0.246	1.15	1.00	1.00	1.00	0.947	1.00	1.00	1.00	34.67	1,643.6	2,613.6	5.06	74.9	304.8	
+0.60D					1.00	1.00	1.00	0.947	1.00	1.00	1.00			0.0	0.00	0.0	0.0	
Length = 22.0 ft	1	0.107	0.042	1.60	1.00	1.00	1.00	0.947	1.00	1.00	1.00	8.23	390.1	3,636.3	1.20	17.7	424.0	

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.9781	11.080		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	5.330	5.330
Max Upward from Load Combinations	5.330	5.330
Max Upward from Load Cases	3.300	3.300
D Only	2.030	2.030
+D+L	2.910	2.910
+D+S	5.330	5.330
+D+0.750L	2.690	2.690
+D+0.750L+0.750S	5.165	5.165
+0.60D	1.218	1.218
L Only	0.880	0.880
S Only	3.300	3.300

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 6 Ext Brg Hdr

CODE REFERENCES

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

Load Combination Set : IBC 2021

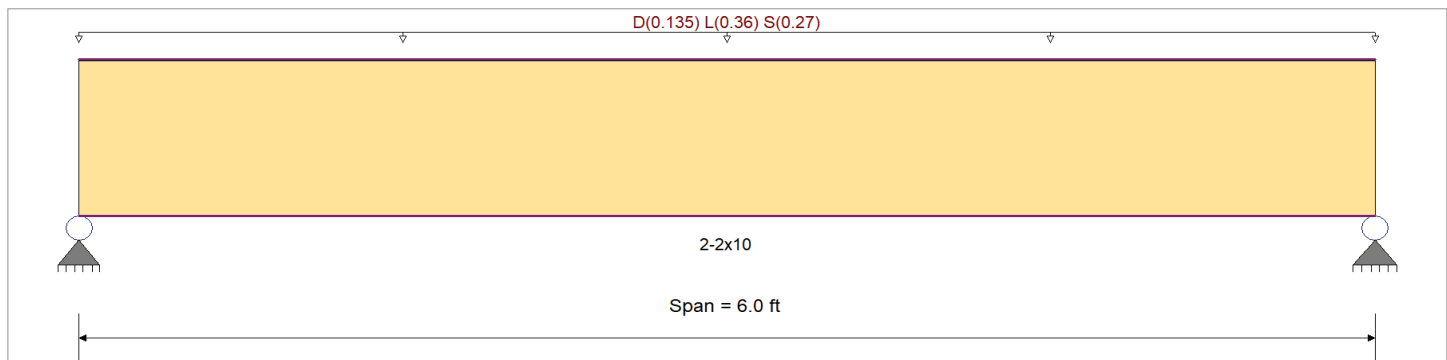
Material Properties

Analysis Method : Allowable Stress Design
 Load Combination : IBC 2021

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

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

Fb +	900.0 psi	E : Modulus of Elasticity	
Fb -	900.0 psi	Ebend- xx	1,600.0ksi
Fc - Prll	1,350.0 psi	Eminbend - xx	580.0ksi
Fc - Perp	625.0 psi		
Fv	180.0 psi		
Ft	575.0 psi	Density	31.210pcf



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, S = 0.030 ksf, Tributary Width = 9.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.674 : 1	Maximum Shear Stress Ratio	=	0.354 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	766.81 psi	fv: Actual	=	73.35 psi
F'b	=	1,138.50 psi	F'v	=	207.00 psi
Load Combination	=	+D+0.750L+0.750S	Load Combination	=	+D+0.750L+0.750S
Location of maximum on span	=	3.000ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.033 in	Ratio =	2158 >=360	Span: 1 : L Only	
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a	
Max Downward Total Deflection	0.056 in	Ratio =	1279 >=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	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v		
D Only	Length = 6.0 ft	1	0.191	0.101	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.61	170.4	891.0	0.00	0.00	0.0	0.0	162.0
+D+L	Length = 6.0 ft	1	0.631	0.332	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.23	624.8	990.0	0.00	0.00	0.0	0.0	180.0
+D+S	Length = 6.0 ft	1	0.449	0.236	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.82	511.2	1,138.5	0.90	48.9	207.0	0.0	0.0
+D+0.750L	Length = 6.0 ft	1	0.413	0.217	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.82	511.2	1,237.5	0.90	48.9	225.0	0.0	0.0
+D+0.750L+0.750S	Length = 6.0 ft	1	0.674	0.354	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	2.73	766.8	1,138.5	1.36	73.3	207.0	0.0	0.0



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Beam 6 Ext Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
+0.60D						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 6.0 ft	1		0.065	0.034	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.36	102.2	1,584.0	0.18	9.8	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0563	3.022		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.823	1.823
Max Upward from Load Combinations	1.823	1.823
Max Upward from Load Cases	1.080	1.080
D Only	0.405	0.405
+D+L	1.485	1.485
+D+S	1.215	1.215
+D+0.750L	1.215	1.215
+D+0.750L+0.750S	1.823	1.823
+0.60D	0.243	0.243
L Only	1.080	1.080
S Only	0.810	0.810

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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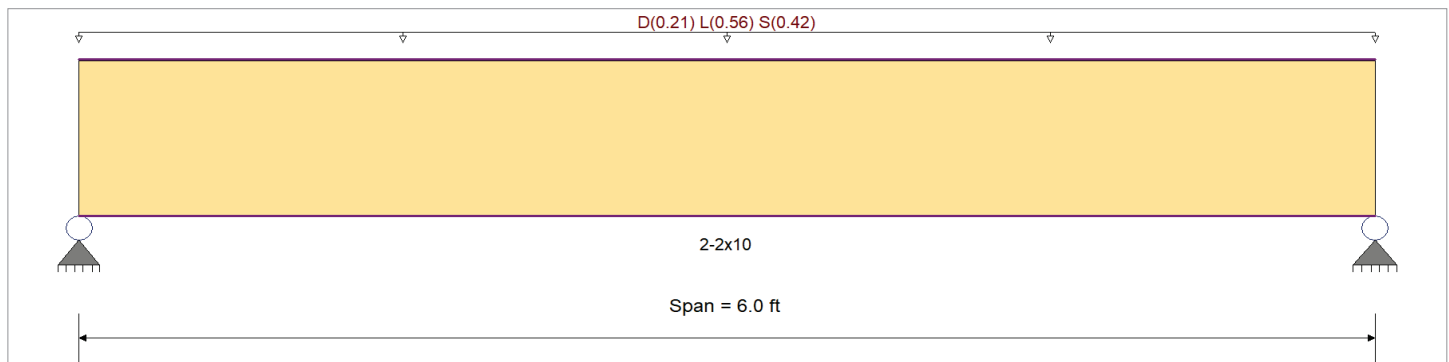
DESCRIPTION: Beam 7 Int Brg Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design	Fb +	900.0 psi	E : Modulus of Elasticity
Load Combination : IBC 2021	Fb -	900.0 psi	Ebend- xx
	Fc - Prll	1,350.0 psi	Eminbend - xx
Wood Species : Douglas Fir-Larch	Fc - Perp	625.0 psi	
Wood Grade : No.2	Fv	180.0 psi	
	Ft	575.0 psi	Density
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling			Repetitive Member Stress Increase



Applied Loads

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

Beam self weight NOT internally calculated and added

Uniform Load : D = 0.0150, L = 0.040, S = 0.030 ksf, Tributary Width = 14.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.911 : 1	Maximum Shear Stress Ratio =	0.551 : 1
Section used for this span	2-2x10	Section used for this span	2-2x10
fb: Actual =	1,192.81 psi	fv: Actual =	114.09 psi
F'b =	1,309.28 psi	F'v =	207.00 psi
Load Combination	+D+0.750L+0.750S	Load Combination	+D+0.750L+0.750S
Location of maximum on span =	3.000ft	Location of maximum on span =	0.000ft
Span # where maximum occurs =	Span # 1	Span # where maximum occurs =	Span # 1
Maximum Deflection			
Max Downward Transient Deflection	0.052 in Ratio =	1387 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in Ratio =	0 <360	n/a
Max Downward Total Deflection	0.088 in Ratio =	822 >=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	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 6.0 ft	1	0.259	0.157	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.15	0.95	265.1	1,024.7	0.0	0.00	0.0	0.0
+D+L	Length = 6.0 ft	1	0.854	0.516	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.15	3.47	971.9	1,138.5	0.0	0.00	0.0	0.0
+D+S	Length = 6.0 ft	1	0.607	0.367	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.15	2.84	795.2	1,309.3	0.0	0.00	0.0	0.0
+D+0.750L	Length = 6.0 ft	1	0.559	0.338	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.15	2.84	795.2	1,423.1	0.0	0.00	0.0	0.0
+D+0.750L+0.750S	Length = 6.0 ft	1	0.911	0.551	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.15	4.25	1,192.8	1,309.3	2.11	114.1	207.0	



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 7 Int Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
+0.60D						1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 6.0 ft	1		0.087	0.053	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.15	0.57	159.0	1,821.6	0.28	15.2	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0876	3.022		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	2.835	2.835
Max Upward from Load Combinations	2.835	2.835
Max Upward from Load Cases	1.680	1.680
D Only	0.630	0.630
+D+L	2.310	2.310
+D+S	1.890	1.890
+D+0.750L	1.890	1.890
+D+0.750L+0.750S	2.835	2.835
+0.60D	0.378	0.378
L Only	1.680	1.680
S Only	1.260	1.260

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC#: KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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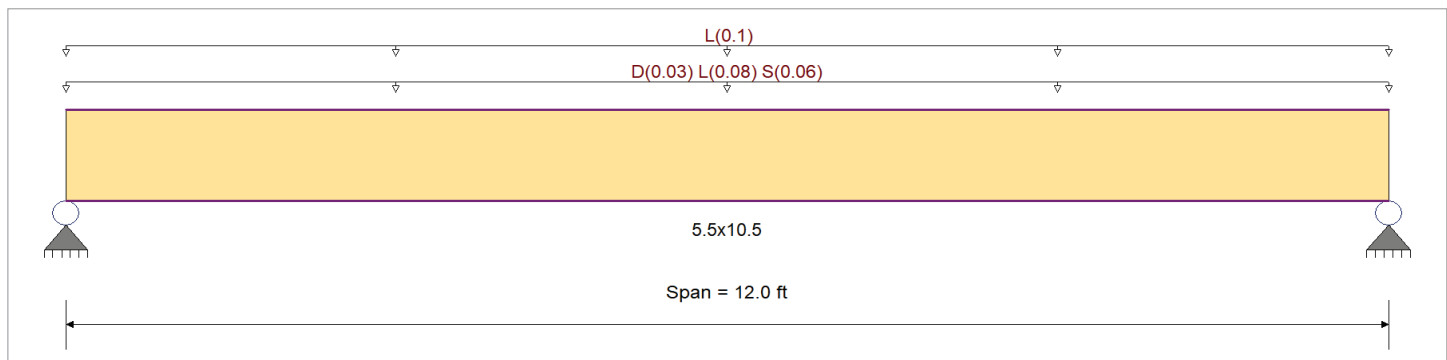
DESCRIPTION: Beam 8 Folding Door

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design	Fb +	2400 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : IBC 2021	Fb -	1850 psi	Ebend- xx	1800ksi
	Fc - Prll	1650 psi	Eminbend - xx	950ksi
Wood Species : DF/DF	Fc - Perp	650 psi	Ebend- yy	1600ksi
Wood Grade : 24F-V4	Fv	265 psi	Eminbend - yy	850ksi
	Ft	1100 psi	Density	31.21 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, S = 0.030 ksf, Tributary Width = 2.0 ft
 Uniform Load : L = 0.10, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.187 : 1	Maximum Shear Stress Ratio	=	0.106 : 1
Section used for this span		5.5x10.5	Section used for this span		5.5x10.5
fb: Actual	=	448.83psi	fv: Actual	=	28.19 psi
F'b	=	2,400.00psi	F'v	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	6.000ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.088 in	Ratio =	1628 >=360	Span: 1 : L Only	
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a	
Max Downward Total Deflection	0.103 in	Ratio =	1395 >=240	Span: 1 : +D+L	
Max Upward Total Deflection	0 in	Ratio =	0 <240	n/a	

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v		
D Only																				
Length = 12.0 ft	1	0.030	0.017	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	0.54	64.1	2,160.0	0.00	0.00	0.0	0.0	0.0	238.5
+D+L																				
Length = 12.0 ft	1	0.187	0.106	1.00	1.00	1.00	1.00	1.000	1.00	1.00	1.00	3.78	448.8	2,400.0	1.09	28.2	265.0	0.0	0.0	0.0
+D+S																				
Length = 12.0 ft	1	0.070	0.040	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	1.62	192.4	2,760.0	0.47	12.1	304.8	0.0	0.0	0.0
+D+0.750L																				
Length = 12.0 ft	1	0.118	0.067	1.25	1.00	1.00	1.00	1.000	1.00	1.00	1.00	2.97	352.7	3,000.0	0.85	22.1	331.3	0.0	0.0	0.0
+D+0.750L+0.750S																				
Length = 12.0 ft	1				1.00	1.00	1.00	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0	0.0	0.0	0.0



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 8 Folding Door

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
Length = 12.0 ft	1	1	0.163	0.092	1.15	1.00	1.00	1.00	1.000	1.00	1.00	1.00	3.78	448.8	2,760.0	1.09	28.2	304.8
+0.60D																0.0	0.00	0.0
Length = 12.0 ft	1	1	0.010	0.006	1.60	1.00	1.00	1.00	1.000	1.00	1.00	1.00	0.32	38.5	3,840.0	0.09	2.4	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.1032	6.044		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	1.260	1.260
Max Upward from Load Combinations	1.260	1.260
Max Upward from Load Cases	1.080	1.080
D Only	0.180	0.180
+D+L	1.260	1.260
+D+S	0.540	0.540
+D+0.750L	0.990	0.990
+D+0.750L+0.750S	1.260	1.260
+0.60D	0.108	0.108
L Only	1.080	1.080
S Only	0.360	0.360

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC#: KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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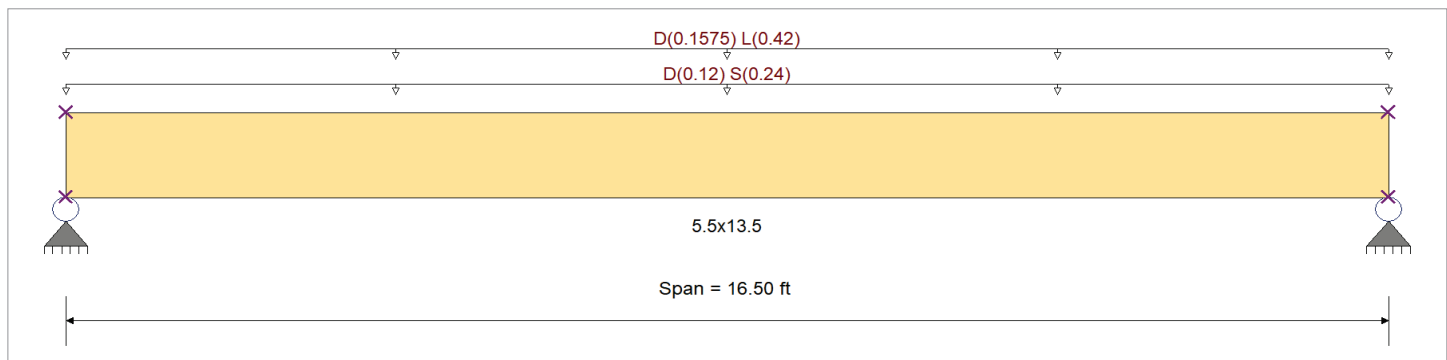
DESCRIPTION: Beam 9 Large Gar Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design	Fb +	2,400.0 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : IBC 2021	Fb -	1,850.0 psi	Ebend- xx	1,800.0ksi
Wood Species : DF/DF	Fc - Prll	1,650.0 psi	Eminbend - xx	950.0ksi
Wood Grade : 24F-V4	Fc - Perp	650.0 psi	Ebend- yy	1,600.0ksi
Beam Bracing : Completely Unbraced	Fv	265.0 psi	Eminbend - yy	850.0ksi
	Ft	1,100.0 psi	Density	31.210pcf



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 = 0.030 ksf, Tributary Width = 8.0 ft
 Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 10.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.723 : 1	Maximum Shear Stress Ratio	=	0.381 : 1
Section used for this span		5.5x13.5	Section used for this span		5.5x13.5
fb: Actual	=	1,705.00psi	fv: Actual	=	100.98 psi
F'b	=	2,358.71psi	F'v	=	265.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	8.250ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection	0.347 in	Ratio =	570 >=360	Span: 1 : L Only	
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a	
Max Downward Total Deflection	0.638 in	Ratio =	310 >=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	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values			
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v	
D Only	Length = 16.50 ft	1	0.319	0.168	0.90	1.00	1.00	0.98	1.000	1.00	1.00	1.00	9.44	678.3	2,127.5	0.0	0.00	0.0	0.0
+D+L	Length = 16.50 ft	1	0.723	0.381	1.00	1.00	1.00	0.98	1.000	1.00	1.00	1.00	23.74	1,705.0	2,358.7	5.00	101.0	265.0	0.0
+D+S	Length = 16.50 ft	1	0.468	0.246	1.15	1.00	1.00	0.98	1.000	1.00	1.00	1.00	17.61	1,265.0	2,702.9	3.71	74.9	304.8	0.0
+D+0.750L	Length = 16.50 ft	1	0.494	0.259	1.25	1.00	1.00	0.98	1.000	1.00	1.00	1.00	20.16	1,448.3	2,930.4	4.25	85.8	331.3	0.0
+D+0.750L+0.750S	Length = 16.50 ft	1				1.00	1.00	0.98	1.000	1.00	1.00	1.00			0.0	0.00	0.0	0.0	0.0



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Beam 9 Large Gar Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
Length = 16.50 ft	1	1	0.699	0.367	1.15	1.00	1.00	0.98	1.000	1.00	1.00	1.00	26.29	1,888.3	2,702.9	5.54	111.8	304.8
+0.60D																0.0	0.00	0.0
Length = 16.50 ft	1	1	0.110	0.057	1.60	1.00	1.00	0.97	1.000	1.00	1.00	1.00	5.67	407.0	3,712.0	1.19	24.1	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.6384	8.310		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	6.373	6.373
Max Upward from Load Combinations	6.373	6.373
Max Upward from Load Cases	3.465	3.465
D Only	2.289	2.289
+D+L	5.754	5.754
+D+S	4.269	4.269
+D+0.750L	4.888	4.888
+D+0.750L+0.750S	6.373	6.373
+0.60D	1.374	1.374
L Only	3.465	3.465
S Only	1.980	1.980

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC#: KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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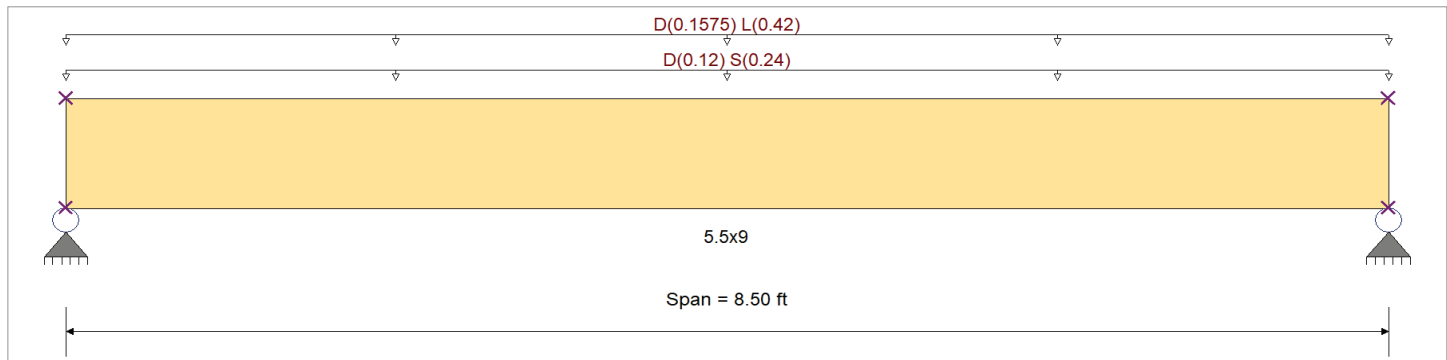
DESCRIPTION: Beam 10 Short Gar Hdr

CODE REFERENCES

Calculations per NDS 2018, IBC 2018, CBC 2019, ASCE 7-16
 Load Combination Set : IBC 2021

Material Properties

Analysis Method : Allowable Stress Design	Fb +	2,400.0 psi	<i>E : Modulus of Elasticity</i>	
Load Combination : IBC 2021	Fb -	1,850.0 psi	Ebend- xx	1,800.0ksi
Wood Species : DF/DF	Fc - Prll	1,650.0 psi	Eminbend - xx	950.0ksi
Wood Grade : 24F-V4	Fc - Perp	650.0 psi	Ebend- yy	1,600.0ksi
Beam Bracing : Completely Unbraced	Fv	265.0 psi	Eminbend - yy	850.0ksi
	Ft	1,100.0 psi	Density	31.210pcf



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 = 0.030 ksf, Tributary Width = 8.0 ft
 Uniform Load : D = 0.0150, L = 0.040 ksf, Tributary Width = 10.50 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.426 1	Maximum Shear Stress Ratio =	0.280 : 1
Section used for this span	5.5x9	Section used for this span	5.5x9
fb: Actual =	1,018.07psi	fv: Actual =	74.09 psi
F'b =	2,387.78psi	F'v =	265.00 psi
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	= 4.250ft	Location of maximum on span	= 0.000ft
Span # where maximum occurs	= Span # 1	Span # where maximum occurs	= Span # 1
Maximum Deflection			
Max Downward Transient Deflection	0.083 in Ratio =	1236 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in Ratio =	0 <360	n/a
Max Downward Total Deflection	0.152 in Ratio =	672 >=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	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v		
D Only	Length = 8.50 ft	1	0.188	0.124	0.90	1.00	1.00	1.00	1.000	1.00	1.00	1.00	2.51	405.0	2,150.2	0.00	0.00	0.0	0.0	238.5
+D+L	Length = 8.50 ft	1	0.426	0.280	1.00	1.00	1.00	0.99	1.000	1.00	1.00	1.00	6.30	1,018.1	2,387.8	0.00	0.00	0.0	0.0	265.0
+D+S	Length = 8.50 ft	1	0.275	0.180	1.15	1.00	1.00	0.99	1.000	1.00	1.00	1.00	4.67	755.3	2,743.6	0.00	0.00	0.0	0.0	304.8
+D+0.750L	Length = 8.50 ft	1	0.290	0.190	1.25	1.00	1.00	0.99	1.000	1.00	1.00	1.00	5.35	864.8	2,980.5	0.00	0.00	0.0	0.0	331.3
+D+0.750L+0.750S	Length = 8.50 ft	1				1.00	1.00	0.99	1.000	1.00	1.00	1.00				0.00	0.00	0.0	0.0	



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Beam 10 Short Gar Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _v	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
Length = 8.50 ft	1	1	0.411	0.269	1.15	1.00	1.00	0.99	1.000	1.00	1.00	1.00	6.98	1,127.5	2,743.6	2.71	82.1	304.8
+0.60D																0.0	0.00	0.0
Length = 8.50 ft	1	1	0.064	0.042	1.60	1.00	1.00	0.99	1.000	1.00	1.00	1.00	1.50	243.0	3,806.9	0.58	17.7	424.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.1517	4.281		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	3.283	3.283
Max Upward from Load Combinations	3.283	3.283
Max Upward from Load Cases	1.785	1.785
D Only	1.179	1.179
+D+L	2.964	2.964
+D+S	2.199	2.199
+D+0.750L	2.518	2.518
+D+0.750L+0.750S	3.283	3.283
+0.60D	0.708	0.708
L Only	1.785	1.785
S Only	1.020	1.020

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Beam 11 Ext Non Brg Hdr

CODE REFERENCES

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

Load Combination Set : IBC 2021

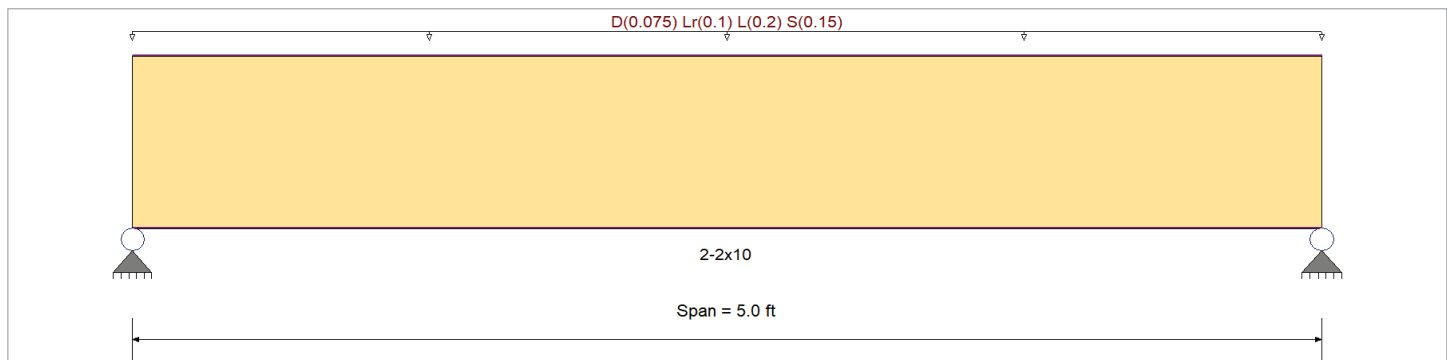
Material Properties

Analysis Method : Allowable Stress Design
 Load Combination : IBC 2021

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

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

Fb +	900.0 psi	E : Modulus of Elasticity	
Fb -	900.0 psi	Ebend- xx	1,600.0ksi
Fc - Prll	1,350.0 psi	Eminbend - xx	580.0ksi
Fc - Perp	625.0 psi		
Fv	180.0 psi		
Ft	575.0 psi	Density	31.210pcf



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, Lr = 0.020, L = 0.040, S = 0.030 ksf, Tributary Width = 5.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.260 : 1	Maximum Shear Stress Ratio	=	0.153 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	295.84psi	fv: Actual	=	31.63 psi
F'b	=	1,138.50psi	F'v	=	207.00 psi
Load Combination	=	+D+0.750L+0.750S	Load Combination	=	+D+0.750L+0.750S
Location of maximum on span	=	2.500ft	Location of maximum on span	=	0.000ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.009 in	Ratio =	6714 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.015 in	Ratio =	3978 >=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	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values				
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F'b	V	fv	F'v		
D Only	Length = 5.0 ft	1	0.074	0.043	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.23	65.7	891.0	0.00	0.00	0.0	0.0	162.0
+D+L	Length = 5.0 ft	1	0.243	0.143	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.86	241.1	990.0	0.00	0.00	0.0	0.0	180.0
+D+Lr	Length = 5.0 ft	1	0.124	0.073	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.55	153.4	1,237.5	0.30	0.00	0.0	0.0	225.0
+D+S	Length = 5.0 ft	1	0.173	0.102	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.70	197.2	1,138.5	0.39	0.00	0.0	0.0	207.0
+D+0.750Lr+0.750L	Length = 5.0 ft	1	0.212	0.125	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.94	263.0	1,237.5	0.52	0.00	0.0	0.0	225.0



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wood Beam

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Beam 11 Ext Non Brg Hdr

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values		
			M	V	CD	CM	C _t	CLx	C _F	C _{fu}	C _i	C _r	M	fb	F ^b	V	f _v	F ^v
+D+0.750L+0.750S						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1		0.260	0.153	1.15	1.00	1.00	1.00	1.100	1.00	1.00	1.00	1.05	295.8	1,138.5	0.59	31.6	207.0
+0.60D						1.00	1.00	1.00	1.100	1.00	1.00	1.00			0.0	0.00	0.0	0.0
Length = 5.0 ft	1		0.025	0.015	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.00	0.14	39.4	1,584.0	0.08	4.2	288.0

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0151	2.518		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1

Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.844	0.844
Max Upward from Load Combinations	0.844	0.844
Max Upward from Load Cases	0.500	0.500
D Only	0.188	0.188
+D+L	0.688	0.688
+D+Lr	0.438	0.438
+D+S	0.563	0.563
+D+0.750Lr+0.750L	0.750	0.750
+D+0.750L+0.750S	0.844	0.844
+0.60D	0.113	0.113
Lr Only	0.250	0.250
L Only	0.500	0.500
S Only	0.375	0.375

General Footing

Project File: cheshire framing 20241204.ec6

LIC#: KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: Roof Girder Footings

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16

Load Combinations Used : IBC 2021

General Information

Material Properties

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

Soil Design Values

Allowable Soil Bearing	=	2.0 ksf
Soil Density	=	110.0 pcf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.000180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	Yes
Add Pedestal Wt for Soil Pressure	:	No
Use Pedestal wt for stability, mom & shear	:	No

Increases based on footing depth

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

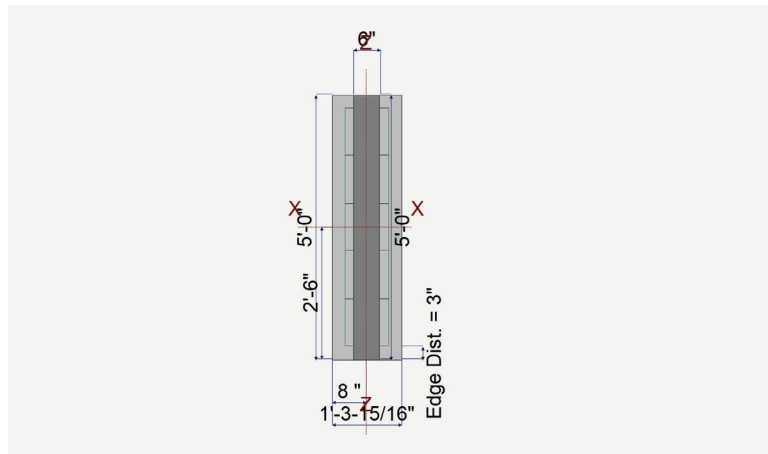
Increases based on footing plan dimension

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

Width parallel to X-X Axis	=	1.330 ft
Length parallel to Z-Z Axis	=	5.0 ft
Footing Thickness	=	12.0 in

Pedestal dimensions...		
px : parallel to X-X Axis	=	6.0 in
pz : parallel to Z-Z Axis	=	60.0 in
Height	=	12.0 in
Rebar Centerline to Edge of Concrete... at Bottom of footing	=	3.0 in

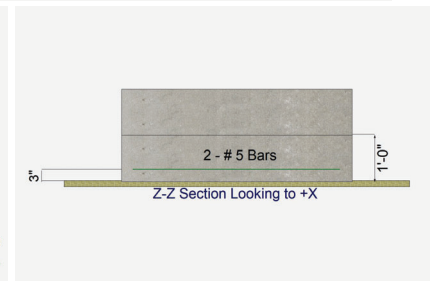
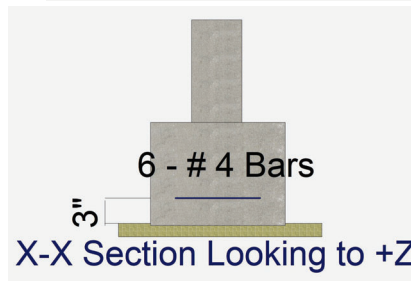


Reinforcing

Bars parallel to X-X Axis	=	
Number of Bars	=	6
Reinforcing Bar Size	=	# 4
Bars parallel to Z-Z Axis	=	
Number of Bars	=	2
Reinforcing Bar Size	=	# 5

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation		
	Bars along X-X Axis	
# Bars required within zone	42.0 %	
# Bars required on each side of zone	58.0 %	



Applied Loads

	D	Lr	L	S	W	E	H
P : Column Load	=	3.0		6.10			k
OB : Overburden	=						ksf
M-xx	=						k-ft
M-zz	=						k-ft
V-x	=						k
V-z	=						k

General Footing

Project File: cheshire framing 20241204.ec6

LIC#: KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Roof Girder Footings

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.7565	Soil Bearing	1.513 ksf	2.0 ksf	+D+S about Z-Z axis
PASS	n/a	Overturing - X-X	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Overturing - Z-Z	0.0 k-ft	0.0 k-ft	No Overturing
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.01837	Z Flexure (+X)	0.1730 k-ft/ft	9.415 k-ft/ft	+1.20D+1.60S
PASS	0.01837	Z Flexure (-X)	0.1730 k-ft/ft	9.415 k-ft/ft	+1.20D+1.60S
PASS	0.0	X Flexure (+Z)	0.0 k-ft/ft	0.0 k-ft/ft	No Moment
PASS	0.0	X Flexure (-Z)	0.0 k-ft/ft	0.0 k-ft/ft	No Moment
PASS	n/a	1-way Shear (+X)	0.0 psi	75.0 psi	n/a
PASS	0.0	1-way Shear (-X)	0.0 psi	0.0 psi	n/a
PASS	n/a	1-way Shear (+Z)	0.0 psi	75.0 psi	n/a
PASS	n/a	1-way Shear (-Z)	0.0 psi	75.0 psi	n/a
PASS	n/a	2-way Punching	0.0 psi	75.0 psi	+1.40D

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xeccc	Zeccc (in)	Actual Soil Bearing Stress @ Location				Actual / Allow Ratio
				Bottom, -Z	Top, +Z	Left, -X	Right, +X	
X-X, D Only	2.0	n/a	0.0	0.5961	0.5961	n/a	n/a	0.298
X-X, +D+S	2.0	n/a	0.0	1.513	1.513	n/a	n/a	0.757
X-X, +D+0.750S	2.0	n/a	0.0	1.284	1.284	n/a	n/a	0.642
X-X, +0.60D	2.0	n/a	0.0	0.3577	0.3577	n/a	n/a	0.179
Z-Z, D Only	2.0	0.0	n/a	n/a	n/a	0.5961	0.5961	0.298
Z-Z, +D+S	2.0	0.0	n/a	n/a	n/a	1.513	1.513	0.757
Z-Z, +D+0.750S	2.0	0.0	n/a	n/a	n/a	1.284	1.284	0.642
Z-Z, +0.60D	2.0	0.0	n/a	n/a	n/a	0.3577	0.3577	0.179

Overturing Stability

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

All units k

Sliding Stability

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

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
X-X, +1.40D	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.40D	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+0.50S	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+0.50S	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+1.60S	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+1.60S	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+0.70S	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +1.20D+0.70S	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +0.90D	0.0	+Z	Top	0.02592	AsMin	0.4662	17.729	OK
X-X, +0.90D	0.0	-Z	Top	0.02592	AsMin	0.4662	17.729	OK
Z-Z, +1.40D	0.05439	-X	Bottom	0.02592	AsMin	0.240	9.415	OK

General Footing

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: Roof Girder Footings

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Side	Tension Surface	As Req'd in ²	Gvrn. As in ²	Actual As in ²	Phi*Mn k-ft	Status
Z-Z, +1.40D	0.05439	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D	0.04662	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D	0.04662	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+0.50S	0.08611	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+0.50S	0.08611	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+1.60S	0.1730	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+1.60S	0.1730	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+0.70S	0.1019	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +1.20D+0.70S	0.1019	+X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +0.90D	0.03496	-X	Bottom	0.02592	AsMin	0.240	9.415	OK
Z-Z, +0.90D	0.03496	+X	Bottom	0.02592	AsMin	0.240	9.415	OK

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu @ -Z	Vu @ +Z	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+1.20D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+1.20D+0.50S	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+1.20D+1.60S	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+1.20D+0.70S	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK
+0.90D	0.00 psi	0.00 psi	0.00 psi	0.00 psi	0.00 psi	75.00 psi	0.00	OK

Two-Way "Punching" Shear

Load Combination...	Vu	Phi*Vn	Vu / Phi*Vn	Status
+1.40D	0.00 psi	90.00psi	0	OK
+1.20D	0.00 psi	90.00psi	0	OK
+1.20D+0.50S	0.00 psi	90.00psi	0	OK
+1.20D+1.60S	0.00 psi	90.00psi	0	OK
+1.20D+0.70S	0.00 psi	90.00psi	0	OK
+0.90D	0.00 psi	90.00psi	0	OK

All units k

Wall Footing

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

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DESCRIPTION: TYPICAL STRIP FOOTINGS (INTERIOR & EXTERIOR)

Code References

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
 Load Combinations Used : IBC 2021

General Information

Material Properties

f'_c : Concrete 28 day strength	=	2.50 ksi
f_y : Rebar Yield	=	60.0 ksi
E_c : 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.	=	0.000140
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
AutoCalc Footing Weight as DL :	=	Yes

Soil Design Values

Allowable Soil Bearing	=	2.0 ksf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.30

Increases based on footing Depth

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

Increases based on footing Width

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

= 2.0 ksf

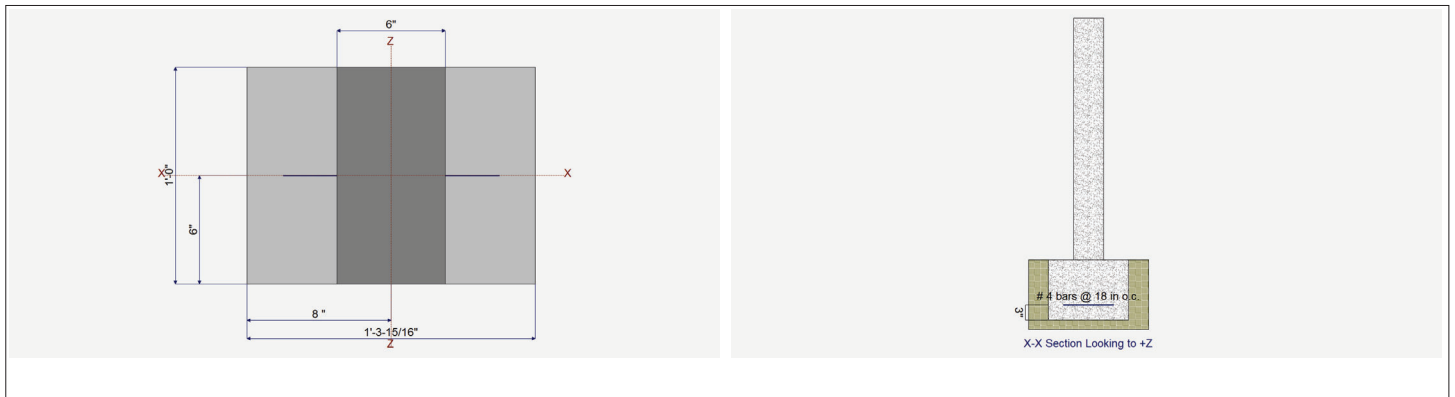
Dimensions

Footing Width	=	1.33 ft
Wall Thickness	=	6.0 in
Wall center offset from center of footing	=	0 in

Footing Thickness	=	12.0 in
Rebar Centerline to Edge of Concrete... at Bottom of footing =	=	3.0 in

Reinforcing

Bars along X-X Axis	=	18.00
Bar spacing	=	18.00
Reinforcing Bar Size	=	# 4



Applied Loads

	D	Lr	L	S	W	E	H
P : Column Load	=	0.450		0.60	0.450		k
OB : Overburden	=						ksf
V-x	=						k
M-zz	=						k-ft
Vx applied	=		in above top of footing				

Wall Footing

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2023

DESCRIPTION: TYPICAL STRIP FOOTINGS (INTERIOR & EXTERIOR)

DESIGN SUMMARY

Design OK

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

Utilization Ratio	Item	Applied	Capacity	Governing Load Combination	
PASS	0.5377	Soil Bearing	1.075 ksf	2.0 ksf	+D+0.750L+0.750S
PASS	0.02387	Z Flexure (+X)	0.1267 k-ft	5.306 k-ft	+1.20D+1.60L+0.50S
PASS	0.007060	Z Flexure (-X)	0.03746 k-ft	5.306 k-ft	+0.90D
PASS	n/a	1-way Shear (+X)	0.0 psi	75.0 psi	n/a
PASS	0.0	1-way Shear (-X)	0.0 psi	0.0 psi	n/a

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc	Actual Soil Bearing Stress		Actual / Allowable Ratio
			-X	+X	
, D Only	2.0 ksf	0.0 in	0.4833 ksf	0.4833 ksf	0.242
, +D+L	2.0 ksf	0.0 in	0.9345 ksf	0.9345 ksf	0.467
, +D+S	2.0 ksf	0.0 in	0.8217 ksf	0.8217 ksf	0.411
, +D+0.750L	2.0 ksf	0.0 in	0.8217 ksf	0.8217 ksf	0.411
, +D+0.750L+0.750S	2.0 ksf	0.0 in	1.075 ksf	1.075 ksf	0.538
, +0.60D	2.0 ksf	0.0 in	0.290 ksf	0.290 ksf	0.145

Units : k-ft

Overturing Stability

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

Sliding Stability

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

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot. or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
, +1.40D	0.05827	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.40D	0.05827	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60L	0.1121	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60L	0.1121	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60L+0.50S	0.1267	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60L+0.50S	0.1267	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L	0.06937	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L	0.06937	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D	0.04995	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D	0.04995	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+1.60S	0.116	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+1.60S	0.116	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60S	0.09656	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+1.60S	0.09656	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+0.50S	0.08394	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+0.50S	0.08394	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+0.70S	0.08977	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +1.20D+0.50L+0.70S	0.08977	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +0.90D	0.03746	-X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK
, +0.90D	0.03746	+X	Bottom	0.0202	Min Temp %	0.1333	5.306	OK

Units : k

One Way Shear

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60L	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60L+0.50S	0 psi	0 psi	0 psi	75 psi	0	OK



Merrell Design Services
Practical Structural Solutions

Project Title: Cheshire Upper Lot
 Engineer: KJH
 Project ID: 23-067
 Project Descr: Two-Story Residence Fdns & Framing

Wall Footing

Project File: cheshire framing 20241204.ec6

LIC# : KW-06011847, Build:20.23.08.30

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DESCRIPTION: TYPICAL STRIP FOOTINGS (INTERIOR & EXTERIOR)

One Way Shear

Units : k

Load Combination...	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.20D+0.50L	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+1.60S	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+1.60S	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+0.50S	0 psi	0 psi	0 psi	75 psi	0	OK
+1.20D+0.50L+0.70S	0 psi	0 psi	0 psi	75 psi	0	OK
+0.90D	0 psi	0 psi	0 psi	75 psi	0	OK



Project Title: Mercer Island Custom Home
 Engineer: KJH
 Project ID: 21-045
 Project Descr: Framing and Foundations

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ASCE 7-16 Wind Forces Chpt 28, Pt2 & Chpt 30, Pt2

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DESCRIPTIO Wind forces - Mercer Island

General Design Values

Calculations per ASCE 7-16

V : Basic Wind Speed per Sect 26.5-1 or 2 **110.0** mph
 User specified minimum design pressu **10.0** psf
 Occupancy per Table 1.5-1 **II** All Buildings and other structures except those listed
 Exposure Category per 26.7 **Exposure C**
 Topographic Factor Kzt per 26.8 **1.00**

Main Force Resisting System Valu

Component & Cladding Values

MRH : Mean Roof Height **30.0** ft Effective Wind Area of Component & Clad **10.0** ft²
 Roof Slope Angle **0 to 5** degrees Roof pitch for cladding pressu **Flat/Hip/Gable** Roof
 LHD : Least Horizontal Dimension **40.0** ft
 a = max (0.04 * LHD, 3, min(0.10 * LHD, 0.4*MRH)) **4.00** ft

Lambda MWFRS: per Figure 26. 1.40 **Lambda Component & Cladding : per Figure 1.40**

Design Wind Pressures

Horizontal Pressures . . .

Zone: A = 26.88 psf Zone: C = 17.78 psf
 Zone: B = -14.00 psf Zone: D = -10.00 psf

Vertical Pressures . . .

Zone: E = -32.34 psf Zone: G = -22.40 psf
 Zone: F = -18.34 psf Zone: H = -14.14 psf

Overhangs . . .

Zone: Eoh = -45.22 psf Zone: Goh = -35.42 psf

ASCE 7-16 Section 28.5.4 Minimum Design Wind Loads requires that the load effects of the design wind pressures from Section 28.5.3 shall not be less than a minimum load defined by assuming the pressures, ps, for zones A and C equal to +16 psf, Zones B and D equal to +8 psf, while assuming ps for Zones E, F, G, and H are equal to 0 psf.

Component & Cladding Design Wind Press

*Design Wind Pressure = Lambda * Kzt * Ps30 ps*

Roof Pressures	Positive	Negative	Overhang Pressures	Negative
Zone 1	12.460	-48.580 psf	Zone 1	*** psf
Zone 1'	12.460	-27.860 psf	Zone 1'	*** psf
Zone 2	12.460	-63.980 psf	Zone 2	-53.900 psf
Zone 2e	***	*** psf	Zone 2e	*** psf
Zone 2n	***	*** psf	Zone 2n	*** psf
Zone 2r	***	*** psf	Zone 2r	*** psf
Zone 3	12.460	-87.220 psf	Zone 3	-73.080 psf
Zone 3e	***	*** psf	Zone 3e	*** psf
Zone 3r	***	*** psf	Zone 3r	*** psf

Wall Pressures

Wall Zone 4 : *** *** psf
 Wall Zone 5 : *** *** psf

*** : There is no value in Figure 30.4-1 Tabular Values

ASCE 7-16 Seismic Base Shear

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DESCRIPTION: Seismic Base Shear Analysis

Specific Description: Cheshire #2

Risk Category

Calculations per ASCE 7-16

Risk Category of Building or Other Structure: "II": All Buildings and other structures except those listed as Category I, III, and IV *SCE 7-16, Page 4, Table 1.5-1*

Seismic Importance Factor = 1 *ASCE 7-16, Page 5, Table 1.5-2*

USER DEFINED Ground Motion

ASCE 7-16 11.4.2

Max. Ground Motions, 5% Damping

$$S_S = 1.630 \text{ g, 0.2 sec response}$$

$$S_1 = 0.620 \text{ g, 1.0 sec response}$$

For the closest datapoint grid location . . .

$$\text{Latitude} = 0.000 \text{ deg North}$$

$$\text{Longitude} = 0.000 \text{ deg West}$$

Site Class, Site Coeff. and Design Category

Classification: "D": Shear Wave Velocity 600 to 1,200 ft/sec = **D** (Based on Testing) *ASCE 7-16 Table 20.3-1*

Site Coefficients F_a & F_v $F_a = 1.00$ *ASCE 7-16 Table 11.4-1 & 11.4-2*
 (using straight-line interpolation from table val) $F_v = 1.70$

Maximum Considered Earthquake Accelerat $S_{MS} = F_a * S_s = 1.630$ *ASCE 7-16 Eq. 11.4-1*
 $S_{M1} = F_v * S_1 = 1.054$ *ASCE 7-16 Eq. 11.4-2*

Design Spectral Acceleration $S_{DS} = S_{MS}^{*2/3} = 1.087$ *ASCE 7-16 Eq. 11.4-3*
 $S_{D1} = S_{M1}^{*2/3} = 0.703$ *ASCE 7-16 Eq. 11.4-4*

Seismic Design Category = **D** *ISCE 7-16 Table 11.6-1 & -2*

Resisting System

ASCE 7-16 Table 12.2-1

Basic Seismic Force Resisting System . . .

Bearing Wall Systems

15.Light-frame (wood) walls sheathed w/wood structural panels rated for shear resistance.

Response Modification Coefficient "I" = 6.50

Building height Limits:

System Overstrength Factor "Wo" = 3.00

Category "A & B" Limit: No Limit

Deflection Amplification Factor "Cd" = 4.00

Category "C" Limit: No Limit

Category "D" Limit: Limit = 65

Category "E" Limit: Limit = 65

Category "F" Limit: Limit = 65

NOTE! See ASCE 7-16 for all applicable footnc

Lateral Force Procedure

ASCE 7-16 Section 12.8.2

Equivalent Lateral Force Procedure

The "Equivalent Lateral Force Procedure" is being used according to the provisions of ASCE 7-16 12.8

Determine Building Period

Use ASCE 12.8-7

Structure Type for Building Period CalculzAll Other Structural Systems

$$\text{" Ct " value} = 0.020 \quad \text{" hn " : Height from base to highest leve} = 20.0 \text{ ft}$$

$$\text{" x " value} = 0.75$$

$$\text{" Ta " Approximate fundamental period using Eq. 12.8-7 : } Ta = Ct * (hn \wedge x) = 0.189 \text{ sec}$$

$$\text{" TL " : Long-period transition period per ASCE 7-16 Maps 22-14 -> 22-17} = 6.000 \text{ sec}$$

$$\text{Building Period " Ta " Calculated from Approximate Method sel=} = 0.189$$

" Cs " Response Coefficient

ASCE 7-16 Section 12.8.1.1

$$S_{DS} : \text{Short Period Design Spectral Response} = 1.087 \quad \text{From Eq. 12.8-2, Preliminary Cs} = 0.167$$

$$\text{" R " : Response Modification Factor} = 6.50 \quad \text{From Eq. 12.8-3 & 12.8-4 , Cs need not excee} = 0.572$$

$$\text{" I " : Seismic Importance Factor} = 1 \quad \text{From Eq. 12.8-5 & 12.8-6, Cs not be less than} = 0.048$$

$$\text{Cs : Seismic Response Coefficient} = \mathbf{0.1672}$$

ASCE 7-16 Seismic Base Shear

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DESCRIPTION: Seismic Base Shear Analysis

Seismic Base Shear

ASCE 7-16 Section 12.8.1

$C_s = 0.1672$ from 12.8.1.1

W (see Sum W_i below) = 118.20 k

Seismic Base Shear $V = C_s * W = 19.76$ k

Vertical Distribution of Seismic Forces

ASCE 7-16 Section 12.8.3

"k" : hx exponent based on $T_a = 1.00$

Table of building Weights by Floor Level...

Level #	W_i : Weight	H_i : Height	$(W_i * H_i^k)$	C_{vx}	$F_x = C_{vx} * V$	Sum Story Shear	Sum Story Moment
2	52.00	22.00	1,144.00	0.6110	12.07	12.07	0.00
1	66.20	11.00	728.20	0.3890	7.69	19.76	132.82
Sum $W_i =$	118.20 k	Sum $W_i * H_i =$	1,872.20 k-ft		Total Base Shear =	19.76 k	Base Moment = 350.2 k-ft

Diaphragm Forces : Seismic Design Category "B" to "F"

ASCE 7-16 12.10.1.1

Level #	W_i	F_i	Sum F_i	Sum W_i	F_{px} : Calcd	F_{px} : Min	F_{px} : Max	F_{px}	Dsgn. Force
2	52.00	12.07	12.07	52.00	12.07	11.30	22.60	12.07	12.07
1	66.20	7.69	19.76	118.20	11.07	14.39	28.77	14.39	14.39

W_{px} Weight at level of diaphragm and other structure elements attached to it.

F_i Design Lateral Force applied at the level.

Sum F_i Sum of "Lat. Force" of current level plus all levels above

MIN Req'd Force @ Level . . . $0.20 * S_{DS} * I * W_{px}$

MAX Req'd Force @ Level . . . $0.40 * S_{DS} * I * W_{px}$

F_{px} : Design Force @ Level . $W_{px} * \text{SUM}(x \rightarrow n) F_i / \text{SUM}(x \rightarrow n) w_i$, x = Current level, n = Top Level

Lateral Force Distribution

Main Wind Force (ult): 23.9 psf (zone c) (See Enercalc)
 Main Wind Force (service): 14.34 psf (zone c)
 Bldg Width 50 ft
 Bldg Length 78 ft
 1st Flr Width 50 ft
 2nd Flr Length 78 ft

Seismic Mass

Roof 51996 lbs
 2nd 66252 lbs
 Cs 0.1672 (See Enercalc)

Transverse Loads Longitudinal Loads

Level	Seismic Weight	Seismic Force	Service Level Forces	Wind Trib ht	Svc Lvl EQ Unit Forces Trans	Service Wind Loads Trans	Svc Lvl EQ Unit Forces Long	Service Wind Loads Long	Floor ht
	(k)	(k)	(k)	ft	lbs/ft	lbs/ft	lbs/ft	lbs/ft	ft
Roof	51996	12.07	8.45	6.5	108	93	169	93	11
2nd	66252	7.69	5.38	11	69	158	108	158	11

Total 19.76 13.83

Wind loads control transverse forces Transverse Wind Total 19.6 k

Seismic loads control longitudinal forces Longitudinal Seismic Total 13.8 k

Transverse Direction Shear Walls

Grid	Roof Trib width (ft)	Roof (lbs)	Lenth of SW (ft)	2nd floor walls (lb/ft)	SW Type	DL Resistance lbs/ft	HD force lbs	HD Type	1st Trib width (sq ft)	1st Floor (lbs)	Lenth of SW (ft)	1st Floor walls (lb/ft)	SW Type	DL Resistance lbs/ft	HD force lbs	HD Type
1	9	839	13	65	W6	178	0	NA	9	2259	13	174	W6	356	0	NA
2	12	1119	18	62	G7	187	0	NA	12	3011	18	167	2G4	374	0	NA
3	14	1305	28.5	46	G7	205	0	NA	14	3513	28.5	123	2G4	410	0	NA
4	14	1305	24.5	53	G7	205	0	NA	14	3513	24.5	143	2G4	410	0	NA
5	12	1119	24.5	46	G7	187	0	NA	12	3011	24.5	123	2G4	374	0	NA
6	9	839	6.5	129	W6	178	524	MSTI48	9	2259	6.5	347	W4	356	4255	HDU5

Longitudinal Direction Shear Walls

Grid	Roof Trib width (ft)	Roof (lbs)	Lenth of SW (ft)	2nd floor walls (lb/ft)	SW Type	DL Resistance lbs/ft	HD force lbs	HD Type	1st Trib width (sq ft)	1st Floor (lbs)	Lenth of SW (ft)	1st Floor walls (lb/ft)	SW Type	DL Resistance lbs/ft	HD force lbs	HD Type
A/B	14	2366	13.87	171	W6	106	1140	MSTI48	14	3873	13.87	450	W3	203	0	NA
B.3	11	1859	7	266	W6	106	2549	MSTI48	11	3043	8	613	W2	203	5026	HDU5
B.7	11	1859	7	266	W6	106	2549	MSTI48	11	3043	8	613	W2	203	5026	HDU5
C/D	14	2366	(6) Cant Cols	NA	Cant C	106	NA	NA	14	3873	28.67	218	W6	203	0	NA

REV 1