



CHESHIRE CUSTOM HOME

Framing and Foundations

9271 SE 76TH STREET, Mercer Island, WA 98040

Prepared for: FormWorks Design Build



9/16/2022

Date: August 12th, 2021

By: Kevin J. Haiar P.E.

August 12th, 2021

Summary

The project involves a new two-story wood framed custom home with basement and involves a total footprint of about 48 ft x 40 ft. The house includes two decks, a large cantilevered roof overhang, and some site retaining walls. The framing system consists of 12" deep engineering joists and involves conventional wood shear walls for lateral resistance to wind and seismic forces. Footings comprise of conventional concrete pad and strip footings.

Design Codes

2018 International Building Code
ASCE/SEI 7-16
NDS Wood Design 2015
ACI 318 Concrete 2014

Design Criteria

Roof Snow Load:	25 psf + 5 psf rain on snow
Importance Factor:	1.0
Wind Speed:	110 mph
Wind Exposure:	C
Seismic Design Category:	D
Seismic S _s :	1.472
Seismic S ₁ :	0.566
Allowable Soil Bearing:	2000 psf (assume)

COVID-19 Information & Resources



City of
MERCER ISLAND

Community Services Departments Government

[Search Our Site](#)

COVID-19 CPD and Construction Information

Community Planning & Development

The City is working on reopening and restarting various programs. City Hall will reopen to the public in September. Follow this link for the latest information.

[Permits, Plan Review, & Inspections](#)

[Land Use and Planning](#)

[How to Apply](#)

[Target Times & Reviews](#)

[Fees](#)

[Weekly Permit Information Bulletin](#)

[City Code](#)

[Design Commission](#)

[Planning Commission](#)

Climatic and Geographic Design Criteria

IRC TABLE R301.2 (1)
Climatic and Geographic Design Criteria

Roof Snow Load ^a	Wind Design ^b		Seismic Design Category ^c	Subject to Damage From:			Outside Design Temp-Heat/Cool	Ice Barrier Under-layment Required	Flood Hazards ^e	Air Freezing Index	Mea Ann Tem
	Speed	Topographic Effects		Weathering ^d	Frost Line Depth	Termite Decay					
25 psf	110 mph	See footnote ^b	D2	Moderate	12"	Slight to Moderate	24°F/83°F	No	NA	113	53°

- A. When using this roof 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. 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).
- C. From IRC Table 301.2(1).
- 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 FIRM identified 06/28/74, Initial FIRM identified 05/16/95, Current Effective Map Date (NSFHA), Reg-Emer Date 06/30/97.

Gravity Loads

<u>Roof Dead Loads:</u>	<u>Weight (psf)</u>
Roofing	1.0
Decking	2.0
Roof Joists/Trusses	2.0
Insulation	1.0
Gyp Ceiling	2.5
Mech/Elec	1.5
Misc.	5.0

Total Roof Dead Load **15.0**

<u>Roof Live Loads:</u>	<u>Weight (psf)</u>
Roof Live Load	20.0
Snow Load + 5psf rain on snow	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)	3
Misc	2.5

Total Wall Load **10**

<u>Floor Dead Loads:</u>	<u>Weight (psf)</u>
Flooring	1.0
Gypcrete/overlay (2")	19.2
Joists	2.0
Gyp Ceiling	2.5
Mech/Elec	1.5
Misc.	3.8

Total Floor Dead Load **30.0**

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

Footing Bearing:

Grid 2 - Worst Case Loading			
Tributary	20		ft
Dead	1499		lbs
Live	1600		lbs
Snow	600		lbs
D+L	3099		lbs
D+0.75L+0.75S	3149		lbs
Allowable Bearing Pressure	2000		psf
Minimum Footing Width	1.57		ft

USE 2FT-6IN WIDE X 12" DP FOOTING AT INT BRG WALLS AND EXT STUD WALLS

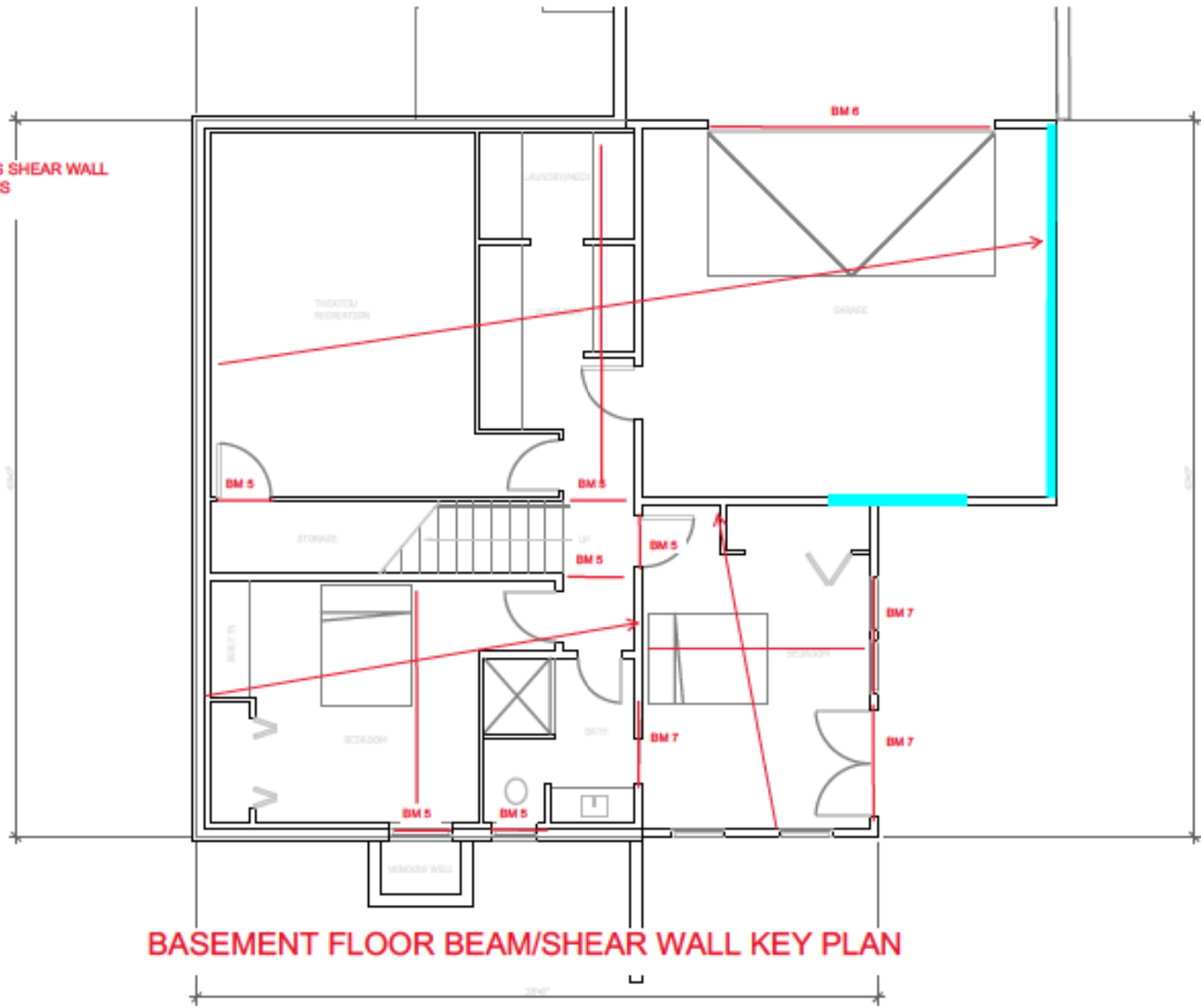
Roof & Floor Framing Beams

BM #	Description	location	Span ft	Roof Trib ft	R DL PLF	Roof S PLF	Roof Live PLF	Floor Trib ft	FL Live PSF	FL Dead PLF	FL Live PLF	Beam Size	Reactions
BM 1	Typ Rf Ext Hdr	Roof Grid 3	5.5	7.5	112.5	225	150	0	0	0	0	(2) 2x10 DFL #2	773
Bm 2	Typ Rf Int Hdr	Roof Grid 2	3	20	300	600	400	0	0	0	0	(2) 2x10 DFL #2	1125
BM 3	Rf East Cantilever	Rf grid 1 & 2	19	10.5	157.5	315	210	0	0	0	0	GL 5.125x10.5 V8	6891
BM 4	2nd flr ext hdr	2nd grid 1 & 2	11.25	10	150	300	200	11	40	330	440	GL 5.125x10.5 V4	2923
BM 5	Typ frl hdr	1st & 2nd, all grids	5.5	10	150	300	200	10	40	300	400	(2) 2x10 DFL #2	1347
BM 6	Garage hdr	1st flr grid 1	16.5	10	150	300	200	20	40	599	800	GL 5.125x18 V4	6512
BM 7	Deck beam	1st flr grid B'	6.5	0	0	0	0	7	40	210	280	(2) 2x10 DFL #2	812

NOTES:

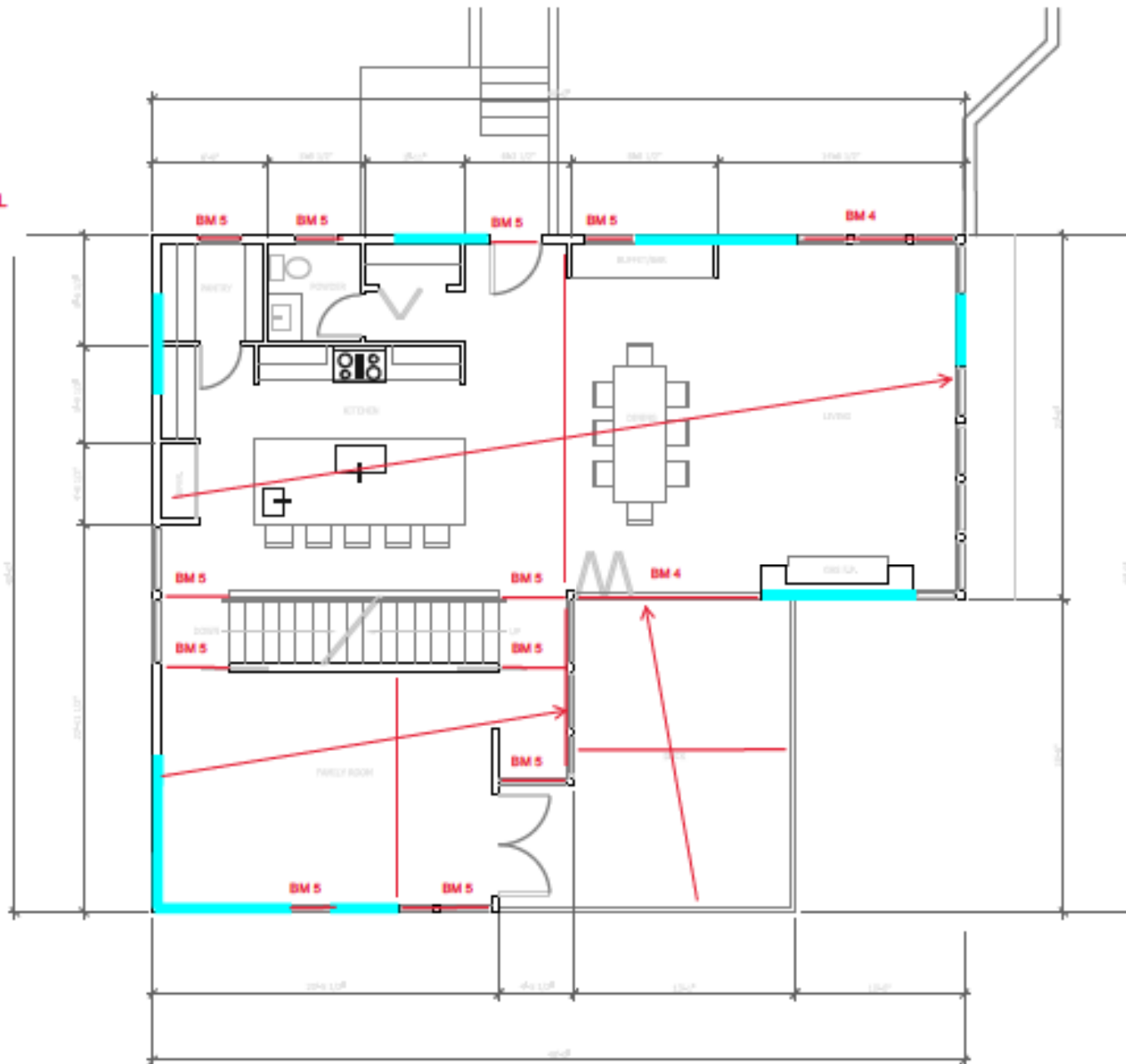
1. SEE ENERCALC OUTPUT SHEETS FOR BEAM DESIGNS
2. TOTAL LOAD INCLUDES LOAD CASES D+L, $D=0.75*L+0.75*S$

INDICATES SHEAR WALL LOCATIONS



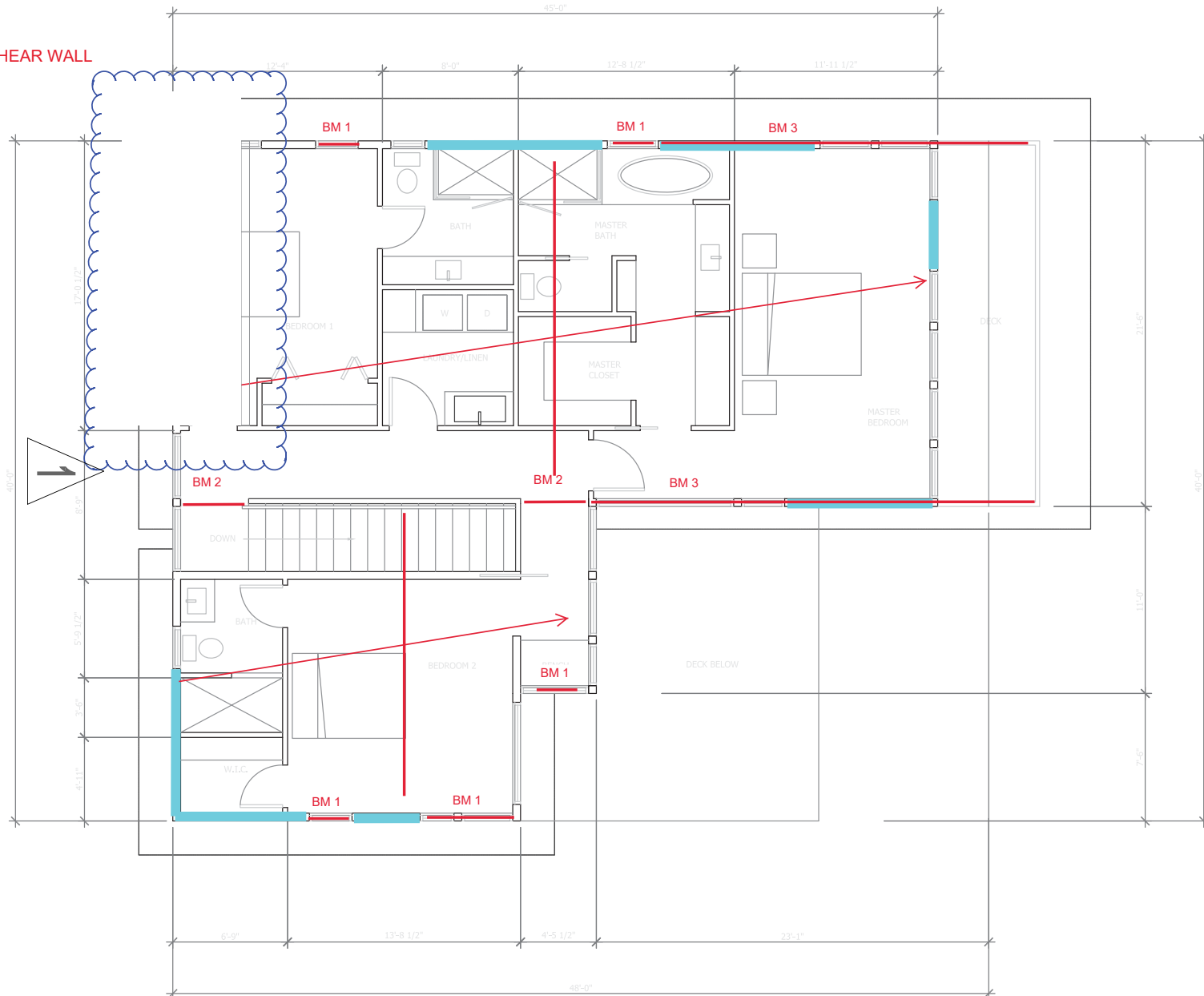
BASEMENT FLOOR BEAM/SHEAR WALL KEY PLAN

INDICATES SHEAR WALL LOCATIONS



MAIN FLOOR BEAM/SHEAR WALL KEY PLAN

INDICATES SHEAR WALL LOCATIONS



SECOND FLOOR BEAM/SHEAR WALL KEY PLAN



RedSpec™ by RedBuilt™
v7.1.12

Project: Project
Location: Mercer Island, WA
Folder: Folder
Date: 8/8/21 6:10 PM
Designer: KJH
Comment:

Type: FLOOR JOISTS

11.875" Red-I58™ @ 16" o.c. with Glued Sheathing

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	%	Design	Allow.	DOL	Combination	Pattern	Pass/Fail	
Shear (lb)	55%	980	1785	Floor(100%)	1.0D+1.0L	All Spans	PASS	
Positive Moment (ft-lb)	82%	5145	6255	Floor(100%)	1.0D+1.0L	All Spans	PASS	
DEFLECTIONS (in)	%	Design	Allow.	Design	Allow.	Combination	Pattern	Pass/Fail
Span Live	99%	0.519	0.525	L / 486	L / 480	1.0D+1.0L	All Spans	PASS
Span Total	86%	0.908	1.050	L / 278	L / 240	1.0D+1.0L	All Spans	PASS

FloorChoice™ Rating: 0.9



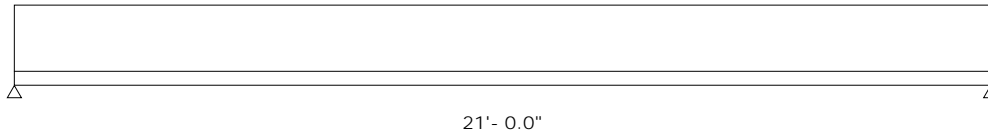
Performance rating is based on: 24 oc (23/32", 3/4") sheathing, glued and nailed, 1 1/2" Lightweight Concrete topping, 1 Row Blocking, 1/2" Gypsum ceiling, simple span, rigid supports. RedSpec has not performed a structural analysis of the sheathing.

SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	560 (100)	560 (100)
Dead Reaction (lb)	420	420
Total Reaction (lb) (DOL%)	980 (100)	980 (100)
Bearing Support	Bottom Wall	Flush Wall
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

HANGERS	Model	Top	Face	Member	Header	Size
Right	None Selected					

SPANS AND LOADS

Dimensions represent horizontal design spans.



APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Floor(100%)	40	30	0	16"	Glued Floor Joist

NOTES

- Building code and design methodology: 2018 IBC ASD (US).
- Product Acceptance: ICC-ES ESR-2994 and LABC/LARC Supplement.
- Deflection analysis is based on composite action with 24 oc (23/32", 3/4") sheathing, glued and nailed.
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.

C:\Users\Kevin\Dropbox\MDS_SHARED\DESIGN PROJECTS-MDS\MDS PROJECTS 2021\21-045 Mercer Island Custom Home\CALCS\REDBUILT\Mercer.red

8/8/2021 6:10:10 PM

Project : Folder : FLOOR JOISTS

Page 1 of 1

The products noted are intended for interior, untreated, non-corrosive applications with normal temperatures and dry conditions of use, and must be installed in accordance with local building code requirements and RedBuilt™ recommendations. The loads, spans, and spacing have been provided by others and must be approved for the specific application by the design professional for the project. Unless otherwise noted, this output has not been reviewed by a RedBuilt™ associate. PRODUCT SUBSTITUTION VOIDS THIS ANALYSIS.

RedBuilt™, RedSpec™, Red-I™, Red-I45™, Red-I45L™, Red-I58™, Red-I65™, Red-I90™, Red-I90H™, Red-I90HS™, Red-L™, Red-W™, Red-S™, Red-M™, Red-H™, RedLam™, FloorChoice™ are trademarks of RedBuilt LLC, Boise ID, USA. Copyright © 2010-2020 RedBuilt LLC. All rights reserved.



RedSpec™ by RedBuilt™
v7.1.12

Project: Project
Location: Mercer Island, WA
Folder: Folder
Date: 8/8/21 6:11 PM
Designer: KJH
Comment:

Type: ROOF JOISTS

11.875" Red-I45L™ @ 16" o.c.

This product meets or exceeds the set design controls for the application and loads listed

DESIGN CONTROLS	%	Design	Allow.	DOL	Combination	Pattern	Pass/Fail
Shear (lb)	32%	630	1955	Snow(115%)	1.0D+1.0S	All Spans	PASS
Positive Moment (ft-lb)	91%	3308	3651	Snow(115%)	1.0D+1.0S	All Spans	PASS

DEFLECTIONS (in)	%	Design	Allow.	Design	Allow.	Combination	Pattern	Pass/Fail
Span Live	95%	0.668	0.700	L / 377	L / 360	1.0D+1.0S	All Spans	PASS
Span Total	95%	1.002	1.050	L / 252	L / 240	1.0D+1.0S	All Spans	PASS

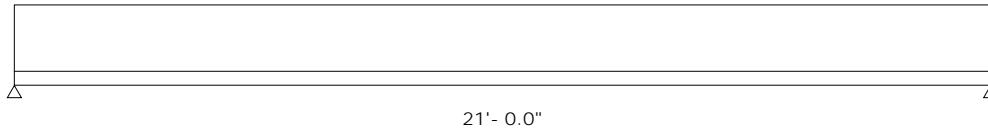
SUPPORTS	Support 1	Support 2
Live Reaction, Critical (lb) (DOL%)	420 (115)	420 (115)
Dead Reaction (lb)	210	210
Total Reaction (lb) (DOL%)	630 (115)	630 (115)
Bearing Support	Bottom Wall	Flush Wall
Req'd Bearing, No Stiffeners (in)	1.75	1.75
Req'd Bearing, Stiffeners (in)	-	-

HANGERS	Model	Top	Face	Member	Header	Size
Right	None Selected					

SPANS AND LOADS

Dimensions represent horizontal design spans.

Member Slope: 0/12



APPLICATION LOADS

Type	Units	DOL	Live	Dead	Partition	Tributary	Member Type
Uniform	psf	Snow(115%)	30	15	0	16"	Snow Roof Joist

NOTES

- Building code and design methodology: 2018 IBC ASD (US).
- Product Acceptance: ICC-ES ESR-2994 and LABC/LARC Supplement.
- Continuous lateral support required at top edge. Lateral support at bottom edge shall be per RedBuilt recommendations.

C:\Users\Kevin\Dropbox\MDS_SHARED\DESIGN PROJECTS-MDS\MDS PROJECTS 2021\21-045 Mercer Island Custom Home\CALCS\REDBUILT\Mercer.red

The products noted are intended for interior, untreated, non-corrosive applications with normal temperatures and dry conditions of use, and must be installed in accordance with local building code requirements and RedBuilt™ recommendations. The loads, spans, and spacing have been provided by others and must be approved for the specific application by the design professional for the project. Unless otherwise noted, this output has not been reviewed by a RedBuilt™ associate. PRODUCT SUBSTITUTION VOIDS THIS ANALYSIS.

RedBuilt™, RedSpec™, Red-I™, Red-I45™, Red-I45L™, Red-I58™, Red-I65™, Red-I90™, Red-I90H™, Red-I90HS™, Red-L™, Red-W™, Red-S™, Red-M™, Red-H™, RedLam™, FloorChoice™ are trademarks of RedBuilt LLC, Boise ID, USA. Copyright © 2010-2020 RedBuilt LLC. All rights reserved.



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

Printed: 9 AUG 2021, 12:33AM

Wood Column

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

DESRIPTIO Typical Stud Design (2x6's at 16" oc)

Code References

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combinations Used : ASCE 7-10

General Information

Analysis Metho	Allowable Stress Design			Wood Section Name	2x6
End Fixities	Top & Bottom Pinned			Wood Grading/Manuf.	Graded Lumber
Overall Column Heigh	9 ft			Wood Member Type	Sawn
<i>(Used for non-slender calculations)</i>					
Wood Specie	Douglas Fir-South			Exact Width	1.50 in
Wood Grade	No.2			Exact Depth	5.50 in
Fb +	850 psi	Fv	180 psi	Area	8.250 in^2
Fb -	850 psi	Ft	525 psi	Ix	20.797 in^4
Fc - Prll	1350 psi	Density	28.72 pcf	Iy	1.547 in^4
Fc - Perp	520 psi			Allow Stress Modification Factors	
E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial	Cf or Cv for Bending	1.30
	Basic	1200	1200	1200 ksi	Cf or Cv for Compression
	Minimum	440	440		1.10
					Cf or Cv for Tension
					1.30
					Cm : Wet Use Factor
					1.0
					Ct : Temperature Fact
					1.0
					Cfu : Flat Use Factor
					1.0
					Kf : Built-up columns
					1.0 NDS 15.3.2
					Use Cr : Repetitive
					No

Brace condition for deflection (buckling) along columns :
 X-X (width) axis Fully braced against buckling ABOUT Y-Y Axis
 Y-Y (depth) axis Unbraced Length for buckling ABOUT X-X Axis = 9

Applied Loads

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

Column self weight included : 14.809 lbs * Dead Load Factor

AXIAL LOADS . . .

Axial Load at 9.0 ft, D = 1.50, L = 1.60, S = 0.60 k

BENDING LOADS . . .

Lat. Uniform Load creating Mx-x, W = 0.040 k/ft

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.4895 : 1**

Load Combination	+D+L
Governing NDS Formula	Comp Only, fc/Fc'
Location of max.above base	0.0 ft
At maximum location values are .	
Applied Axial	3.115 k
Applied Mx	0.0 k-ft
Applied My	0.0 k-ft
Fc : Allowable	771.29 psi

Maximum SERVICE Lateral Load Reactions . .

Top along Y-Y	0.180 k	Bottom along Y-Y	0.180 k
Top along X-X	0.0 k	Bottom along X-X	0.0 k

Maximum SERVICE Load Lateral Deflections . . .

Along Y-Y	0.2392 in	at	4.530 ft	above base
for load combination : W Only				
Along X-X	0.0 in	at	0.0 ft	above base
for load combination : n/a				

Other Factors used to calculate allowable stresses . . .

	Bending	Compression	Tension
--	---------	-------------	---------

PASS Maximum Shear Stress Ratio = **0.06818 : 1**

Load Combination	+D+0.60W
Location of max.above base	9.0 ft
Applied Design Shear	19.636 psi
Allowable Shear	288.0 psi

Load Combination Results

Load Combination	C _D	C _P	Maximum Axial + Bending Stress Ratios			Maximum Shear Ratios		
			Stress Ratio	Status	Location	Stress Ratio	Status	Location
D Only	0.900	0.560	0.2455	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+L	1.000	0.519	0.4895	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+S	1.150	0.467	0.3212	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+0.750L	1.250	0.437	0.4054	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+0.750L+0.750S	1.150	0.467	0.4807	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+0.60W	1.600	0.356	0.3184	PASS	4.470 ft	0.06818	PASS	9.0 ft
+D+0.750L+0.450W	1.600	0.356	0.4037	PASS	4.470 ft	0.05114	PASS	9.0 ft
+D+0.750L+0.750S+0.450W	1.600	0.356	0.4829	PASS	4.470 ft	0.05114	PASS	9.0 ft
+0.60D+0.60W	1.600	0.356	0.2641	PASS	4.470 ft	0.06818	PASS	9.0 ft



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

Printed: 9 AUG 2021, 12:33AM

Wood Column

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Typical Stud Design (2x6's at 16" oc)

Load Combination Results

Load Combination	C _D	C _P	Maximum Axial + Bending Stress Ratios			Maximum Shear Ratios		
			Stress Ratio	Status	Location	Stress Ratio	Status	Location
+0.60D	1.600	0.356	0.1304	PASS	0.0 ft	0.0	PASS	9.0 ft



Wood Column

Lic. #: KW-06011847

DESCRIPTION Double Stud Post

Code References

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combinations Used : ASCE 7-16

General Information

Analysis Method	Allowable Stress Design			Wood Section Name	2-2x6
End Fixities	Top & Bottom Pinned			Wood Grading/Manuf.	Graded Lumber
Overall Column Height	9 ft			Wood Member Type	Sawn
<i>(Used for non-slender calculations)</i>					
Wood Species	Douglas Fir-South			Exact Width	3.0 in
Wood Grade	No.2			Exact Depth	5.50 in
Fb +	850 psi	Fv	180 psi	Area	16.50 in ²
Fb -	850 psi	Ft	525 psi	Ix	41.594 in ⁴
Fc - Prll	1350 psi	Density	28.72 pcf	Iy	12.375 in ⁴
Fc - Perp	520 psi			Allow Stress Modification Factors	
E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial	Cf or Cv for Bending	1.30
	Basic	1200	1200	1200 ksi	Cf or Cv for Compression
	Minimum	440	440		1.10
					Cf or Cv for Tension
					1.30
					Cm : Wet Use Factor
					1.0
					Ct : Temperature Fact
					1.0
					Cfu : Flat Use Factor
					1.0
					Kf : Built-up columns
					1.0 NDS 15.3.2
					Use Cr : Repetitive
					No
				Brace condition for deflection (buckling) along columns :	
				X-X (width) axis	Fully braced against buckling ABOUT Y-Y Axis
				Y-Y (depth) axis	Unbraced Length for buckling ABOUT X-X Axis = 9

Applied Loads

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

Column self weight included : 29.618 lbs * Dead Load Factor

AXIAL LOADS . . .

Axial Load at 9.0 ft, D = 3.0, L = 4.0 k

BENDING LOADS . . .

Lat. Uniform Load creating Mx-x, W = 0.160 k/ft

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.7230 : 1**
 Load Combination +D+0.750L+0.450W
 Governing NDS Formula $\sigma_{comp} + M_{xx}$, NDS Eq. 3.9-3
 Location of max. above base 4.470 ft
 At maximum location values are .
 Applied Axial 6.030 k
 Applied Mx 0.7290 k-ft
 Applied My 0.0 k-ft
 Fc : Allowable 844.78 psi

Maximum SERVICE Lateral Load Reactions . .
 Top along Y-Y 0.720 k Bottom along Y-Y 0.720 k
 Top along X-X 0.0 k Bottom along X-X 0.0 k

Maximum SERVICE Load Lateral Deflections . . .
 Along Y-Y 0.4783 in at 4.530 ft above base
 for load combination : W Only
 Along X-X 0.0 in at 0.0 ft above base
 for load combination : n/a

Other Factors used to calculate allowable stresses . . .
 Bending Compression Tension

PASS Maximum Shear Stress Ratio = **0.1364 : 1**
 Load Combination +D+0.60W
 Location of max. above base 9.0 ft
 Applied Design Shear 39.273 psi
 Allowable Shear 288.0 psi

Load Combination Results

Load Combination	C _D	C _P	Maximum Axial + Bending Stress Ratios			Maximum Shear Ratios		
			Stress Ratio	Status	Location	Stress Ratio	Status	Location
D Only	0.900	0.560	0.2455	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+L	1.000	0.519	0.5524	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+0.750L	1.250	0.437	0.4501	PASS	0.0 ft	0.0	PASS	9.0 ft
+D+0.60W	1.600	0.356	0.5896	PASS	4.470 ft	0.1364	PASS	9.0 ft
+D+0.750L+0.450W	1.600	0.356	0.7230	PASS	4.470 ft	0.1023	PASS	9.0 ft
+0.60D+0.60W	1.600	0.356	0.5112	PASS	4.470 ft	0.1364	PASS	9.0 ft
+0.60D	1.600	0.356	0.1304	PASS	0.0 ft	0.0	PASS	9.0 ft



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

Printed: 9 AUG 2021, 12:29AM

Wood Column

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

DESCRIPTION Double Stud Post

Code References

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combinations Used : ASCE 7-10

General Information

Analysis Method	Allowable Stress Design			Wood Section Name	2-2x6	
End Fixities	Top & Bottom Pinned			Wood Grading/Manuf.	Graded Lumber	
Overall Column Height	10 ft			Wood Member Type	Sawn	
<i>(Used for non-slender calculations)</i>						
Wood Species	Douglas Fir-Larch			Exact Width	3.0 in	
Wood Grade	No.2			Exact Depth	5.50 in	
Fb +	900 psi	Fv	180 psi	Area	16.50 in ²	
Fb -	900 psi	Ft	575 psi	Ix	41.594 in ⁴	
Fc - Prll	1350 psi	Density	31.21 pcf	Iy	12.375 in ⁴	
Fc - Perp	625 psi					
E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial	Allow Stress Modification Factors		
	Basic	1600	1600	1600 ksi	Cf or Cv for Bending	1.30
	Minimum	580	580		Cf or Cv for Compression	1.10
					Cf or Cv for Tension	1.30
					Cm : Wet Use Factor	1.0
					Ct : Temperature Fact	1.0
					Cfu : Flat Use Factor	1.0
					Kf : Built-up columns	1.0 <i>NDS 15.3.2</i>
					Use Cr : Repetitive	No
Brace condition for deflection (buckling) along columns :						
X-X (width) axis Fully braced against buckling ABOUT Y-Y Axis						
Y-Y (depth) axis Fully braced against buckling ABOUT X-X Axis						

Applied Loads

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

Column self weight included : 35.761 lbs * Dead Load Factor

AXIAL LOADS . . .

Axial Load at 10.0 ft, D = 3.0, L = 3.0, S = 3.0 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = **0.2674 : 1**
 Load Combination +D+0.750L+0.750S
 Governing NDS Formula Comp Only, fc/Fc'
 Location of max.above base 0.0 ft
 At maximum location values are .
 Applied Axial 7.536 k
 Applied Mx 0.0 k-ft
 Applied My 0.0 k-ft
 Fc : Allowable 1,707.75 psi

Maximum SERVICE Lateral Load Reactions . .
 Top along Y-Y 0.0 k Bottom along Y-Y 0.0 k
 Top along X-X 0.0 k Bottom along X-X 0.0 k

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

PASS Maximum Shear Stress Ratio = **0.0 : 1**
 Load Combination +0.60D
 Location of max.above base 10.0 ft
 Applied Design Shear 0.0 psi
 Allowable Shear 288.0 psi

Other Factors used to calculate allowable stresses . . .
Bending Compression Tension

Load Combination Results

Load Combination	C _D	C _P	Maximum Axial + Bending Stress Ratios			Maximum Shear Ratios		
			Stress Ratio	Status	Location	Stress Ratio	Status	Location
D Only	0.900	1.000	0.1377	PASS	0.0 ft	0.0	PASS	10.0 ft
+D+L	1.000	1.000	0.2463	PASS	0.0 ft	0.0	PASS	10.0 ft
+D+S	1.150	1.000	0.2142	PASS	0.0 ft	0.0	PASS	10.0 ft
+D+0.750L	1.250	1.000	0.1726	PASS	0.0 ft	0.0	PASS	10.0 ft
+D+0.750L+0.750S	1.150	1.000	0.2674	PASS	0.0 ft	0.0	PASS	10.0 ft
+0.60D	1.600	1.000	0.04646	PASS	0.0 ft	0.0	PASS	10.0 ft



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

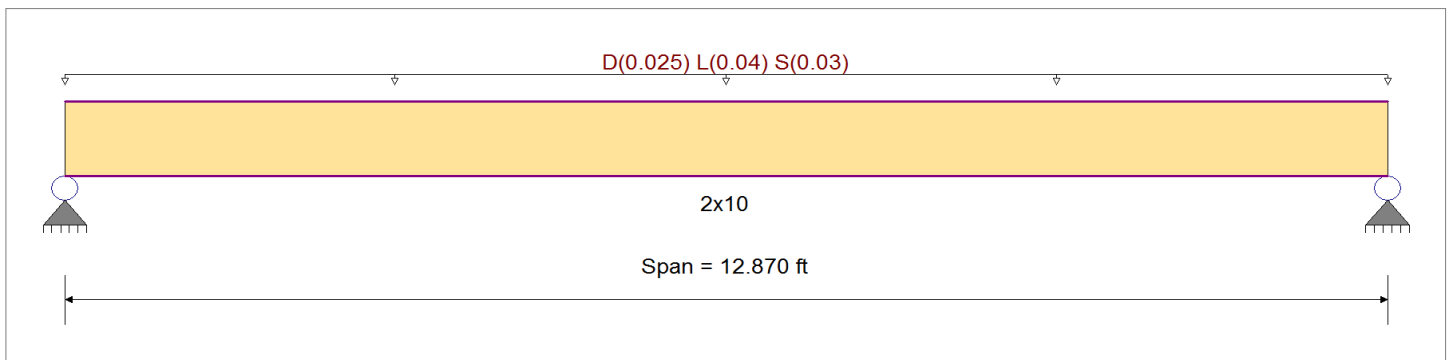
DESCRIPTIO Deck Joists

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	900 psi	E : Modulus of Elasti	
Load Combinati	ASCE 7-10	Fb -	900 psi	Ebend- xx	1600ksi
		Fc - Prll	1350 psi	Eminbend - x	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			Repetitive Member Stress Increa	



Applied Loads

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

Beam self weight calculated and added to loads
 Uniform Load : D = 0.0250, L = 0.040, S = 0.030, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.714 : 1	Maximum Shear Stress Ratio	=	0.239 : 1
Section used for this span		2x10	Section used for this span		2x10
fb: Actual	=	935.10psi	fv: Actual	=	49.47 psi
Fb: Allowable	=	1,309.28psi	Fv: Allowable	=	207.00 psi
Load Combination		+D+0.750L+0.750S	Load Combination		+D+0.750L+0.750S
Location of maximum on span	=	6.435ft	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		0.157 in	Ratio =		984 >=360
Max Upward Transient Deflection		0.000 in	Ratio =		0 <360
Max Downward Total Deflection		0.316 in	Ratio =		489 >=240
Max Upward Total Deflection		0.000 in	Ratio =		0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values					
			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	Length = 12.870 ft	1	0.317	0.106	0.90	1.100	1.00	1.15	1.00	1.00	1.00	0.58	325.31	1024.65	0.00	0.00	0.00	0.00	0.00	0.00
+D+L	Length = 12.870 ft	1				1.100	1.00	1.15	1.00	1.00	1.00	1.41	789.91	1138.50	0.00	0.00	0.00	0.00	0.00	0.00
+D+S	Length = 12.870 ft	1	0.694	0.232	1.00	1.100	1.00	1.15	1.00	1.00	1.00	1.20	673.76	1309.28	0.00	0.00	0.00	0.00	0.00	0.00
+D+0.750L	Length = 12.870 ft	1	0.515	0.172	1.15	1.100	1.00	1.15	1.00	1.00	1.00	1.20	673.76	1423.13	0.00	0.00	0.00	0.00	0.00	0.00
+D+0.750L+0.750S	Length = 12.870 ft	1	0.473	0.158	1.25	1.100	1.00	1.15	1.00	1.00	1.00	1.20	673.76	1423.13	0.00	0.00	0.00	0.00	0.00	0.00
+D+0.60D	Length = 12.870 ft	1	0.714	0.239	1.15	1.100	1.00	1.15	1.00	1.00	1.00	1.67	935.10	1309.28	0.00	0.00	0.00	0.00	0.00	0.00
	Length = 12.870 ft	1	0.107	0.036	1.60	1.100	1.00	1.15	1.00	1.00	1.00	0.35	195.18	1821.60	0.00	0.00	0.00	0.00	0.00	0.00



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Deck Joists

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.3158	6.482		0.0000	0.000

Vertical Reactions

Support notation : Far left is #'

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	0.518	0.518
Overall MINimum	0.193	0.193
D Only	0.180	0.180
+D+L	0.438	0.438
+D+S	0.373	0.373
+D+0.750L	0.373	0.373
+D+0.750L+0.750S	0.518	0.518
+0.60D	0.108	0.108
L Only	0.257	0.257
S Only	0.193	0.193



Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

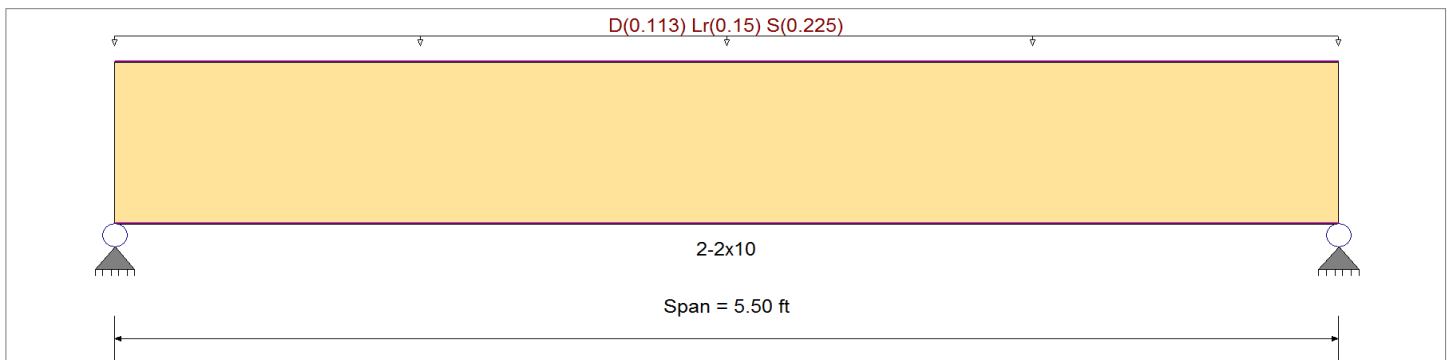
DESCRIPTIO Beam 1

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	900 psi	E : Modulus of Elasti	
Load Combination	ASCE 7-10	Fb -	900 psi	Ebend- xx	1600ksi
		Fc - Prll	1350 psi	Eminbend - x	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 loads

Uniform Load : D = 0.1130, Lr = 0.150, S = 0.2250, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.320	1	Maximum Shear Stress Ratio	=	0.179	: 1
Section used for this span		2-2x10		Section used for this span		2-2x10	
fb: Actual	=	364.87	psi	fv: Actual	=	36.95	psi
Fb: Allowable	=	1,138.50	psi	Fv: Allowable	=	207.00	psi
Load Combination		+D+S		Load Combination		+D+S	
Location of maximum on span	=	2.750	ft	Location of maximum on span	=	4.737	ft
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.015	in	Ratio =	4484	>=360	
Max Upward Transient Deflection		0.000	in	Ratio =	0	<360	
Max Downward Total Deflection		0.023	in	Ratio =	2932	>=240	
Max Upward Total Deflection		0.000	in	Ratio =	0	<240	

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values								
			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	Length = 5.50 ft	1	0.142	0.079	0.90	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.45	126.23	891.00	0.00	0.00	0.00	0.24	12.78	162.00	
+D+Lr	Length = 5.50 ft	1				1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.02	285.32	1237.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
+D+S	Length = 5.50 ft	1	0.320	0.179	1.15	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.30	364.87	1138.50	0.00	0.00	0.00	0.68	36.95	207.00	
+D+0.750Lr	Length = 5.50 ft	1				1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	245.55	1237.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
+D+0.750S	Length = 5.50 ft	1	0.198	0.111	1.25	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.09	305.21	1138.50	0.00	0.00	0.00	0.57	30.91	207.00	
+0.60D	Length = 5.50 ft	1	0.048	0.027	1.60	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.27	75.74	1584.00	0.00	0.00	0.00	0.14	7.67	288.00	



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Beam 1

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0225	2.770		0.0000	0.000

Vertical Reactions

Load Combination	Support notation : Far left is #'		Values in KIPS
	Support 1	Support 2	
Overall MAXimum	0.946	0.946	
Overall MINimum	0.619	0.619	
D Only	0.327	0.327	
+D+Lr	0.740	0.740	
+D+S	0.946	0.946	
+D+0.750Lr	0.637	0.637	
+D+0.750S	0.791	0.791	
+0.60D	0.196	0.196	
Lr Only	0.413	0.413	
S Only	0.619	0.619	



Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

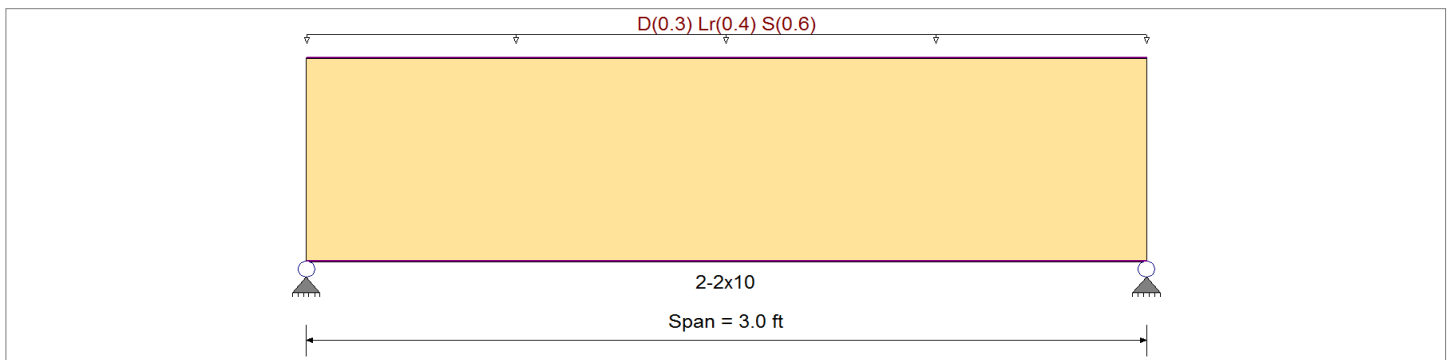
DESCRIPTION Beam 2

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	900.0 psi	E : Modulus of Elasticity	
Load Combination	ASCE 7-10	Fb -	900.0 psi	Ebend- xx	1,600.0ksi
		Fc - Prll	1,350.0 psi	Eminbend - x	580.0ksi
Wood Species	Douglas Fir-Larch	Fc - Perp	625.0 psi		
Wood Grade	No.2	Fv	180.0 psi		
		Ft	575.0 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 calculated and added to loads
 Uniform Load : D = 0.30, Lr = 0.40, S = 0.60, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.251 : 1	Maximum Shear Stress Ratio	=	0.174 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	285.90psi	fv: Actual	=	35.93 psi
Fb: Allowable	=	1,138.50psi	Fv: Allowable	=	207.00 psi
Load Combination		+D+S	Load Combination		+D+S
Location of maximum on span	=	1.500ft	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		0.003 in	Ratio =	10361	>=360
Max Upward Transient Deflection		0.000 in	Ratio =	0	<360
Max Downward Total Deflection		0.005 in	Ratio =	6862	>=240
Max Upward Total Deflection		0.000 in	Ratio =	0	<240

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values							
			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	Length = 3.0 ft	1	0.108	0.075	0.90	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.34	96.57	891.00	0.00	0.00	0.00	0.22	12.13	162.00
+D+Lr	Length = 3.0 ft	1				1.100	1.00	1.00	1.00	1.00	1.00	1.00	0.79	222.79	1237.50	0.00	0.00	0.00	0.00	0.00	28.00	225.00
+D+S	Length = 3.0 ft	1	0.251	0.174	1.15	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.02	285.90	1138.50	0.00	0.00	0.00	0.66	35.93	207.00	
+D+0.750Lr	Length = 3.0 ft	1				1.100	1.00	1.00	1.00	1.00	1.00	1.00	0.68	191.23	1237.50	0.00	0.00	0.00	0.00	0.00	24.03	225.00
+D+0.750S	Length = 3.0 ft	1	0.155	0.107	1.25	1.100	1.00	1.00	1.00	1.00	1.00	1.00	0.85	238.57	1138.50	0.00	0.00	0.00	0.55	29.98	207.00	
+0.60D	Length = 3.0 ft	1				1.100	1.00	1.00	1.00	1.00	1.00	1.00	0.21	57.94	1584.00	0.00	0.00	0.00	0.00	0.00	7.28	288.00



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Beam 2

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.0052	1.511		0.0000	0.000

Vertical Reactions

Load Combination	Support notation : Far left is #'		Values in KIPS	
	Support 1	Support 2		
Overall MAXimum	1.359	1.359		
Overall MINimum	0.900	0.900		
D Only	0.459	0.459		
+D+Lr	1.059	1.059		
+D+S	1.359	1.359		
+D+0.750Lr	0.909	0.909		
+D+0.750S	1.134	1.134		
+0.60D	0.275	0.275		
Lr Only	0.600	0.600		
S Only	0.900	0.900		



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

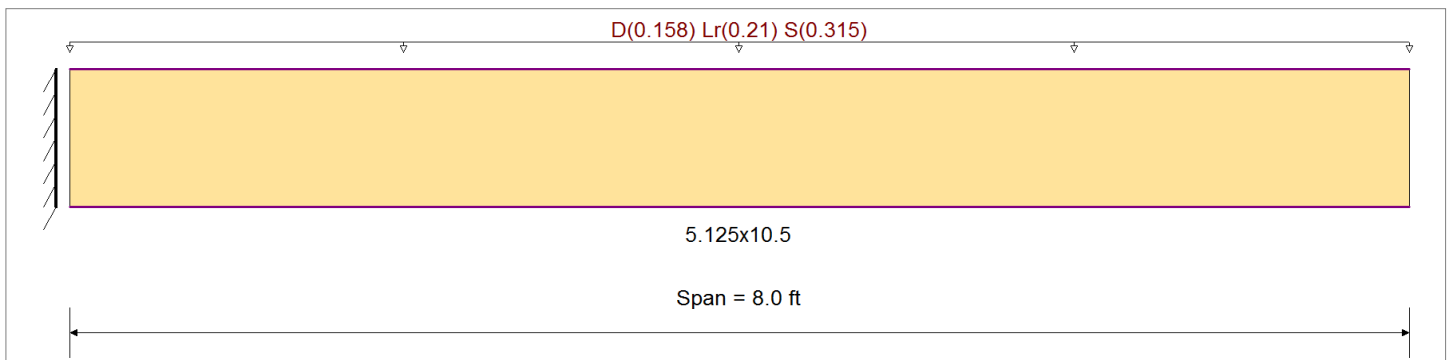
DESCRIPTIO Beam 3

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	2,400.0 psi	E : Modulus of Elasti	
Load Combination	ASCE 7-10	Fb -	2,400.0 psi	Ebend- xx	1,800.0ksi
Wood Species	DF/DF	Fc - Prll	1,650.0 psi	Eminbend - x	950.0ksi
Wood Grade	24F-V8	Fc - Perp	650.0 psi	Ebend- yy	1,600.0ksi
		Fv	265.0 psi	Eminbend - y	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 calculated and added to loads

Uniform Load : D = 0.1580, Lr = 0.210, S = 0.3150, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.716	1	Maximum Shear Stress Ratio	=	0.317	: 1
Section used for this span		5.125x10.5		Section used for this span		5.125x10.5	
fb: Actual	=	1,976.29psi		fv: Actual	=	96.64 psi	
Fb: Allowable	=	2,760.00psi		Fv: Allowable	=	304.75 psi	
Load Combination		+D+S		Load Combination		+D+S	
Location of maximum on span	=	0.000ft		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		0.312	in	Ratio =	614	>=360	
Max Upward Transient Deflection		0.000	in	Ratio =	0	<360	
Max Downward Total Deflection		0.481	in	Ratio =	398	>=240	
Max Upward Total Deflection		0.000	in	Ratio =	0	<240	

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values							
			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	Length = 8.0 ft	1	0.320	0.142	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.43	691.83	2160.00	0.00	0.00	0.00	1.21	33.83	238.50
+D+Lr	Length = 8.0 ft	1	0.516	0.229	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	12.15	1,548.13	3000.00	0.00	0.00	0.00	2.72	75.70	331.25
+D+S	Length = 8.0 ft	1	0.716	0.317	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	15.51	1,976.29	2760.00	0.00	0.00	0.00	3.47	96.64	304.75
+D+0.750Lr	Length = 8.0 ft	1	0.445	0.197	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	10.47	1,334.06	3000.00	0.00	0.00	0.00	2.34	65.23	331.25
+D+0.750S	Length = 8.0 ft	1	0.600	0.266	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	12.99	1,655.17	2760.00	0.00	0.00	0.00	2.90	80.94	304.75
+0.60D	Length = 8.0 ft	1	0.108	0.048	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.26	415.10	3840.00	0.00	0.00	0.00	0.73	20.30	424.00



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Beam 3

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+S	1	0.4807	8.000		0.0000	0.000

Vertical Reactions

Load Combination	Support notation : Far left is #'		Values in KIPS
	Support 1	Support 2	
Overall MAXimum	3.877		
Overall MINimum	2.520		
D Only	1.357		
+D+Lr	3.037		
+D+S	3.877		
+D+0.750Lr	2.617		
+D+0.750S	3.247		
+0.60D	0.814		
Lr Only	1.680		
S Only	2.520		



Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

DESCRIPTIO Beam 4

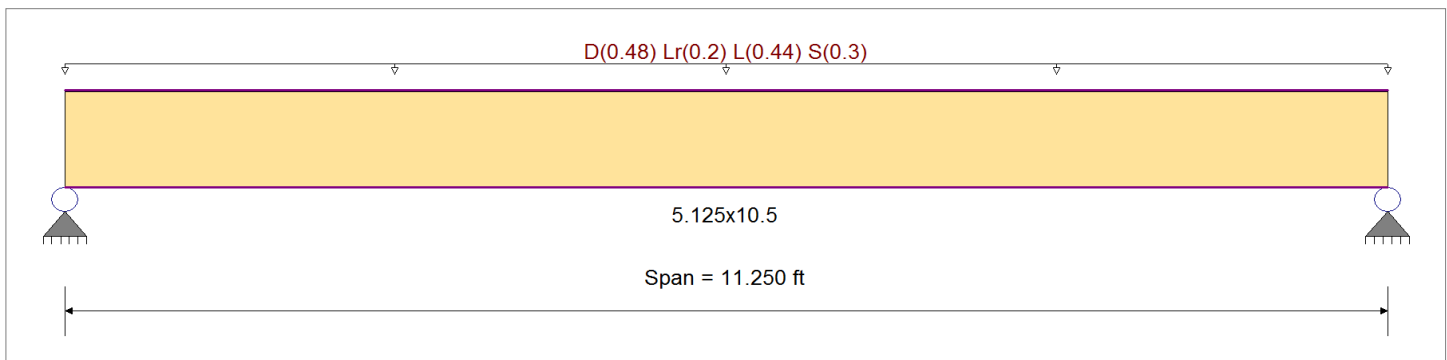
CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	2400 psi	E : Modulus of Elasti	
Load Combination	ASCE 7-10	Fb -	1850 psi	Ebend- xx	1800ksi
Wood Species	DF/DF	Fc - Prll	1650 psi	Eminbend - x	950ksi
Wood Grade	24F-V4	Fc - Perp	650 psi	Ebend- yy	1600ksi
		Fv	265 psi	Eminbend - y	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.

Uniform Load : D = 0.480, Lr = 0.20, L = 0.440, S = 0.30, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.773 1	Maximum Shear Stress Ratio =	0.461 : 1
Section used for this span	5.125x10.5	Section used for this span	5.125x10.5
fb: Actual =	1,854.65psi	fv: Actual =	122.14 psi
Fb: Allowable =	2,400.00psi	Fv: Allowable =	265.00 psi
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span =	5.625ft	Location of maximum on span =	10.388 ft
Span # where maximum occurs =	Span # 1	Span # where maximum occurs =	Span # 1
Maximum Deflection			
Max Downward Transient Deflection	0.179 in Ratio =	753	>=360
Max Upward Transient Deflection	0.000 in Ratio =	0	<360
Max Downward Total Deflection	0.422 in Ratio =	320	>=240
Max Upward Total Deflection	0.000 in Ratio =	0	<240

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values					
			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	Length = 11.250 ft	1	0.448	0.267	0.90	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.59	967.65	2160.00	0.00	0.00	0.00	0.00
+D+L	Length = 11.250 ft	1	0.773	0.461	1.00	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	14.55	1,854.65	2400.00	0.00	0.00	0.00	0.00
+D+Lr	Length = 11.250 ft	1	0.457	0.273	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	10.76	1,370.83	3000.00	0.00	0.00	0.00	0.00
+D+S	Length = 11.250 ft	1	0.570	0.340	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	12.34	1,572.42	2760.00	0.00	0.00	0.00	0.00
+D+0.750Lr+0.750L	Length = 11.250 ft	1	0.645	0.385	1.25	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	15.19	1,935.29	3000.00	0.00	0.00	0.00	0.00
+D+0.750L+0.750S	Length = 11.250 ft	1	0.756	0.451	1.15	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	16.37	2,086.49	2760.00	0.00	0.00	0.00	0.00
+0.60D	Length = 11.250 ft	1	0.151	0.090	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	4.56	580.59	3840.00	0.00	0.00	0.00	0.00



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Beam 4

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.4216	5.666		0.0000	0.000

Vertical Reactions

Support notation : Far left is #'

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	5.822	5.822
Overall MINimum	1.688	1.688
D Only	2.700	2.700
+D+L	5.175	5.175
+D+Lr	3.825	3.825
+D+S	4.388	4.388
+D+0.750Lr+0.750L	5.400	5.400
+D+0.750L+0.750S	5.822	5.822
+0.60D	1.620	1.620
Lr Only	1.125	1.125
L Only	2.475	2.475
S Only	1.688	1.688



Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

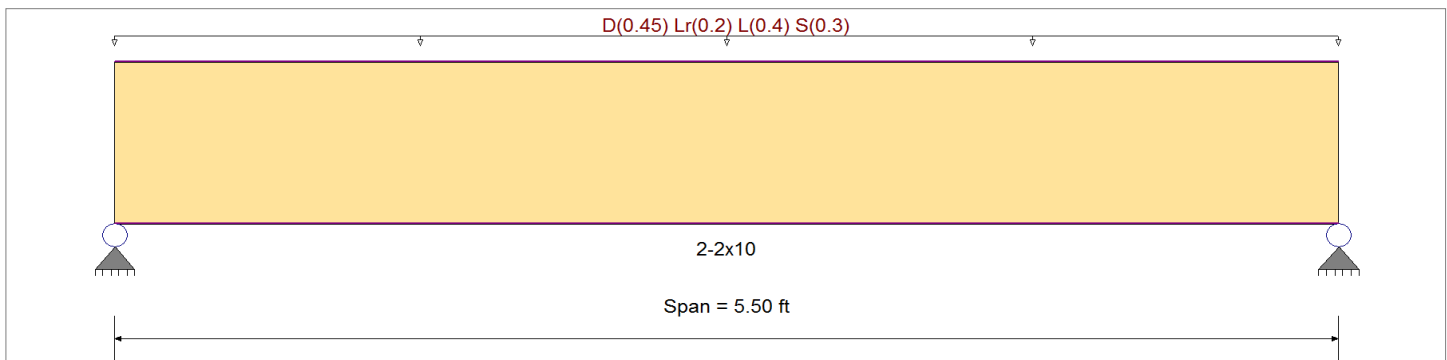
DESCRIPTIO Beam 5

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	900.0 psi	E : Modulus of Elasti	
Load Combination	ASCE 7-10	Fb -	900.0 psi	Ebend- xx	1,600.0ksi
Wood Species	Douglas Fir-Larch	Fc - Prll	1,350.0 psi	Eminbend - x	580.0ksi
Wood Grade	No.2	Fc - Perp	625.0 psi		
		Fv	180.0 psi		
		Ft	575.0 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 calculated and added to loads

Uniform Load : D = 0.450, Lr = 0.20, L = 0.40, S = 0.30, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.917 : 1	Maximum Shear Stress Ratio	=	0.511 : 1
Section used for this span		2-2x10	Section used for this span		2-2x10
fb: Actual	=	907.91 psi	fv: Actual	=	91.95 psi
Fb: Allowable	=	990.00 psi	Fv: Allowable	=	180.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	2.750ft	Location of maximum on span	=	4.737 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection		0.026 in	Ratio =		2522 >=360
Max Upward Transient Deflection		0.000 in	Ratio =		0 <360
Max Downward Total Deflection		0.064 in	Ratio =		1028 >=240
Max Upward Total Deflection		0.000 in	Ratio =		0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values								
			M	V	Cd	CF/V	Ci	Cr	Cm	Ct	CL	M	fb	F'b	V	fv	F'v						
D Only	Length = 5.50 ft	1	0.543	0.302	0.90	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.72	483.66	891.00	0.00	0.00	0.00	0.00	0.00	162.00	
+D+L	Length = 5.50 ft	1	0.917	0.511	1.00	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.24	907.91	990.00	0.00	0.00	0.00	0.00	0.00	0.00	180.00
+D+Lr	Length = 5.50 ft	1	0.562	0.313	1.25	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.48	695.79	1237.50	0.00	0.00	0.00	0.00	0.00	0.00	225.00
+D+S	Length = 5.50 ft	1	0.704	0.392	1.15	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.86	801.85	1138.50	0.00	0.00	0.00	0.00	0.00	0.00	207.00
+D+0.750Lr+0.750L	Length = 5.50 ft	1	0.777	0.433	1.25	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.43	960.94	1237.50	0.00	0.00	0.00	0.00	0.00	0.00	225.00
+D+0.750L+0.750S	Length = 5.50 ft	1	0.914	0.509	1.15	1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.71	1,040.49	1138.50	0.00	0.00	0.00	0.00	0.00	0.00	207.00
+0.60D						1.100	1.00	1.00	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Beam 5

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values		
			M	V	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	fb	F'b	V	fv	Fv
	Length = 5.50 ft	1	0.183	0.102	1.60	1.100	1.00	1.00	1.00	1.00	1.00	1.03	290.20	1584.00	0.54	29.39	288.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.750S	1	0.0642	2.770		0.0000	0.000

Vertical Reactions

Load Combination	Support notation : Far left is #'		Values in KIPS	
	Support 1	Support 2		
Overall MAXimum	2.698	2.698		
Overall MINimum	0.825	0.825		
D Only	1.254	1.254		
+D+L	2.354	2.354		
+D+Lr	1.804	1.804		
+D+S	2.079	2.079		
+D+0.750Lr+0.750L	2.492	2.492		
+D+0.750L+0.750S	2.698	2.698		
+0.60D	0.752	0.752		
Lr Only	0.550	0.550		
L Only	1.100	1.100		
S Only	0.825	0.825		



Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

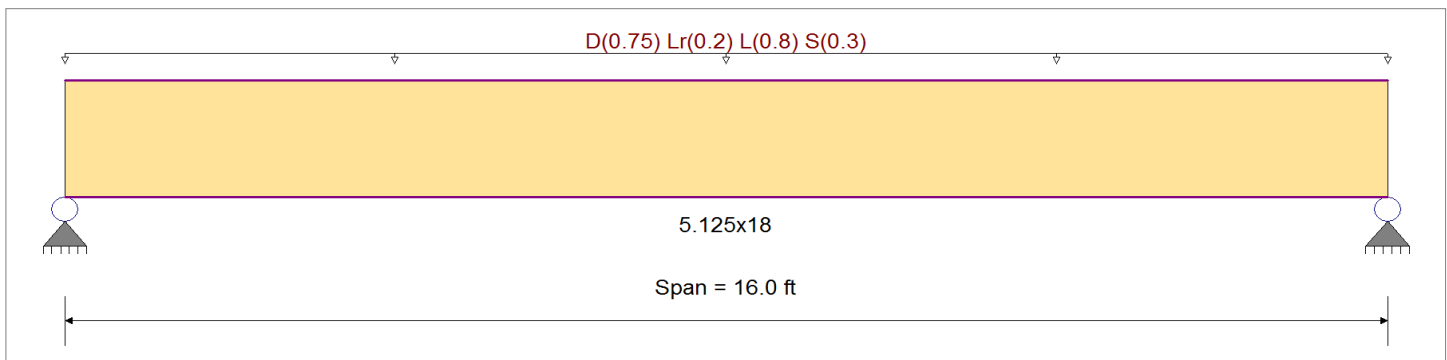
DESCRIPTIO Beam 6

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	2,400.0 psi	E : Modulus of Elasti	
Load Combination	ASCE 7-10	Fb -	1,850.0 psi	Ebend- xx	1,800.0ksi
Wood Species	DF/DF	Fc - Prll	1,650.0 psi	Eminbend - x	950.0ksi
Wood Grade	24F-V4	Fc - Perp	650.0 psi	Ebend- yy	1,600.0ksi
		Fv	265.0 psi	Eminbend - y	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 calculated and added to loads

Uniform Load : D = 0.750, Lr = 0.20, L = 0.80, S = 0.30, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.920	< 1	Maximum Shear Stress Ratio	=	0.630	: 1
Section used for this span		5.125x18		Section used for this span		5.125x18	
fb: Actual	=	2,178.42	psi	fv: Actual	=	166.96	psi
Fb: Allowable	=	2,368.17	psi	Fv: Allowable	=	265.00	psi
Load Combination		+D+L		Load Combination		+D+L	
Location of maximum on span	=	8.000	ft	Location of maximum on span	=	14.540	ft
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.265	in	Ratio =		725	>=360
Max Upward Transient Deflection		0.000	in	Ratio =		0	<360
Max Downward Total Deflection		0.528	in	Ratio =		363	>=240
Max Upward Total Deflection		0.000	in	Ratio =		0	<240

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios										Moment Values			Shear Values							
			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	Length = 16.0 ft	1	0.501	0.343	0.90	0.987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	24.64	1,068.39	2131.35	0.00	0.00	0.00	5.04	81.88	238.50
+D+L	Length = 16.0 ft	1	0.920	0.630	1.00	0.987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	50.24	2,178.42	2368.17	0.00	0.00	0.00	10.27	166.96	265.00
+D+Lr	Length = 16.0 ft	1	0.455	0.311	1.25	0.987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	31.04	1,345.90	2960.21	0.00	0.00	0.00	6.34	103.15	331.25
+D+S	Length = 16.0 ft	1	0.545	0.373	1.15	0.987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	34.24	1,484.65	2723.39	0.00	0.00	0.00	7.00	113.79	304.75
+D+0.750Lr+0.750L	Length = 16.0 ft	1	0.712	0.488	1.25	0.987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	48.64	2,109.04	2960.21	0.00	0.00	0.00	9.94	161.64	331.25
+D+0.750L+0.750S	Length = 16.0 ft	1	0.813	0.557	1.15	0.987	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	51.04	2,213.11	2723.39	0.00	0.00	0.00	10.43	169.62	304.75
+0.60D						0.987	1.00	1.00	1.00	1.00	1.00	1.00	1.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Beam 6

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values		
			M	V	C _d	C _{F/V}	C _i	C _r	C _m	C _t	C _L	M	fb	F'b	V	fv	Fv
	Length = 16.0 ft	1	0.169	0.116	1.60	0.987	1.00	1.00	1.00	1.00	1.00	14.78	641.04	3789.06	3.02	49.13	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	0.5277	8.058		0.0000	0.000

Vertical Reactions

Load Combination	Support notation : Far left is #'		Values in KIPS	
	Support 1	Support 2		
Overall MAXimum	12.760	12.760		
Overall MINimum	2.400	2.400		
D Only	6.160	6.160		
+D+L	12.560	12.560		
+D+Lr	7.760	7.760		
+D+S	8.560	8.560		
+D+0.750Lr+0.750L	12.160	12.160		
+D+0.750L+0.750S	12.760	12.760		
+0.60D	3.696	3.696		
Lr Only	1.600	1.600		
L Only	6.400	6.400		
S Only	2.400	2.400		



Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. #: KW-06011847

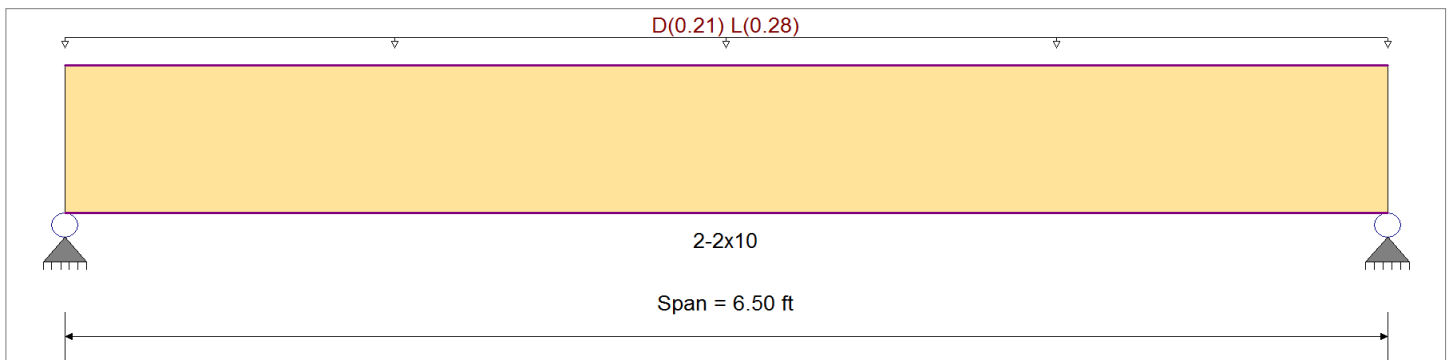
DESCRIPTION Beam 7

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	900 psi	E : Modulus of Elasticity	
Load Combination	ASCE 7-10	Fb -	900 psi	Ebend- xx	1600ksi
		Fc - Prll	1350 psi	Eminbend - x	580ksi
Wood Species	Douglas Fir-Larch	Fc - Perp	625 psi		
Wood Grade	No.2	Fv	180 psi		
		Ft	575 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 calculated and added to loads
 Uniform Load : D = 0.210, L = 0.280, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.742	1	Maximum Shear Stress Ratio	=	0.371	: 1
Section used for this span		2-2x10		Section used for this span		2-2x10	
fb: Actual	=	734.78	psi	fv: Actual	=	66.78	psi
Fb: Allowable	=	990.00	psi	Fv: Allowable	=	180.00	psi
Load Combination		+D+L		Load Combination		+D+L	
Location of maximum on span	=	3.250	ft	Location of maximum on span	=	5.741	ft
Span # where maximum occurs	=	Span # 1		Span # where maximum occurs	=	Span # 1	
Maximum Deflection							
Max Downward Transient Deflection		0.036	in	Ratio =	2183	>=360	
Max Upward Transient Deflection		0.000	in	Ratio =	0	<360	
Max Downward Total Deflection		0.063	in	Ratio =	1232	>=240	
Max Upward Total Deflection		0.000	in	Ratio =	0	<240	

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values					
			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	Length = 6.50 ft	1	0.359	0.180	0.90	1.100	1.00	1.00	1.00	1.00	1.00	1.14	320.00	891.00	0.00	0.00	0.00	0.00	0.00	162.00
+D+L	Length = 6.50 ft	1	0.742	0.371	1.00	1.100	1.00	1.00	1.00	1.00	1.00	2.62	734.78	990.00	0.00	0.00	0.00	0.00	0.00	180.00
+D+0.750L	Length = 6.50 ft	1	0.510	0.255	1.25	1.100	1.00	1.00	1.00	1.00	1.00	2.25	631.09	1237.50	0.00	0.00	0.00	0.00	0.00	225.00
+0.60D	Length = 6.50 ft	1	0.121	0.061	1.60	1.100	1.00	1.00	1.00	1.00	1.00	0.68	192.00	1584.00	0.00	0.00	0.00	0.00	0.00	288.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0633	3.274		0.0000	0.000



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. # : KW-06011847

Merrell Design Services PLLC

DESCRIPTIO Beam 7

Vertical Reactions

Support notation : Far left is #'

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.612	1.612
Overall MINimum	0.910	0.910
D Only	0.702	0.702
+D+L	1.612	1.612
+D+0.750L	1.385	1.385
+0.60D	0.421	0.421
L Only	0.910	0.910



Wood Beam

Lic. #: KW-06011847

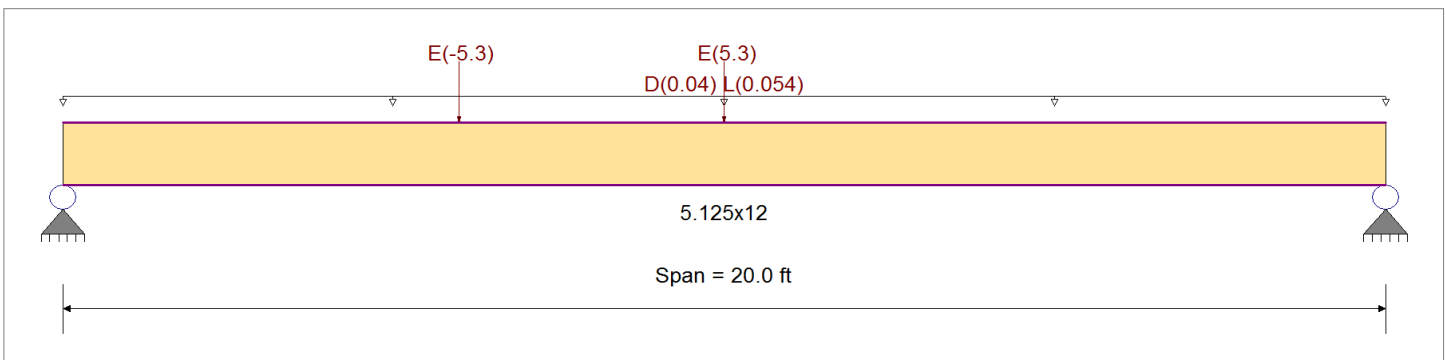
DESCRIPTION Grid C second flr shear tfer beam

CODE REFERENCES

Calculations per NDS 2015, IBC 2015, CBC 2016, ASCE 7-10
 Load Combination Set : ASCE 7-10

Material Properties

Analysis Method	Allowable Stress Design	Fb +	2,400.0 psi	E : Modulus of Elasti	
Load Combination	ASCE 7-10	Fb -	2,400.0 psi	Ebend- xx	1,800.0ksi
Wood Species	DF/DF	Fc - Prll	1,650.0 psi	Eminbend - x	950.0ksi
Wood Grade	24F-V8	Fc - Perp	650.0 psi	Ebend- yy	1,600.0ksi
		Fv	265.0 psi	Eminbend - y	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 calculated and added to loads
 Uniform Load : D = 0.040, L = 0.0540, Tributary Width = 1.0 ft
 Point Load : E = 5.30 k @ 10.0 ft
 Point Load : E = -5.30 k @ 6.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	0.261 : 1	Maximum Shear Stress Ratio	=	0.183 : 1
Section used for this span		5.125x12	Section used for this span		5.125x12
fb: Actual	=	1,000.63psi	fv: Actual	=	77.52 psi
Fb: Allowable	=	3,840.00psi	Fv: Allowable	=	424.00 psi
Load Combination		+D+0.750L+0.5250E	Load Combination		+D+0.70E
Location of maximum on span	=	10.000ft	Location of maximum on span	=	6.058 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1
Maximum Deflection					
Max Downward Transient Deflection		0.258 in	Ratio =		930 >=360
Max Upward Transient Deflection		0.000 in	Ratio =		0 <360
Max Downward Total Deflection		0.387 in	Ratio =		620 >=240
Max Upward Total Deflection		0.000 in	Ratio =		0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios								Moment Values			Shear Values						
			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	Length = 20.0 ft	1	0.120	0.049	0.90	1.000	1.00	1.00	1.00	1.00	1.00	2.67	260.14	2160.00	0.00	0.00	0.00	0.48	11.77	238.50
+D+L	Length = 20.0 ft	1	0.218	0.089	1.00	1.000	1.00	1.00	1.00	1.00	1.00	5.37	523.56	2400.00	0.00	0.00	0.00	0.97	23.69	265.00
+D+0.750L	Length = 20.0 ft	1	0.153	0.063	1.25	1.000	1.00	1.00	1.00	1.00	1.00	4.69	457.70	3000.00	0.00	0.00	0.00	0.85	20.71	331.25
+D+0.70E	Length = 20.0 ft	1	0.256	0.183	1.60	1.000	1.00	1.00	1.00	1.00	1.00	10.09	984.05	3840.00	0.00	0.00	0.00	3.18	77.52	424.00
+D+0.750L+0.5250E	Length = 20.0 ft	1	0.261	0.149	1.60	1.000	1.00	1.00	1.00	1.00	1.00	10.26	1,000.63	3840.00	0.00	0.00	0.00	2.60	63.31	424.00
+0.60D						1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00	0.00	0.00	0.00



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

Printed: 9 AUG 2021, 12:29AM

Wood Beam

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24

Lic. #: KW-06011847

Merrell Design Services PLLC

DESCRIPTION Grid C second flr shear tfer beam

Load Combination	Segment Length	Span #	Max Stress Ratios									Moment Values			Shear Values		
			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 = 20.0 ft	1	0.041	0.017	1.60	1.000	1.00	1.00	1.00	1.00	1.00	1.60	156.09	3840.00	0.29	7.06	424.00	
+0.60D+0.70E					1.000	1.00	1.00	1.00	1.00	1.00			0.00	0.00	0.00	0.00	
Length = 20.0 ft	1	0.229	0.178	1.60	1.000	1.00	1.00	1.00	1.00	1.00	9.02	879.99	3840.00	3.09	75.47	424.00	

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+0.750L+0.5250E	1	0.3865	10.949		0.0000	0.000

Vertical Reactions

Support notation : Far left is #'

Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	1.073	1.495
Overall MINimum	0.540	1.060
D Only	0.533	0.533
+D+L	1.073	1.073
+D+0.750L	0.938	0.938
+D+0.70E	-0.209	1.275
+D+0.750L+0.5250E	0.382	1.495
+0.60D	0.320	0.320
+0.60D+0.70E	-0.422	1.062
L Only	0.540	0.540
E Only	-1.060	1.060

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).

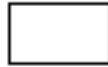
Please note – The K_{zt} values indicated on this map are approximations based upon periodic calculations of representative samplings around Mercer Island. These values are intended for City of Mercer Island’s plan review purposes only.

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

Printed: 9 AUG 2021, 12:36AM

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

Software copyright ENERCALC, INC. 1983-2020, Build:12.20.8.24
 Merrell Design Services PLLC

Lic. # : KW-06011847

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 Figur 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 pe*

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

Project File: mercer.ec6

LIC#: KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Seismic Base Shear Analysis

Specific Description:

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 *ASCE 7-16, Page 4, Table 1.5-1*

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

Gridded S_s & S₁ values from ASCE 7-16

ASCE 7-16 11.4.2

Max. Ground Motions, 5% Damping

$$S_S = 1.424 \text{ g, 0.2 sec response}$$

$$S_1 = 0.4949 \text{ g, 1.0 sec response}$$

Location: Mercer Island, WA 98040

Latitude = 47.569 deg North

Longitude = 122.232 deg West

For the closest datapoint grid location . . .

Latitude = 47.570 deg North

Longitude = 122.230 deg West

Site Class, Site Coeff. and Design Category

Classification: "E": Shear Wave Velocity must be less than 600 ft/sec = **E** *ASCE 7-16 Table 20.3-1*

Site Coefficients Fa & Fv $F_a = 1.20$ *ASCE 7-16 Table 11.4-1 & 11.4-2*
(using straight-line interpolation from table val) $F_v = 2.21$

Maximum Considered Earthquake Accelerat $S_{MS} = F_a * S_s = 1.709$ *ASCE 7-16 Eq. 11.4-1*
 $S_{M1} = F_v * S_1 = 1.094$ *ASCE 7-16 Eq. 11.4-2*

Design Spectral Acceleration $S_{DS} = S_{MS}^{2/3} = 1.139$ *ASCE 7-16 Eq. 11.4-3*
 $S_{D1} = S_{M1}^{2/3} = 0.729$ *ASCE 7-16 Eq. 11.4-4*

Seismic Design Category = **D** *ASCE 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 "R" = 6.50

System Overstrength Factor "Wo" = 3.00

Deflection Amplification Factor "Cd" = 4.00

Building height Limits :

Category "A & B" Limit: No Limit

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 CalculaAll Other Structural Systems

"Ct" value = 0.020 "hn": Height from base to highest level 30.0 ft

"x" value = 0.75

"Ta" Approximate fundamental period using Eq. 12.8-7 : $T_a = C_t * (h_n^x) = 0.256 \text{ sec}$

"TL": Long-period transition period per ASCE 7-16 Maps 22-14 -> 22-17 6.000 sec

Building Period "Ta" Calculated from Approximate Method sele= 0.256

"Cs" Response Coefficient

ASCE 7-16 Section 12.8.1.1

S_{DS} : Short Period Design Spectral Response = 1.139 From Eq. 12.8-2, Preliminary Cs = 0.175

"R": Response Modification Factor = 6.50 From Eq. 12.8-3 & 12.8-4, Cs need not excee = 0.438

"I": Seismic Importance Factor = 1 From Eq. 12.8-5 & 12.8-6, Cs not be less than = 0.050

Cs : Seismic Response Coefficient = 0.1753





ASCE 7-16 Seismic Base Shear

Project File: mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Seismic Base Shear Analysis

Seismic Base Shear

ASCE 7-16 Section 12.8.1

$C_s = 0.1753$ from 12.8.1.1

W (see Sum W_i below) = 161.50 k

Seismic Base Shear $V = C_s * W = 28.30$ 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
3	31.30	30.00	939.00	0.3124	8.84	8.84	0.00
2	69.50	21.00	1,459.50	0.4856	13.75	22.59	79.59
1	60.70	10.00	607.00	0.2020	5.72	28.30	328.06
Sum $W_i =$	161.50 k	Sum $W_i * H_i =$	3,005.50 k-ft		Total Base Shear =	28.30 k	Base Moment = 611.1 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
3	31.30	8.84	8.84	31.30	8.84	7.13	14.26	8.84	8.84
2	69.50	13.75	22.59	100.80	15.57	15.83	31.67	15.83	15.83
1	60.70	5.72	28.30	161.50	10.64	13.83	27.66	13.83	13.83

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 .. $W_{px} * \text{SUM}(x->n) F_i / \text{SUM}(x->n) w_i$, x = Current level, n = Top Level



Restrained Retaining Wall

Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Mercer Basement Walls_Reve

Code Reference

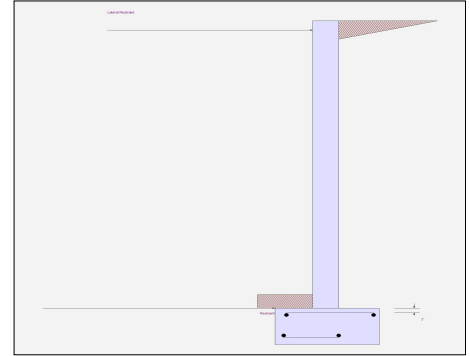
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	10.50 ft
Wall height above soil	=	_____ ft
Total Wall Height	=	10.50 ft
Top Support Height	=	10 ft
Slope Behind Wall	=	0
Height of Soil over Toe	=	6 in

Soil Data

Allow Soil Bearing	=	2000 psf
Equivalent Fluid Pressure Method		
At-Rest Heel Pressure	=	40.0 psf/ft
	=	0.0 psf/ft
Passive Pressure	=	300.0 psf/ft
Soil Density	=	110.0 pcf
Footing Soil Frictior	=	0.4 psf
Soil height to ignore for passive pressure	=	12 in



Surcharge Loads

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

Axial Load Applied to Stem

Axial Dead Load	=	750.0 lbs
Axial Live Load	=	800.0 lbs
Axial Load Eccentricity	=	in

Earth Pressure Seismic Load

Uniform Lateral Load Applied to Stem

Lateral Load	=	100.0 #/ft
...Height to Top	=	10.0 ft
...Height to Bottom	=	ft
Load Type	=	Earth (H) (Service Level)
Wind on Exposed Stem	=	0.00 psf (Strength Level)
Wind acts left-to-right toward retention side.		

Adjacent Footing Load

Adjacent Footing Load	=	lbs
Footing Width	=	ft
Eccentricity	=	in
Wall to Ftg CL Dist	=	ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	ft
Poisson's Ratio	=	0.3

K_h Soil Density Multiplier = 0.0710 g Added seismic per unit area = 64.693 psf

Design Summary

Total Bearing Load	=	4,611.67 lbs
...resultant ecc.	=	0.0 in
Soil Pressure @ Toe	=	1,537.22 psf OK
Soil Pressure @ Heel	=	1,537.22 psf OK
Allowable	=	psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,951.33 psf
ACI Factored @ Heel	=	1,951.33 psf
Footing Shear @ Toe	=	1.371 psi OK
Footing Shear @ Heel	=	2.343 psi OK
Allowable	=	88.741 psi
Reaction at Top	=	1,126.84 lbs
Reaction at Bottom	=	3,348.55 lbs

Sliding Calcs

Lateral Sliding Force	=	3,348.55 lbs
-----------------------	---	--------------

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

Load Factors

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

Concrete Stem Construction

Thickness	=	8.00 in
Wall Weight	=	100.0 psf
Stem is FIXED to top of footing		

	@ Top Support	Mmax Between Top & Base	@ Base of Wall
Design Height Above Ftg	Stem OK = 10 ft	Stem OK = 0.04016 ft	Stem OK = 0.00 ft
Rebar Size	# 6	# 6	# 6
Rebar Spacing	10.00 in	10.00 in	10.00 in
Rebar Placed at	Center	Center	Center
Rebar Depth 'd'	4.0 in	4.0 in	4.0 in
Design Data			
fb/FB + fa/Fa	= 0.002	0.866	0.866
Moment.....Actual	= 12.886 ft-#	7,315.55 ft-#	7,315.55 ft-#
Moment.....Allowable	= 8,446.61 ft-#	8,446.61 ft-#	8,446.61 ft-#
Shear Force @ this height	= 1,563.31 lbs		4,085.69 lbs
Shear.....Actual	= 32.569 psi		85.119 psi
Shear.....Allowable	= 88.741 psi		88.741 psi



Restrained Retaining Wall

Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Mercer Basement Walls_Reve

Footing Strengths & Dimensions

Toe Width	=	.16666666 ft
Heel Width	=	.83333333
Total Footing Width	=	3.0
Footing Thickness	=	16.0 in
Key Width	=	in
Key Depth	=	in
Key Distance from Toe	=	ft
f'c =	3,500.0 psi	Fy = 60000 psi
Footing Concrete Density	=	150 pcf
Min. As %	=	0.0018
Cover @ Top	= 2 in	@ Btm.= 3 in

Footing Design Results

	Toe	Heel
Factored Pressure	= 1,951.33	1,951.33 psf
Mu' : Upward	= 1,327.99	ft-#
Mu' : Downward	= 208.250	ft-#
Mu: Design	= 1,120	-221 ft-#
Actual 1-Way Shear	= 1.371	psi
Allow 1-Way Shear	= 88.741	88.741 psi

Other Acceptable Sizes & Spacings:

Toe: # 6 @ 18.00 in	-or-	#4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.8
Heel: # 6 @ 18.00 in	-or-	#4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.8
Key: # 0 @ 0.00 in	-or-	No key defined
Min footing T&S reinf Area		1.04 in2
Min footing T&S reinf Area per foot		0.35 in2 /ft
If one layer of horizontal bars:		If two layers of horizontal bars:
#4@ 6.94 in		#4@ 13.89 in
#5@ 10.76 in		#5@ 21.53 in
#6@ 15.28 in		#6@ 30.56 in

Summary of Forces on Footing : Slab RESISTS sliding, stem is FIXED at footing

Forces acting on footing for soil pressure

>>> Sliding Forces are restrained by the adjacent slab

Load & Moment Summary For Footing : For Soil Pressure Calcs

Moment @ Top of Footing Applied from Stem	=	-4,970.93 ft-#
Surcharge Over Heel	= 0.0 lbs	0.0 ft
Adjacent Footing Load	= 0.0 lbs	0.0 ft
Axial Dead Load on Stem	= 1,550.0 lbs	1.50 ft
Soil Over Toe	= 64.167 lbs	0.5833 ft
Surcharge Over Toe	= 0.0 lbs	0.0 ft
Stem Weight	= 1,050.0 lbs	1.50 ft
Soil Over Heel	= 1,347.50 lbs	2.417 ft
Footing Weight	= 600.0 lbs	1.50 ft
Total Vertical Force	= 4,611.67 lbs	Base Moment = 3,122.96 ft-#

Stem is specified to be fixed to footing, and top restraint is assumed to react out any tendency for moment at the footing/soil interface, so uniform soil pressure is assumed.

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





Merrell Design Services
Practical Structural Solutions

Project Title:
Engineer:
Project ID:
Project Descr:

Restrained Retaining Wall

Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: [Mercer Basement Walls_Reve](#)

Rebar Lap & Embedment Lengths Information





Restrained Retaining Wall

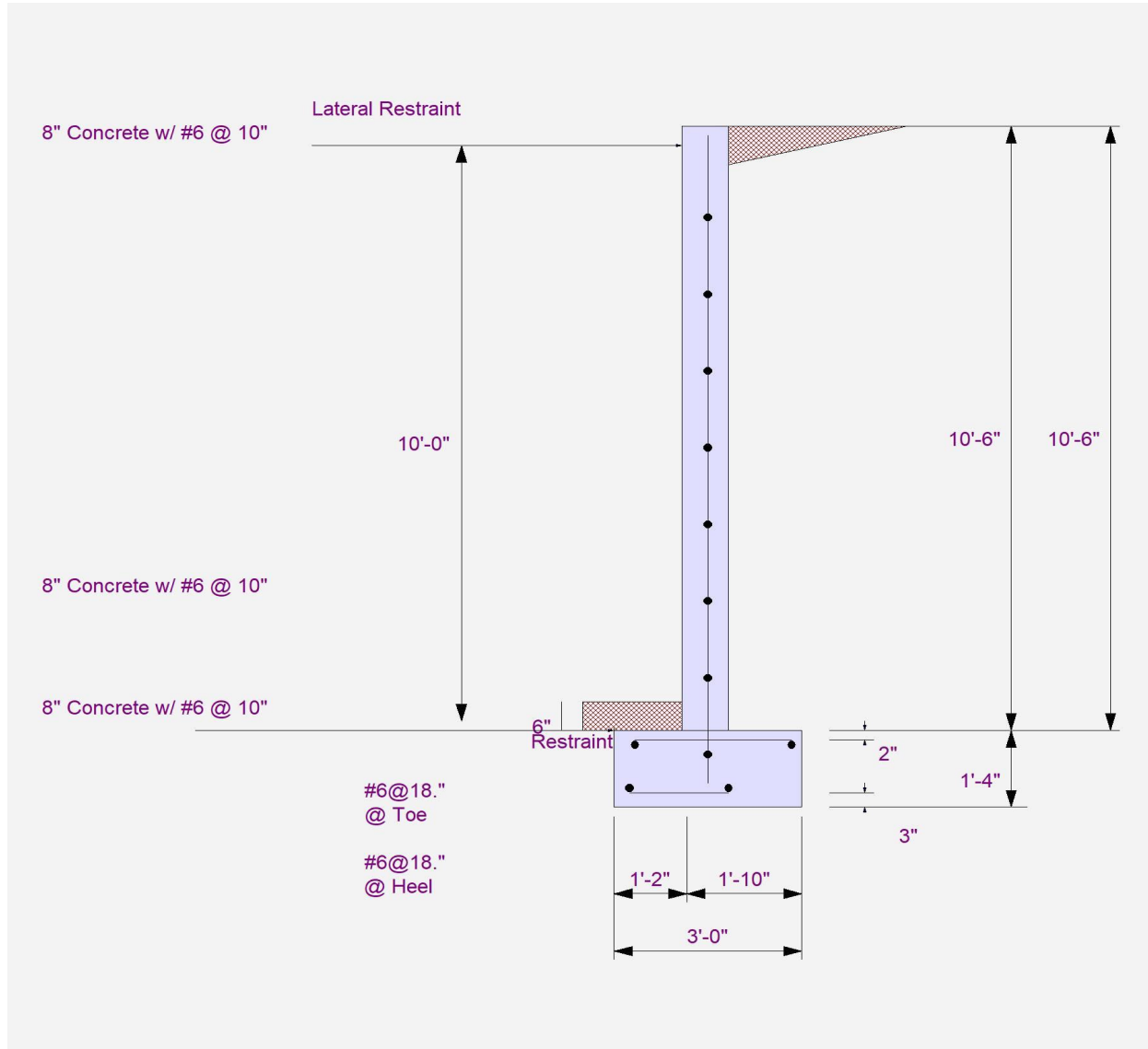
Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Mercer Basement Walls_Reve



Cantilevered Retaining Wall

Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Site Retaining Wall Rev1 - City Comments

Code Reference

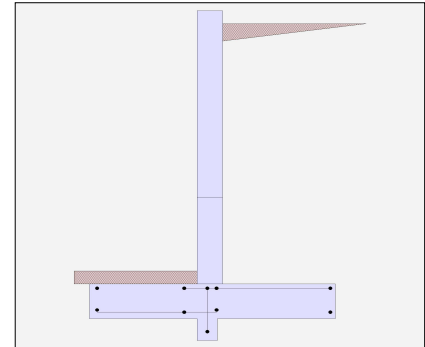
Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16

Criteria

Retained Height	=	10.00 ft
Wall height above soil	=	0.50 ft
Slope Behind Wall	=	0.00
Height of Soil over Toe	=	6.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,000.0 psf
Equivalent Fluid Pressure Method		
Active Heel Pressure	=	40.0 psf/ft
	=	
Passive Pressure	=	300.0 psf/ft
Soil Density, Heel	=	110.00 pcf
Soil Density, Toe	=	110.00 pcf
Footing Soil Friction	=	0.350
Soil height to ignore for passive pressure	=	12.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	40.0 psf
Used for Sliding & Overturning		

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	=	8.000
(Multiplier used on soil density)		

Stem Weight Seismic Load

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	=	0.0 psf (Strength Level)

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	=	Spread Footing
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Uniform Seismic Force	=	90.667
Total Seismic Force	=	1,027.556

F_p / W_p Weight Multiplier	=	0.200 g	Added seismic base force	183.8 lbs
-------------------------------	---	---------	--------------------------	-----------



Cantilevered Retaining Wall

Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Site Retaining Wall Rev1 - City Comments

Design Summary

Wall Stability Ratios

Overturning	=	2.49	OK
Sliding	=	1.10	Ratio < 1.5!
Global Stability	=	1.67	
Total Bearing Load = 7,362 lbs			
...resultant ecc. = 11.61 in			
Eccentricity within middle third			
Soil Pressure @ Toe	=	1,588	psf OK
Soil Pressure @ Heel	=	252	psf OK
Allowable	=	2,000	psf
Soil Pressure Less Than Allowable			
ACI Factored @ Toe	=	2,223	psf
ACI Factored @ Heel	=	353	psf
Footing Shear @ Toe	=	25.3	psi OK
Footing Shear @ Heel	=	17.6	psi OK
Allowable	=	82.2	psi

Sliding Calcs

Lateral Sliding Force	=	3,471.9	lbs
less 100% Passive Force	=	1,227.4	lbs
less 100% Friction Force	=	2,576.6	lbs
Added Force Req'd	=	0.0	lbs OK
...for 1.5 Stability	=	1,403.9	lbs NG

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

Load Factors

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

Stem Construction

Design Height Above Ftg

ft =

Wall Material Above "Ht" =

Design Method =

Thickness =

Rebar Size =

Rebar Spacing =

Rebar Placed at =

Design Data

fb/FB + fa/Fa =

Total Force @ Section

Service Level lbs =

Strength Level lbs =

Moment....Actual

Service Level ft-# =

Strength Level ft-# =

Moment.....Allowable ft-# =

Shear.....Actual

Service Level psi =

Strength Level psi =

Shear.....Allowable psi =

Anet (Masonry) in2 =

Wall Weight psf =

Rebar Depth 'd' in =

Masonry Data

f'm psi =

Fs psi =

Solid Grouting =

Modular Ratio 'n' =

Equiv. Solid Thick. =

Masonry Block Type =

Masonry Design Method = ASD

Concrete Data

f'c psi =

Fy psi =

2nd

Stem OK

ft = 3.33

Concrete

SD

10.00

6

12.00

Edge

0.405

0.971

lbs =

2,206.0

ft-# =

5,818.1

ft-# =

14,363.2

psi =

24.1

psi =

88.7

in2 =

125.0

in =

7.63

Bottom

Stem OK

ft = 0.00

Concrete

SD

10.00

6

10.00

Edge

0.971

4,369.2

ft-# =

16,578.1

ft-# =

17,059.6

psi =

47.8

psi =

88.7

psi =

88.7

psi =

125.0

psi =

7.63

Sliding factor of safety = 1.5 is accomplished through provided values in the geotechnical report.



Cantilevered Retaining Wall

Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Site Retaining Wall Rev1 - City Comments

Concrete Stem Rebar Area Details

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>
2nd Stem		
As (based on applied moment) :	0.177 in ² /ft	
(4/3) * As :	0.2359 in ² /ft	Min Stem T&S Reinf Area 1.720 in ²
200bd/fy : 200(12)(7.625)/60000 :	0.305 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in ² /ft
0.0018bh : 0.0018(12)(10) :	0.216 in ² /ft	Horizontal Reinforcing Options :
	=====	<u>One layer of :</u> <u>Two layers of :</u>
Required Area :	0.2359 in ² /ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.44 in ² /ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.4461 in ² /ft	#6@ 22.00 in #6@ 44.00 in

	<u>Vertical Reinforcing</u>	<u>Horizontal Reinforcing</u>
Bottom Stem		
As (based on applied moment) :	0.5042 in ² /ft	
(4/3) * As :	0.6723 in ² /ft	Min Stem T&S Reinf Area 0.800 in ²
200bd/fy : 200(12)(7.625)/60000 :	0.305 in ² /ft	Min Stem T&S Reinf Area per ft of stem Height : 0.240 in ² /ft
0.0018bh : 0.0018(12)(10) :	0.216 in ² /ft	Horizontal Reinforcing Options :
	=====	<u>One layer of :</u> <u>Two layers of :</u>
Required Area :	0.5042 in ² /ft	#4@ 10.00 in #4@ 20.00 in
Provided Area :	0.528 in ² /ft	#5@ 15.50 in #5@ 31.00 in
Maximum Area :	1.4461 in ² /ft	#6@ 22.00 in #6@ 44.00 in

Footing Data

Toe Width	=	3.50 ft
Heel Width	=	4.50
Total Footing Width	=	8.00
Footing Thickness	=	16.00 in
Key Width	=	8.00 in
Key Depth	=	10.00 in
Key Distance from Toe	=	3.50 ft
f'c =	3,000 psi	Fy = 60,000 psi
Footing Concrete Density	=	150.00 pcf
Min. As %	=	0.0018
Cover @ Top	2.00	@ Btm.= 3.00 in

Footing Design Results

	<u>Toe</u>	<u>Heel</u>	
Factored Pressure	=	2,223	353 psf
Mu' : Upward	=	11,947	4,296 ft-#
Mu' : Downward	=	2,266	10,487 ft-#
Mu: Design	=	9,681 OK	6,191 ft-# OK
phiMn	=	24,143	50,539 ft-#
Actual 1-Way Shear	=	25.30	17.61 psi
Allow 1-Way Shear	=	82.16	82.16 psi
Toe Reinforcing	=	# 6 @ 12.00 in	
Heel Reinforcing	=	# 6 @ 6.00 in	
Key Reinforcing	=	# 4 @ 12.00 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: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.83 in, #8@ 27.43 in, #9@ 34.72 in, #10@ 44.09 in

Heel: #4@ 6.94 in, #5@ 10.76 in, #6@ 15.27 in, #7@ 20.83 in, #8@ 27.43 in, #9@ 34.72 in, #10@ 44.09 in

Key: #4@ 13.88 in, #5@ 18 in, #6@ 18 in, #7@ 18 in

Min footing T&S reinf Area	2.76	in ²
Min footing T&S reinf Area per foot	0.35	in ² /ft
<u>If one layer of horizontal bars:</u>		<u>If two layers of horizontal bars:</u>
#4@ 6.94 in		#4@ 13.89 in
#5@ 10.76 in		#5@ 21.53 in
#6@ 15.28 in		#6@ 30.56 in

Cantilevered Retaining Wall

Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Site Retaining Wall Rev1 - City Comments

Summary of Overturning & Resisting Forces & Moments

ItemOVERTURNING.....		RESISTING.....			
	Force lbs	Distance ft	Moment ft-#	Force lbs	Distance ft	Moment ft-#	
HL Act Pres (ab water tbl)	2,568.9	3.78	9,704.7	Soil Over HL (ab. water tbl)	4,033.3	6.17	24,872.2
HL Act Pres (be water tbl)				Soil Over HL (bel. water tbl)		6.17	24,872.2
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 =	192.5	1.75	336.9
Seismic Earth Load =	719.3	5.67	4,076.0	Surcharge Over Toe =	140.0	1.75	245.0
Seismic Stem Self Wt =	183.8	6.58	1,209.7	Stem Weight(s) =	1,312.5	3.92	5,140.6
				Earth @ Stem Transitions =			
Total	= 3,471.9	O.T.M. =	14,990.3	Footing Weight =	1,600.0	4.00	6,400.0
				Key Weight =	83.3	3.83	319.4
				Vert. Component =			
Resisting/Overturning Ratio		=	2.49	Total =	7,361.7 lbs	R.M.=	37,314.2
Vertical Loads used for Soil Pressure =		7,361.7 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 may be 1.1 per section 1807.2.3 of IBC.

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)	0.058 in





Cantilevered Retaining Wall

Project File: TJ_Mercer.ec6

LIC# : KW-06011847, Build:20.22.8.17

Merrell Design Services PLLC

(c) ENERCALC INC 1983-2022

DESCRIPTION: Site Retaining Wall Rev1 - City Comments

Rebar Lap & Embedment Lengths Information

Stem Design Segment: 2nd

Stem Design Height: 3.33 ft above top of footing

Lap Splice length for #6 bar specified in this stem design segment =	23.73 in
Development length for #6 bar specified in this stem design segment =	18.26 in

Stem Design Segment: Bottom

Stem Design Height: 0.00 ft above top of footing

Lap Splice length for #6 bar specified in this stem design segment =	23.73 in
Development length for #6 bar specified in this stem design segment =	18.26 in

Hooked embedment length into footing for #6 bar specified in this stem design segment =	10.98 in
As Provided =	0.5280 in ² /ft
As Required =	0.5042 in ² /ft

