

STRUCTURAL CALCULATIONS

FOR

McGinnis Residence

4157 W. 2200 S.

Taylor, Utah

3/24/2020



Karras Engineering PLLC

Pleasant View, Utah

801-786-0849

Design Criteria

Governing Code:		2015 IRC
Seismic:	Category	D1
	Ss=	116.70%
	Fa=	1.03
	Ra=	6
	I =	1
Wind:	Basic wind speed (mph 3 sec gust)	115
	Exposure	C
	I =	1
Roof Loads	Dead (psf)	15
	Snow (psf)	30
Floor Loads	Dead (psf)	10
	Live (psf)	40
Soil Bearing Pressure	(psf)	1500
Steel	fy=	60 ksi

Footing Design

Loads:

Roof:					
Dead	Plywood	3.0	(psf)		
	Insulation	2.0			
	Shingles	2.0			
	Felt	1.5			
	Gypsum	2.5			
	Truss	4.0			
	Sub Total	15.0	(psf)		
	Tributary Width	23.0	(ft)		
				Total	345 (plf)
Live	Snow Load	30	(psf)		
	Tributary Width	23.0	(ft)		
				Total	690 (plf)
Floor:					
Dead	Dead Load	10.0	(psf)		
	Tributary Width	0.0	(ft)		
				Total	0 (plf)
Live	Live Load	40	(psf)		
	Tributary Width	0.0	(ft)		
				Total	0 (plf)
Walls:					
	Framing	20.0			
	Siding	10.0			
	Sub Total	30.0	(psf)		
	Wall Height	12.0	(ft)		
				Total	360 (plf)
Foundation:	Concrete Unit Weight	150	(#/ft ³)		
	Wall Width	0.67	(ft)		
	Wall Height	3.5	(ft)		
				Total	351.75 (plf)
Footing:	Concrete Unit Weight	150	(#/ft ³)		
	Footing Width	1.67	(ft)		
	Footing Height	0.833	(ft)		
				Total	208.67 (plf)
				Total:	1955 (plf)
Assumed Soil Bearing Pressure		1500 (#/ft ³)			
Actual Footing Width		1.3 (ft)			

20" x 10" Concrete footing with (2) # 4 bars continuous

Shearwall & Connection Requirements

Connections			
Wall	Top Plate		Sill Plate
	Uplift	Shear	Shear
Transverse (lb)	40791	7184	7472
Longitudinal (lb)	33424	6540	6540

Roof Diaphragm Connection			
Wall	Uplift (@24" O.C.)		Shear (@24" O.C.)
Transverse (plf)		880	163
Longitudinal (plf)		174	102
Simpson H1	490	Problem	415 OK

Anchor Bolt Spacing				
Wall	O.C. Spacing (in)		Plate Strength	
	1/2"	5/8"	Doogie Fir (lb/bolt)	
Transverse (plf)	88	126	1/2"	620
1/2 @ 32" O.C.	OK		5/8"	890
5/8" @ 32" O.C.		OK		
Longitudinal (plf)	146	209		
1/2 @ 32" O.C.	OK			
5/8" @ 32" O.C.		OK		

Wall Shear									
Transverse Walls	Shearwall Length (ft)	Tributary Ln (ft)		Wind Shear (plf)			Seismic Shear (plf)		
		Roof	Floor	Roof	Floor	Base	Roof	Floor	Base
Wall A	36	32	0	104	0	104	100	0	100
Wall B	36	32	0	104	0	104	100	0	100
Wall C	0	0	0						
Wall D	0	0	0						
Longitudinal Walls									
Wall 1	24	22	0	76	0	76	150	0	150
Wall 2	48	22	0	38	0	38	75	0	75
Wall 3	0	0	0						
Wall 4	0	0	0						

Controlling Shear		
Transverse Walls	Design Shear (plf)	Nailing Schedule
Wall A	104	8d w/ 6 in Edge, 12 in Field
Wall B	104	8d w/ 6 in Edge, 12 in Field
Wall C	0	8d w/ 6 in Edge, 12 in Field
Wall D	0	8d w/ 6 in Edge, 12 in Field
Longitudinal Walls		
Wall 1	150	8d w/ 6 in Edge, 12 in Field
Wall 2	75	8d w/ 6 in Edge, 12 in Field
Wall 3	0	8d w/ 6 in Edge, 12 in Field
Wall 4	0	8d w/ 6 in Edge, 12 in Field

Holdown Requirements

Gross Moment			
Transverse Walls	Shear (plf)	Length (ft)	Moment (plf-lbs)
Wall A	104	14	1453
Wall B	104	14	1453
Wall C	0	14	0
Wall D	0	14	0
Longitudinal Walls			
Wall 1	150	14	2095
Wall 2	75	14	1048
Wall 3	0	14	0
Wall 4	0	14	0

Resistive Moment					
Transverse Walls	Roof Dead (plf)	Roof Snow (plf)	Floor (plf)	Wall (plf)	Total (plf)
Wall A	47	0	10	280	337
Wall B	47	0	10	280	337
Wall C	0	0	10	280	290
Wall D	0	0	10	280	290
Longitudinal Walls					
Wall 1	348	0	220	280	848
Wall 2	348	0	220	280	848
Wall 3	0	0	0	280	280
Wall 4	0	0	0	280	280

Holdown Requirements					
Transverse Walls	Shear Wall Length (ft)				
	4	8	12	16	20
Wall A	1048	643	238	-167	-572
Wall B	1048	643	238	-167	-572
Wall C					
Wall D					
Longitudinal Walls					
Wall 1	1078	61	-957	-1974	-2992
Wall 2	30	-987	-2005	-3022	-4039
Wall 3					
Wall 4					

Wind Analysis

Pressures for 115 mph Wind*									
Member vs Roof Angle	Horizontal (psf)					Vertical (psf)			
	End		Interior			Roof End		Roof Interior	
	Wall	Roof	Wall	Roof	Roof	Wind	Lee	Wind	Lee
Transverse 20	22.4	-5.9	15.0	-3.3		-19.4	-13.5	-13.5	-10.2
Transverse 30 to 45	18.1	12.5	14.5	10.0		7.1	-11.1	6.0	-9.5
Transverse Interpolation	23.1	0.0	15.1	0.0		-23.5	-13.9	-16.5	-10.3
Longitudinal	16.1	0.0	10.7	0.0		-19.4	-11.1	-13.5	-8.6

* for a mean roof height of 30ft in Exposure B.

Roof Details	
Type	Gable
Pitch	4/12
Angle (deg)	18.4
Roof Height (ft)	7.3
Mean Roof Height (ft)	17.7

Exposure C Factors	
Ht	Table Value
15	1.21
20	1.29
25	1.35
30	1.4

Design Factor	
Bld Height	21.3
Roof	1.00
Wall	1.00

Diaphragm Dimensions				
Member	Transverse (ft)	Longitudinal (ft)	Height (ft)	Trib Length (ft)
Roof	44	64	14	7
Floor	0	0	0	0

Tributary Wall Distances		
	End	Interior
Transverse (ft)	6.4	51.2
Longitudinal (ft)	4.4	35.2

Walls	Horizontal					
	End			Interior		
	R Wall	F Wall	Roof	R Wall	F Wall	Roof
Transverse (lb)	2070	0	0	5402	0	0
Longitudinal (lb)	993	0	0	2639	0	0

Walls	Vertical			
	Roof End		Roof Interior	
	Wind	Lee	Wind	Lee
Transverse (lb)	-6630.3	-3902	-18629	-11629
Longitudinal (lb)	-5464.2	-3122.4	-15186	-9651

Totals				
Walls	Horizontal		Vertical	
	Shear (lbs)	Shear (plf)	Uplift (lbs)	Uplift (plf)
Transverse (lb)	7472	170	-40791	-927
Longitudinal (lb)	3632	57	-33424	-522

Seismic Analysis

Seismic Coefficient		
Ss (%g)	116.70%	.2 sec Spectral Response
Fa	1.03	Table 1615.1.2 (2)
Ra	6	Table 1617.6
Ie	1.0	Table 1604.5
Sms=FaSs	1.20201	(Eq. 16-16)
Sds=(2/3)Sms	0.81	(Eq. 16-18)
S.D. Category	D1	
Response Coefficient	0.161	(Eq. 16-49)

Diaphragm Dimensions			
Member	Transverse (ft)	Longitudinal (ft)	Height (ft)
Roof	44	64	14
Floor			

Base Shear						
Transverse						
Diaphragm	Diaphragm (lb)	Wall Trib (ft)	Wall (lb)	Total (lb)	Shear (lb)***	Shear (plf)
Roof*	44525	7.0	17920	62445	7184	163
Floor**	0	0.0	0	0	0	0
Total				62445	7184	163
Longitudinal						
Diaphragm	Diaphragm (lb)	Wall Trib (ft)	Wall (lb)	Total (lb)	Shear (lb)***	Shear (plf)
Roof*	44525	7.00	12320	56845	6540	102
Floor**	0	0	0	0	0	0
Total				56845	6540	102

*This value includes 20% of snow load over 30 psf.

**This value includes 10 psf for partition load.

***This value divided by 1.4



WoodWorks[®]
SOFTWARE FOR WOOD DESIGN

COMPANY

PROJECT

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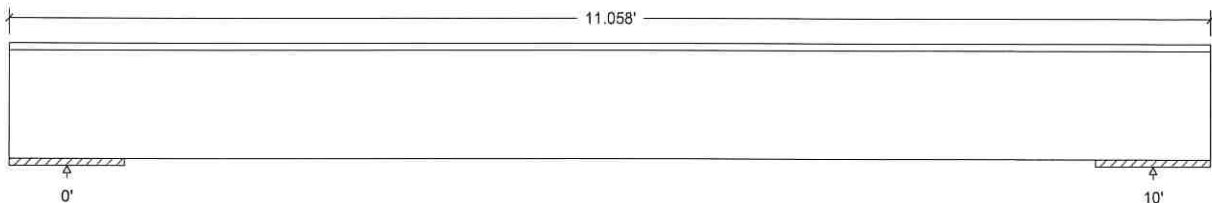
Design Check Calculation Sheet

WoodWorks Sizer 11.1

Loads:

Load	Type	Distribution	Pat-tern	Location [ft]		Magnitude		Unit
				Start	End	Start	End	
Load1	Dead	Full UDL				345.0		plf
Load2	Snow	Full UDL				690.0		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:				
Dead	1725			1725
Snow	3450			3450
Factored:				
Total	5175			5175
Bearing:				
Capacity				
Beam	33337			33337
Des ratio				
Beam	0.16			0.16
Load comb	#2			#2
Length	12.70*			12.70*
Min req'd	12.70*			12.70*
Cb	1.00			1.00
Cb_min	1.00			1.00

*Minimum bearing length setting used: 12-11/16" for end supports

LVL n-ply, 1.8E, 2600Fb, 1-3/4"x11-7/8", 2-ply (3-1/2"x11-7/8")

Supports: All - Non-wood

Total length: 11.06'; Clear span: 8.942'; volume = 3.2 cu.ft.

Lateral support: top= full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	$f_v = 130$	$F_v' = 328$	psi	$f_v/F_v' = 0.40$
Bending(+)	$f_b = 1887$	$F_b' = 2993$	psi	$f_b/F_b' = 0.63$
Live Defl'n	$0.18 = L/679$	$0.33 = L/360$	in	0.53
Total Defl'n	$0.31 = L/388$	$0.67 = L/180$	in	0.46

Additional Data:

FACTORS:	F/E(ksi)	CD	CM	Ct	CL	CV	Cfu	Cr	Cfrc	Ci	Cn	LC#
F_v'	295	1.15	-	1.00	-	-	-	-	1.00	-	1.00	2
F_b'	2600	1.15	-	1.00	1.000	1.00	-	1.00	1.00	-	-	2
F_{cp}'	750	-	-	1.00	-	-	-	-	1.00	-	-	-
E'	1.8 million	-	1.00	-	-	-	-	-	1.00	-	-	2
E_{min}'	0.93 million	-	1.00	-	-	-	-	-	1.00	-	-	2

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = D+S, V max = 5175, V design = 3603 lbs
 Bending(+): LC #2 = D+S, M = 12938 lbs-ft
 Deflection: LC #2 = D+S (live)
 LC #2 = D+S (total)
 D=dead L=live S=snow W=wind I=impact Lr=roof live Lc=concentrated E=earthquake
 All LC's are listed in the Analysis output
 Load combinations: ASCE 7-10 / IBC 2015

CALCULATIONS:

Deflection: $EI = 440e06$ lb-in²/ply
 "Live" deflection = Deflection from all non-dead loads (live, wind, snow...)
 Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

Design Notes:

- WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
- Please verify that the default deflection limits are appropriate for your application.
- SCL-BEAMS (Structural Composite Lumber): the attached SCL selection is for preliminary design only. For final member design contact your local SCL manufacturer.
- Size factors vary from one manufacturer to another for SCL materials. They can be changed in the database editor.
- BUILT-UP SCL-BEAMS: contact manufacturer for connection details when loads are not applied equally to all plys.



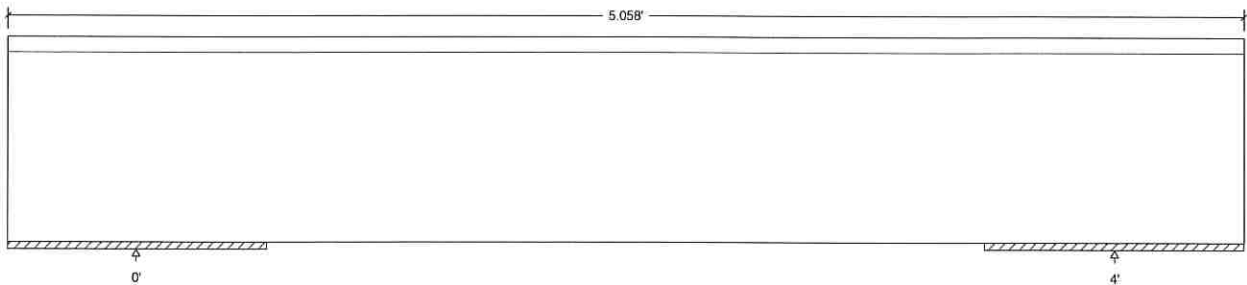
Design Check Calculation Sheet

WoodWorks Sizer 11.1

Loads:

Load	Type	Distribution	Pat-tern	Location [ft]		Magnitude		Unit
				Start	End	Start	End	
Load1	Dead	Full UDL				345.0		plf
Load3	Snow	Full UDL				690.0		plf

Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :



Unfactored:			
Dead	690		690
Snow	1380		1380
Factored:			
Total	2070		2070
Bearing:			
Capacity			
Beam	23812		23812
Des ratio			
Beam	0.09		0.09
Load comb	#2		#2
Length	12.70*		12.70*
Min req'd	12.70*		12.70*
Cb	1.00		1.00
Cb min	1.00		1.00

*Minimum bearing length setting used: 12-11/16" for end supports

Lumber n-ply, D.Fir-L, No.2, 2x10, 2-ply (3"x9-1/4")

Supports: All - Non-wood

Total length: 5.06'; Clear span: 2.942'; volume = 1.0 cu.ft.

Lateral support: top= full, bottom= at supports;

Analysis vs. Allowable Stress and Deflection using NDS 2015 :

Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	Fv = 39	Fv' = 207	psi	Fv/Fv' = 0.19
Bending(+)	Fb = 581	Fb' = 1136	psi	Fb/Fb' = 0.51
Live Defl'n	0.01 = <L/999	0.13 = L/360	in	0.09
Total Defl'n	0.02 = <L/999	0.27 = L/180	in	0.08

Additional Data:

FACTORS:	F/E(ksi)	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrrt	Ci	Cn	LC#
Fv'	180	1.15	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	900	1.15	1.00	1.00	1.000	1.100	1.00	1.00	1.00	1.00	-	2
Fcp'	625	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.6 million	1.00	1.00	-	-	-	-	-	1.00	1.00	-	2
Emin'	0.58 million	1.00	1.00	-	-	-	-	-	1.00	1.00	-	2

CRITICAL LOAD COMBINATIONS:

Shear : LC #2 = D+S, V max = 2070, V design = 725 lbs

Bending(+): LC #2 = D+S, M = 2070 lbs-ft

Deflection: LC #2 = D+S (live)

LC #2 = D+S (total)

D=dead L=live S=snow W=wind I=impact Lr=roof live Lc=concentrated E=earthquake

All LC's are listed in the Analysis output

Load combinations: ASCE 7-10 / IBC 2015

CALCULATIONS:

Deflection: EI = 158e06 lb-in²/ply

Live deflection = Deflection from all non-dead loads (live, wind, snow...)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.

Design Notes:

- WoodWorks analysis and design are in accordance with the ICC International Building Code (IBC 2015), the National Design Specification (NDS 2015), and NDS Design Supplement.
- Please verify that the default deflection limits are appropriate for your application.
- Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
- BUILT-UP BEAMS: It is assumed that each ply is a single continuous member (that is, no butt joints are present) fastened together securely at intervals not exceeding 4 times the depth and that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may be required.