

S.D.A., Inc. P.C.

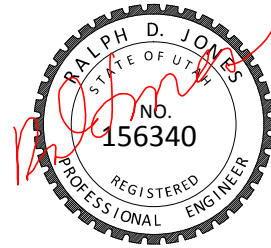
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Structural Calculations
Prepared for

Kade Bambrough
Detached Garage
4086 West 3675 North
Ogden (West Weber), Utah
84404

February 24, 2021



02/24/2021

These calculations are valid only for the house being built on this lot,
and if the engineer's signature is in red ink.

Dead Loads

Roof			
Asphalt Shingles			2.0
Sheathing	2.5	0.5	1.3
Insulation	0.5	12.0	6.0
Drywall	5.0	0.5	2.5
Trusses @ 24" O.C.			3.3
Total			15.0

Floor			
Sheathing	2.5	0.8	1.9
Flooring			1.0
Insulation	0.5	10.0	5.0
Drywall	5.0	0.5	2.5
Trusses			2.5
Total			12.9

Walls			
Exterior			
Sheathing	2.5	0.5	1.3
Studs 2x6 @ 16" O.C.	1.0	1.6	1.6
Insulation			1.5
Drywall	5.0	0.5	2.5
Stucco			10.0
Total			16.8
Interior			
Studs 2x4 @ 16" O.C.			1.0
Drywall	5.0	1.0	5.0
Total			6.0
Garage			
Sheathing	2.5	0.5	1.3
Studs 2x6 @ 16" O.C.	1.0	1.6	1.6
Insulation			1.0
Drywall	5.0	0.5	2.5
Total			6.3

Design Criteria

Kade Bambrough
 Detached Garage
 4086 West 3675 North
 Ogden (West Weber), Utah

Governing Code

2018 IBC

Loads

Roof

Type

Slope 7/12

Snow Load, Ground (psf)*

Snow Load, Roof (psf)

Snow Load Reduced (psf)

Dead (psf)

Dead Horizontal (psf)

Total Roof (psf)

Floor

Live (psf)

Dead (psf)

Total Floor (psf)

Deck

Live (psf)

Dead (psf)

Total Deck (psf)

Wind

Ultimate Speed

Surface Roughness

Risk Category II

Seismic

Category

Ss (g)

Fa

Sms

Sds

Ra

Ie

Gable

Wall Heights (ft)		
Footing	-2.5	30
Foundation	0.00	
Main Wall	10.00	
Floor Thickness	1.00	
Upper Wall	4.50	
Total Height	15.50	

Wall Lengths (ft)		
Upper Transverse	42	
Lower Transverse	42	
Upper Longitudinal	60	
Lower Longitudinal	60	
Eave Overhang	1.33	16

Roof Tributary (ft)	
Transverse	3
Longitudinal	21

Floor Tributary (ft)		
Joist Spacing	0.00	0
Lower Transverse	0.00	
Main Bearing Wall (from front)	0	
Lower Longitudinal, Back	0	
Lower Longitudinal, Front	0	

* Utah State University

Material Properties

Footings and Foundation

Soil Bearing Pressure (psf)	1500
Concrete fc' (psi)	2500
Concrete Reinforcing (psi)	60000

Beams

	DF	GL	ML	TS	VL
Fb (psi)	900	2400	2600	2325	2900
Fv (psi)	180	165	285	310	290
Fc (psi) II	1300	1700	2460	2050	2900
Fc (psi) Perpendicular	625	625	900	800	650
E (psi)	1.6E+06	1.8E+06	1.8E+06	1.55E+06	2.0E+06

Douglas Fir #2 Size Factors

Depth (in)	Fb	Ft	Fc
4	1.5	1.5	1.15
6	1.3	1.3	1.1
8	1.2	1.2	1.1
10	1.1	1.1	1.0
12	1.0	1.0	1.0

Roof Beam Distributive Loads

	RB1	RB2	RB3	RB5
<u>Load Parameters</u>				
Roof Snow Load (psf)	21	21	21	21
Roof Dead Load (psf)	15	15	15	15
Roof Tributary (ft)	8	3	24	3
Wall Load (psf)	17	17	17	17
Wall Tributary (ft)	2	8	5	8
Beam Weight (plf)	7	7	7	13
Total Live Load (plf)	168	63	504	63
Total Dead Load (plf)	160	186	451	193
Total Load (plf)	328	249	955	256
<u>Beam Requirements</u>				
Beam Span (ft)	4	4	4	18
Max Shear (lb)	657	499	1910	2300
Max Moment (ft-lb)	657	499	1910	10350
Bearing Required (in)	0.35	0.27	1.02	0.73
<u>Beam Properties</u>				
Type	DF	DF	DF	ML
Depth (in)	9.25	9.25	9.25	11.875
Width (in)	3	3	3	3.5
<u>Adjustment Factors</u>				
Load Duration, Cd	1.15	1.15	1.15	1.15
Bending				
Wet Service, Cm	1.00	1.00	1.00	1.00
Size, Cf, Cv (ML, GL)	1.10	1.10	1.10	1.00
Repetitive Member, Cr	1.00	1.00	1.00	1.00
Tabulated Value, Fb (psi)	900	900	900	2600
F'B = Fb(Cd)(Cm)(Cf)(Cr) (psi)	1139	1139	1139	2993
Shear				
Wet Service, Cm	1.00	1.00	1.00	1.00
Shear, CH	1.00	1.00	1.00	1.00
Tabulated Value, Fv	180	180	180	285
F'v=Fv(Cd)(Cm)(Ch) (psi)	207	207	207	328
<u>Actual Stresses</u>				
Bending fb = M/S (psi)	184	140	536	1510
Shear fv = 1.5V/A (psi)	36	27	103	83
<u>Margins</u>				
Bending < 100% OK	16%	12%	47%	50%
Shear < 100% OK	17%	13%	50%	25%
<u>Deflections</u>				
Wet Service Factor, Cm	1	1	1	1
E' = E(Cm)(Ct)	1.6E+06	1.6E+06	1.6E+06	1.8E+06
L/240 Live Allowable (in)	0.20	0.20	0.20	0.90
Live Actual (in)	0.00	0.00	0.01	0.17
L/180 Dead Allowable (in)	0.27	0.27	0.27	1.20
Dead Actual (in)	0.01	0.00	0.02	0.69
<u>Check</u>				
	OK	OK	OK	OK

Floor Beam Distributive Loads

RB-4

Load Parameters

Roof Snow Load (psf)	21
Roof Dead Load (psf)	15
Roof Tributary (ft)	24
Wall Load (psf)	17
Wall Tributary (ft)	5
Floor Live Load (psf)	40
Floor Dead Load (psf)	10
Floor Tributary (ft)	11
Beam Weight (plf)	26
Total Live Load (plf)	944
Total Dead Load (plf)	580
Total Load (plf)	1524

Beam Requirements

Beam Span (ft)	16
Max Shear (lb)	12195
Max Moment (ft-lb)	48779
Bearing Required (in)	2.58

Beam Properties

Type	ML
Depth (in)	16
Width (in)	5.25

Adjustment Factors

Load Duration, Cd	1.15
Bending	
Wet Service, Cm	1.00
Size, Cf, Cv (ML, GL)	0.97
Repetitive Member, Cr	1.00
Tabulated Value, Fb (psi)	2600
F'B = Fb(Cd)(Cm)(Cf)(Cr) (psi)	2896
Shear	
Wet Service, Cm	1.00
Shear, CH	1.00
Tabulated Value, Fv	285
F'v=Fv(Cd)(Cm)(Ch) (psi)	328

Actual Stresses

Bending fb = M/S (psi)	2613
Shear fv = 1.5V/A (psi)	218

Margins

Bending < 100% OK	90%
Shear < 100% OK	66%

Deflections

Wet Service Factor, Cm	1
E' = E(Cm)(Ct)	1.8E+06
L/360 Live Allowable (in)	0.53
Live Actual (in)	0.43
L/240 Dead Allowable (in)	0.80
Dead Actual (in)	0.70

Check

OK

Footing/Foundation Calculations

Exterior

Concrete Specs

Concrete f_c' (psi)	2500
Concrete Density (pcf)	150
Rebar (psi)	60000

Foundation Specs

Overall Height (ft), (in)	2.50
Wall Thickness	0.67
Area (alf)	1.67
Weight (plf)	250

8

Roof Load

Dead (psf)	15
Live (psf)	21
Span (ft)	42
1/2 Total Roof Load (plf)	756

Floor Load

Dead (psf)	13
Live (psf)	40
Span (ft)	1
1/2 Total Floor Load (plf)	26

Wall Load

Wall Load (psf)	17
Height (ft)	14
Total Wall Load (plf)	236

Calculations

Total Building Loads (plf)	1018
Foundation Load (plf)	250
Total Weight on Soil (plf)	1268
Soil Bearing Pressure (psf)	1500
Footing Width (in)	10

Seismic Analysis

Seismic Coefficient	
Ss (g)	1.24
Fa	1.20
Ra	6.50
Ie	1.00
Sms=FaSs	1.48
Sds=(2/3)Sms	0.99
S.D. Category	D
LC Coefficient	0.70
Cs	0.15

Dead Loads		
Roof	Wall	Floor
15	17	13

Interior Walls		
Tibutary	Length	Load
5	0	

Diaphragm Dimensions			
Member	Transverse (ft)	Longitudinal (ft)	Height (ft)
Roof	45	63	16
Floor	30	40	10

Force						
Transverse						
Diaphragm	Diaphragm (lb)	Wall Trib (ft)	Wall (lb)	Total (lb)***	Shear (lb)	Shear (plf)
Roof*	41987	5.0	10093	36456	5573	125
Floor**	15450	5.0	6729	15525	2374	79
Total				51981	7947	178
Longitudinal						
Diaphragm	Diaphragm (lb)	Wall Trib (ft)	Wall (lb)	Total (lb)***	Shear (lb)	Shear (plf)
Roof*	41987	5.00	6700	34081	3647	58
Floor**	15450	5	5046	14348	1535	38
Total				48428	5183	83

Force Distribution						
Diaphragm	Transverse			Longitudinal		
	WxHx (ft-lb)	Cvx (lb)	Fx (ft-lb)	WxHx (lb)	Cvx	Fx
Roof*	565063	0.78	6234	528250	0.79	4076
Floor**	155250	0.22	1713	143475	0.21	1107
Total	720313		7947	671725		5183

*Includes 20% of snow load over 30 psf

**Includes 6 psf for interior wall load

***LC Included

Wind Analysis

Pressures for 105 (mph) Wind								
	Horizontal (psf)				Vertical (psf)			
	A	B	C	D	E	F	G	H
Transverse	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-10.2
Longitudinal	17.5	-9.1	11.6	-5.4	-21.0	-11.9	-14.6	-9.2

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

Roof Details	
Slope	7
Angle (deg)	30.3
Roof Height (ft)	12.3
Eave Overhang (ft)	1.3
Mean Roof Height (ft)	16.1

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

Design Factor	
Bld Height	22.3
Roof	1.29
Wall	1.21

Dimensions				
Member	Transverse (ft)	Longitudinal (ft)	Height (ft)	Trib Length (ft)
Lower Wall	42	60	10.00	5.00
Totals			10.00	5.00

Wall/Roof Tributaries		
	a	Interior
Transverse (ft)	4.20	25.80
Longitudinal (ft)	4.20	16.80

LC Wind 0.6
Triangle 2.5

Horizontal Shear Distribution Table (LBs)									
Trans	Roof		Wall		Floor		Lower Wall		Total*
	B	D	A	C	A	C	A	C	
Top Plate	1779	2867	1001	1586	0	0	0	0	4340
Long	Roof		Wall		Floor		Lower Wall		Total*
	A	C	A	C	A	C	A	C	
Top Plate	232	4729	445	1811					4330

* LC included

Pressures for 105 Wind									
Roof Angle (degrees)	LOAD CASE	Horizontal (psf)				Vertical (psf)			
		A	B	C	D	E	F	G	H
0 TO 5	1	17.5	-9.1	11.6	-5.4	-21.0	-11.9	-14.5	-9.2
15	1	22.0	-7.3	14.6	-4.1	-21.0	-13.7	-14.6	-10.5
20	1	24.2	-6.4	16.1	-3.5	-21.0	-14.6	-14.6	-11.1
25	1	21.9	3.5	15.9	3.6	-9.7	-13.3	-7.1	-10.7
30	1	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-10.3
45	1	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-4.2

Interpolation Table									
PITCH	ANGLE	A	B	C	D	E	F	G	H
4	18.4	23.5	-6.7	15.6	-3.7	-21.0	-14.3	-14.6	-10.9
5	22.6	23.0	-1.2	16.0	0.2	-15.1	-13.9	-10.7	-10.9
6	26.6	21.2	6.6	15.8	5.9	-6.2	-12.9	-7.1	-10.6
7	30.3	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-10.2
8	33.7	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-10.2
9	36.9	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-10.2
10	39.8	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-10.2
11	42.5	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-10.2
12	45.0	19.7	13.4	15.6	10.8	1.5	-11.9	-7.1	-10.2

Wind Analysis Cont.

Overhang	
Eoh	Goh
-7.9	-6.9
-29.4	-23.0

Vertical Uplift Table (plf)					
Trans	Roof (plf)		Dead Load (plf)		Total*
	E	Eoh	Roof	Wall	
Top Plate	2	-14	35	84	14
Long	Roof (plf)		Dead Load (plf)		Total*
	E	Eoh	Roof	Wall	
Top Plate	-569	-51	432	168	-112

Roof Diaphragm Connection				
Wall	Uplift (@24" O.C)		Shear (@24" O.C.)	
Transverse		-28		103
Longitudinal		225		72
Simpson H2.5	565	OK	565	OK

Shear Wall

Shearwall Parameters											
Left			Right			Front			Rear		
h	bs	h/bs	h	bs	h/bs	h	bs	h/bs	h	bs	h/bs
10.0	6.0	1.7	10.0	7.0	1.4	10.0	6.0	1.7	10.0	25.0	0.4
10.0	4.0	2.5	10.0	5.0	2.0	10.0	10.0	1.0	10.0	31.0	0.3
10.0	14.0	0.7	10.0	4.0	2.5	10.0	11.0	0.9	10.0	0.0	0.0
10.0	0.0	0.0	10.0	10.0	1.0	10.0	5.0	2.0	10.0	0.0	0.0
Total	24.00			26.00			32.00			56.00	

Controlling Shear (LBS)					
Wall	TP		MTP		Control
	Seismic	Wind	Seismic	Wind	TP
Trans	3117	4340	0	0	4340
Long	2038	4330	0	0	4330
					Wind
					Wind

Wall Shear		
Trans	SW Length	Shear
Left	24	181
Right	26	167

Wall Shear		
Long	SW Length	Shear
Front	32	135
Rear	56	77
Middle	34	64

Shear Wall Cont

Allowable Shear (plf) For Wood Structural Panel Shear Walls							
Control	Thickness	Fastener Penetration	Fastener	Fastener Spacing at panel edges (inches)			
				6	4	3	2
Wind	7/16"	1-3/8"	8d common	365	533	685	895
Seismic	7/16"	1-3/8"	8d common	260	380	490	640

Values for 15/32" sheathing, studs @ 16" O.C., see note 2, Table 4.3A, SDPWS

Values have been divided by 2 per SDPWS 4.3.3

Wall Shear						
Trans	Control	Design Shear	H/W Adjustments		Adjstd Shear	Nailing Schedule
			Ratio	Factor		
Left	Wind	181	2.50	0.94	193	SW 6
Right	Wind	167	2.50	0.94	178	SW 6
Long						
Front	Wind	135	2.00	1.00	135	SW 6
Rear	Wind	77	0.40	1.00	77	SW 6
Middle	Wind	64	0.29	1.00	64	SW 6

** See FTAO Spreadsheet

Holdown Requirements

OT Moment				Resistive Force						HD
<i>Left</i>	Roof		Total Moment (ft-plf)	Roof		Wall		Total		Force
	Load (plf)	Height (ft)		Load (psf)	Trib (ft)	Load (psf)	Trib (ft)	LC Factor	Force (plf)	
6	193	15.5	2990	15	3	17	15.5	0.6	183	2439
4	193	15.5	2990	15	3	17	15.5	0.6	183	2623

OT Moment				Resistive Force						HD
<i>Right</i>	Roof		Total Moment (ft-plf)	Roof		Wall		Total		Force
	Load (plf)	Height (ft)		Load (psf)	Trib (ft)	Load (psf)	Trib (ft)	LC Factor	Force (plf)	
7	178	15.5	2760	15	3	17	15.5	0.6	183	2118
5	178	15.5	2760	15	3	17	15.5	0.6	183	2301

OT Moment				Resistive Force						HD
<i>Front</i>	Roof		Total Moment (ft-plf)	Roof		Wall		Total		Force
	Load (plf)	Height (ft)		Load (psf)	Trib (ft)	Load (psf)	Trib (ft)	LC Factor	Force (plf)	
6	135	15.5	2097	15	31	17	15.5	0.6	438	782
10	135	15.5	2097	15	31	17	15.5	0.6	438	-95

OT Moment				Resistive Force						HD
<i>Rear</i>	Roof		Total Moment (ft-plf)	Roof		Wall		Total		Force
	Load (plf)	Height (ft)		Load (psf)	Trib (ft)	Load (psf)	Trib (ft)	LC Factor	Force (plf)	
25	77	15.5	1199	15	31	17	15.5	0.6	438	-4282
31	77	15.5	1199	15	31	17	15.5	0.6	438	-5597

OT Moment				Resistive Force						HD
<i>Middle</i>	Roof		Total Moment (ft-plf)	Roof		Wall		Total		Force
	Load (plf)	Height (ft)		Load (psf)	Trib (ft)	Load (psf)	Trib (ft)	LC Factor	Force (plf)	
34	64	15.5	987	0	1	6	15.5	0.6	59	-12
34	64	15.5	987	0	1	6	15.5	0.6	59	-12

Holdown Capacities			
3000 psi Concrete	End Distance*		
	Midwall	Corner	Endwall
STHD10	3400	2940	2295
STHD14	3815	3815	3500

* Cracked

