

Post Frame Structural Engineering Calculations

Roper Al Martinelli Sourdough
Post Frame Building
41.363725, -111.628441
Sourdough, Utah

Prepared for:

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Design Criteria

Codes

IBC 2018
 ASCE7-16

Risk Category **I** ASCE 7-16 Table 1.5-1

Is	0.8	ASCE 7-16 Table 1.5-2
Ie	1.0	ASCE 7-16 Table 1.5-2

Seismic Loads

S1	0.22	ASCE 7 Hazard Tool
SM1	0.57	ASCE 7 Hazard Tool
SMS	0.96	ASCE 7 Hazard Tool
TL	8	ASCE 7 Hazard Tool

Site Class	D	(ASSUMED)
SDC	D	ASCE 7 Hazard Tool

R (Cant)	1.5	ASCE7-16 table 12.2-1
R (SW)	6.5	ASCE7-16 table 12.2-1

Wind Loads

V	105	mph 3 Sec Gust
Category	C	
Elevation	7430	ft USU Snow Load Map

Snow Loads

Pg	212	psf USU Snow Load Map
Ws	12	psf

Ce	1.0	ASCE7-16 Table 7.3-1
Ct	1.2	ASCE7-16 Table 7.3-2
Cs	0.94	ASCE7-16 Figure 7.4-1

Pf	142	ASCE7-16 Eq 7.3-1
Ps	134	ASCE7-16 Eq 7.4-1

Dead Loads

Roof	6	psf (Trusses, Purlins, 29 gauge metal)
Floor	10	psf (Joists, 3/4" OSB)
Walls	1	psf (Posts)
Concrete	145	pcf

Live Loads

Roof	20	psf ASCE7-16 Table 4.3-1
Floor	40	psf ASCE7-16 Table 4.3-1

Soil Properties

Geotechnical Report by N/A
Report Number N/A
Date of Report N/A

If no report is listed above, the follow values are assumed
Unified Soil Classification Assumed to be GW, GP, SW, or SP IBC Table 1610.1

Bearing Pressure 1500 psf

Active Pressure 35 pcf

At Rest Presssure 60 pcf

Passive Pressure 250 pcf

Coefficient of Friction 0.3

Lateral Bearing Pressure 400 psf/ft
IBC 1806.1, 1806.2, & 1806.3.4

**Engineer assumes stable soil conditions.
If there are any global stability concerns, a geotechnical report is required.

Deflection Criteria

Roof

Live Load L/150 Table 1604.3 Footnote a
Total Load L/120 Table 1604.3

Floor

Live Load L/360 Table 1604.3
Total Load L/240 Table 1604.3

Wall

Live Load L/90 Table 1604.3 Footnote a

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Main Building Info

Ridge Ht	17.5	ft
Width	12	ft
Length	30	ft
Clear Ht	14	ft
Floor Level	0	ft
Floor Area	0	ft^2

Pitch 4 :12

Bearing Posts	8	quantity
Gable Posts	0	quantity
Post Spacing	10	ft

Pier Diameter Requirements

Bearing Pressure	1500	psf
Adj Bearing Pressure	1800	psf

Tributary Area	60	ft^2
Axial Load	8394.97	lbs

Minimum Area	4.663872	ft^2
Minimum Diameter	29.2	in



ELF

SD1	0.38	Eq 11.4-4
SDS	0.64	Eq 11.4-3
Cs	0.43	Eq 12.8-2
Ta	0.16	Eq 12.8-7
Ct	0.02	table 12.8-2
x	0.75	table 12.8-2
hn	15.75	
Cs Max	1.60	Eq 12.8-3
Cs Max	N/A	Eq 12.8-4
Cs Min	0.03	Eq 12.8-5
Cs Min	0.01	Eq 12.8-5
Cs Min	N/A	Eq 12.8-6
Cs Max	1.60	
Cs Min	0.03	
Cs	0.43	
V (lbs)	1423	Eq 12.8-1

Building Info

Z (ft)	Area (ft^2)	Weight (psf)	Weight (lbs)	Wx (lbs)	Cvx	Fx (lbs)	Shear (lbs)
Ridge	17.5	360	6	2160			
Top Clear Ht	14	1176	1	1176	2748	1.000	3267
Floor	0	0	10	0			
Bottom Clear Ht	0	0	1	0	588	0.000	0
				3336			3267

Width	12
Length	30

Roof Pitch F-B 4 :12 Pitch

k=1 for T<=5

Simplified Seismic

V	3267	Eq 12.14-12
F	1	1 1 story 1.1 2 story 1.2 3 story

Top
Bottom

Wx (lbs)	Fx (lbs)	Shear (lbs)
2748	3016	3016
588	251	3267

Directional

hn	15.75		V	105 mph 3 Sec Gust
G	0.85	(26.11.4,26.11.2)	Category	C
ke	0.7641692	table 26.9-1		
kzt	1	26.8.2		
kd	0.85	table 26.6-1		
kh	0.8575	table 26.10-1		

Surface	Cp	L/B or h/L	z or h	kz or kh	Theta	q (psf)	p (psf)	Area (ft^2)	Force (lbs)
Top Front Wall	0.80	0.40	14	0.85	0.00	15.58	10.60	0	0
Bottom Front Wall	0.80	0.40	0	0.85	0.00	15.58	10.60	0	0
Front Roof Plane	-0.18	1.31	15.75	0.86	18.43	15.72	-2.41	105	-253
Top Rear Wall	-0.50	0.40	15.75	0.86	0.00	15.72	-6.68	0	0
Bottom Rear Wall	-0.50	0.40	15.75	0.86	0.00	15.72	-6.68	0	0
Rear Roof Plane	-0.60	1.31	15.75	0.86	18.43	15.72	-8.02	105	-842
Top Left Wall	0.80	2.50	14	0.85	0.00	15.58	10.60	0	0
Bottom Left Wall	0.80	2.50	0	0.85	0.00	15.58	10.60	0	0
Left Roof Plane	0.80	0.53	15.75	0.86	90.00	15.72	10.69	21	224
Top Right Wall	-0.28	2.50	15.75	0.86	0.00	15.72	-3.67	0	0
Bottom Right Wall	-0.28	2.50	15.75	0.86	0.00	15.72	-3.67	0	0
Right Roof Plane	-0.28	0.53	15.75	0.86	90.00	15.72	-3.67	21	-77

L/R Walls	Shear (lbs)
Top	589
Bottom	589

F/B Walls	Shear (lbs)
Top	302
Bottom	302

Simplified Wind

Case A	A	B	C	D
Ps30	23.51	0.00	15.63	0.00
Ps	28.73	0.00	19.10	0.00

Case B	A	C
Ps30	17.50	11.60
Ps	21.39	14.18

a 3 Lambda 1.222

	C&D (lbs)	C&D/2 (lbs)	A&B (lbs)	L/R Shear (lbs)	C&D (lbs)	C&D/2 (lbs)	AA&BA (lbs)	AB (lbs)	A&B (lbs)	F/B Shear (lbs)
Top	0	0	404	404	298	298	404	151	151	449
Bottom	0	0	809	809	298	298	809	303	303	600

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Shear Table

	Top		Bottom	
	F/B	L/R	F/B	L/R
ELF	3267	3267	3267	3267
Simplified S	3016	3016	3267	3267
Directional	302	589	302	589
Simplified W	449	404	600	809

Factored Shear Table (0.6W 0.7E)

	Top		Bottom	
	F/B	L/R	F/B	L/R
ELF	2287	2287	2287	2287
Simplified S	2111	2111	2287	2287
Directional	181	354	181	354
Simplified W	269	243	360	485

Factored Shear Table (0.6W 0.7E)

	Top		Bottom	
	F/B	L/R	F/B	L/R
Simplified S	2111	2111	2287	2287
Directional	180.99189	353.565543	180.99189	353.5655429

Factored Shear Table (0.6W 0.7E)

	Top		Bottom	
	F/B	L/R	F/B	L/R
Max Load	2111	2111	2287	2287

Nonconstrained Global

Diameter	b	24	30		in
	A	0.66	0.57		
Dist. To P	h	14	14		ft
Force	P	264	264		lbs
Allow Lat Bearing	S1	469	433		psf
Depth Guess	d	3.52	3.25		ft
Depth Actual	d	3.51	3.25		ft
Depth Actual	d	42	39		in

	DF-L #1	HF #1	Triad Laminated Treated	
Height	14	14	11	(ft)
Bearing Posts	8	8	8	quantity
Gable Posts	0	0	0	quantity
Column b	5.75	5.75	6	(in)
Column h	7.5	7.5	7.125	(in)
Sx (Bearing)	53.91	53.91	50.77	(in^3)
Sy (Gable)	41.33	41.33	42.75	(in^3)
Area	43.13	43.13	42.75	(in^2)
Ix (Bearing)	202.15	202.15	180.85	(in^4)
Iy (Gable)	118.82	118.82	128.25	(in^4)
Fb'	1536	1248	840	(psi)
Fv'	217.6	179.2	216	(psi)
E'	1520000	1235000	1650000	(psi)
Fc'	217	176	424	(psi)
Emin'	551000	446500	724222	(psi)
FcE	226	183	434	(psi)
Fc*	1280	1088	2400	(psi)
C	0.8	0.8	0.9	
Cp	0.17	0.16	0.18	
Req'd Shear	2287	2287	2287	(lbs)
Shear Capacity	75072	61824	73872	(lbs)
Shear Ratio	0.030	0.037	0.031	
Check	OK	OK	OK	
Req'd Moment	29554	29554	23221	(ftlbs)
DL	360	360	360	(lbs)
fb	822	822	686	(psi)
fc	8	8	8	(psi)
Ratio	0.557	0.693	0.833	
Perp to Ridge	OK	OK	OK	
Req'd Moment	29554	29554	23221	(ftlbs)
DL	360	360	360	(lbs)
fb	1073	1073	815	(psi)
fc	8	8	8	(psi)
Ratio	0.727	0.903	0.990	
Para to Ridge	OK	OK	OK	



Combined Bending and Axial

Fc 850 psi
 Fc* 1088 psi
 Fc' 770 psi
 Emin 470000 psi
 Emin' 446500 psi
 Fb 975 psi
 Fb* 1248 psi
 Fb' 1243 psi
 Sx 53.91 in³

fb1 260 psi
 FcE2 32917 psi
 fb2 0 psi
 FcE1 1143 psi
 FbE 17574 psi
 fc 146 psi

l2 24 in
 l1 168 in
 ke 0.8
 le2 19.2 in
 le1 134.4 in
 d2 5.75 in
 d1 7.5 in
 Rb 5.521568
 c 0.8

Factors	
CD	1.6
CM	1.0
Ct	1.0
CL	1.00
CF	1.0
Cfu	1.0
CI	0.8
Cr	1.0
CV	1.0
Cc	1.0
CI	1.0
CVR	1.0
Cp	0.71

fc<FCE1 OK
 fc<FcE2 OK
 fb1<FbE OK
 Check 0.28 (3.9-3)
 Check 0.00 (3.9-4)

Ref. # 51
 Plys 1
 Section 6 X 8 HF #1
 Height 14 ft
 Vertical Load 6296 lbs
 Lateral Load 48 plf
 Moment 1168 ft lbs



Combined Bending and Axial

Fc	1500	psi
Fc*	1920	psi
Fc'	1309	psi
Emin	724222	psi
Emin'	688011	psi
Fb	525	psi
Fb*	672	psi
Fb'	671	psi
Sx	50.77	in^3
fb1	276	psi
FcE2	55229	psi
fb2	0	psi
FcE1	1589	psi
FbE	31038	psi
fc	147	psi
l2	24	in
l1	168	in
ke	0.8	
le2	19.2	in
le1	134.4	in
d2	6	in
d1	7.125	in
Rb	5.157519	
c	0.9	

Factors	
CD	1.6
CM	1.0
Ct	1.0
CL	1.00
CF	1.0
Cfu	1.0
CI	0.8
Cr	1.0
CV	1.0
Cc	1.0
CI	1.0
CVR	1.0
Cp	0.68

Ref. #	103
Plys	1
Section	Triad (4) Ply 2x8
Height	14 ft
Vertical Load	6296 lbs
Lateral Load	48 plf
Moment	1168 ft lbs

fc<FCE1	OK
fc<FcE2	OK
fb1<FbE	OK
Check	0.47 (3.9-3)
Check	0.00 (3.9-4)

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Purlin Calc

Span (ft)	9.25
Plys	1
Ref. #	3

	Live Loads	Dead Loads	Units		
Distributed	179	8	plf		

Deflection Limits

Live load	L/	150
Total Load	L/	120

Factors	
CD	1.00
CM	1.0
Ct	1.0
CL	1.0
CF	1.2
Cfu	1.0
Cl	1.0
Cr	1.15
CV	1.0
Cc	1.0
Cj	1.0
CVR	1.0

12" Lap Required Nailing
 7 16D @ each end and middle
 22 16D Total each lap

Type	#	Size		Design
	1	2 X 8 DF-L#2	Lapped	OK

Fb	900.00 psi	Max Moment	1,330 ft lbs	Flexure Check	Ratio
Fb'	1242.00 psi	Location	0.00 ft From Left	OK	0.978
Sx	13.14 In ³	Req Sx	12.85 In ³		

Fv	180.00 psi	L Reaction	863 lbs	Shear Check	Ratio
Fv'	180.00 psi	R Reaction	863 lbs	OK	0.661
Area	10.88 In ²	Max Shear	863 lbs		
	3.4.3.1	Req Area	7.19 In ²	Adj Shear Check	Ratio
(Non Hangered Loads)		Adj Max Shear	759 lbs	OK	0.582
		Req Area	6.33 In ²		

E	1,600,000 psi	Max LL Defl.	0.077 In	LL Deflection Check	Actual L/
E'	1,600,000 psi	Location	4.63 ft From Left	OK	1438
Ix	47.63 In ⁴				

Deflection Limits		Max TL Defl.	0.081 In	TL Deflection Check	Actual L/
LL	0.740 In	Location	4.63 ft From Left	OK	1377
TL	0.925 In				