E22093-01

Engineering West, L.L.C.

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3764 North 1100 West
Pleasant View, UT 84414

Design Calculations

25 May 2022

Project
Legacy Mountain Estates
Huntsville, UT
Wolf Creek Resorts

Design Codes

International Building Code 2018
ASCE 7-16 (Minimum Design Loads for Buildings and Other Structures)
ACI 318 (Building Code Requirements for Structural Concrete)
ACI 530 (Building Code Requirements for Masonry Structures)
AISC ASD 13th Edition (Structural Steel)
ANSI / AF&PA (National Design Specification for Wood Construction)

Design Criteria

Occupancy Category II
Building Classification (IBC 2018)
Site Class (ASCE 7-16)
Occupancy Importance Factors
Seismic Factor $I_e = 1.0$
Snow Factor $I_s = 1.0$
Wind Factor $I_w = 1.0$

LICENSED PROFESSIONAL ENGINEER
No 171553
STEVEN J. CARLSON
STATE OF UTAH

5/25/22

4, 5, 6

Design Loads

Occupancy Live Loads *(IBC 2018)*

Snow Loads *(See ASCE 7, Chapter 7, IBC 2018)*

Ground Snow Load (P_g) **110** PSF *(See ASCE 7-16)*
Thermal Factor $\mathbf{C_t = 1.1}$ (ASCE 7-16)
Snow Exposure Factor (ASCE 7-16) $\mathbf{C_e = 0.9}$
Flat Roof Snow Load (P_f), $0.7C_eC_tIP_g = 0.7(0.9)(1.1)(1.0)P_g = 0.693P_g =$ **76** PSF
Unbalanced / Drift Loads ASCE 7-16

Wind Loads *(See ASCE 7-16)*

Basic Wind Speed V **115** MPH (3 Second Gust)
Exposure Category **C** (IBC 2018)

Materials

Wood (National Design Specification for Wood Construction (NDS 05))
(IBC 2018)

Dimensional Lumber

Douglas Fir No. 2 (or Better)		
Flexural Stress F_b		900 PSI
Compression Perpendicular to Grain	$F_{c\perp}$	625 PSI
Compression Parallel to Grain	$F_{c\parallel}$	1,350 PSI
Horizontal Shear	F_v	180 PSI
Modulus of Elasticity	E	1,600,000 PSI

Concrete

Compressive Strength Slabs on Grade / Footings	2,500 PSI
Foundations	3,000 PSI
Suspended Slabs	4,000 PSI

Masonry

Hollow Brick	(ASTM C652-15)	F'_m	1,900 PSI (Min)
Mortar	(ASTM C270-14A, Type M or S)	F'_c	1,800 PSI (Min)
Grout	(ASTM C476-16)	F'_c	2,500 PSI

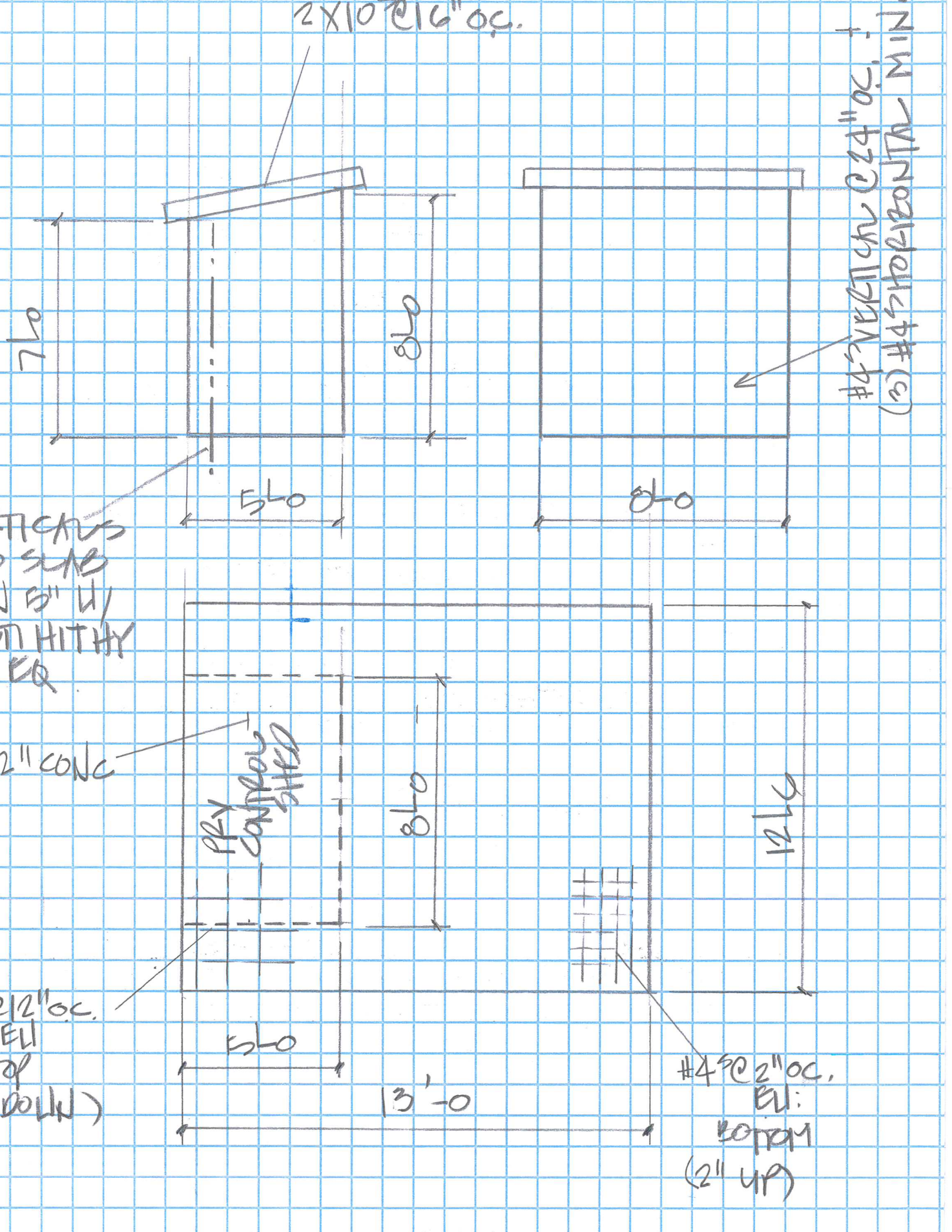
Reinforcement

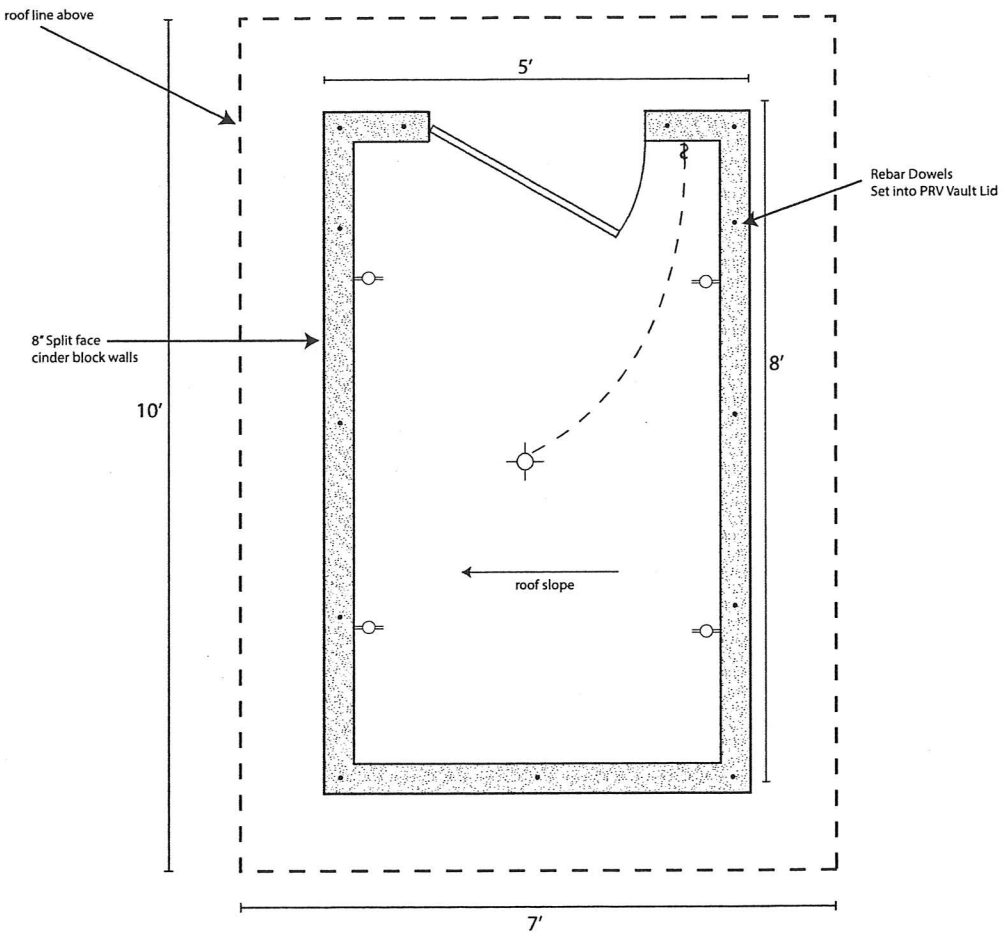
Grade 60, Yield Strength	60,000 PSI
Tensile Strength	90,000 PSI

General Notes

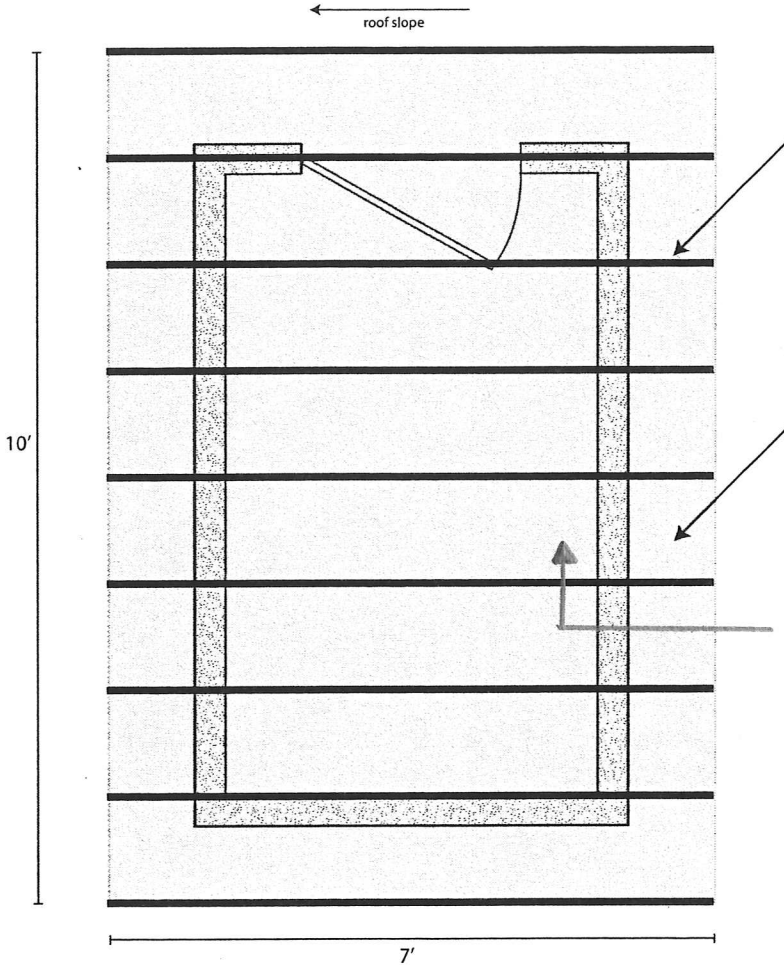
These calculations, and accompanying plans, are for one project, at one location only. All plans and calculations should be wet stamped.
Engineering West's scope covers structural design of structure only. Specifically excluded are electrical, HVAC, plumbing, interior and exterior finishes etc.: Even if this information is included on a stamped drawings.
Construction materials and details shall be in strict conformance with the latest edition of the International Building Code and other referenced standards. Details not in conformance with the calculations shall be approved in writing by the engineer.
Unless specifically indicated no investigation has been made by Engineering West, of the lot, or it's soil characteristics, to determine it's ability to support the structure. Engineering West, LLC has assumed a 1,500 psf allowable soil bearing pressure. If there are any concerns with regard to the site a geo-technical specialist should be consulted. If conditions indicate a need for additional structural design, based on the soil conditions, including grade, Engineering West should be notified immediately.
The above design criteria should be reviewed and approved by the building official and contractor to assure actual conditions meet those used. Engineering West should be notified immediately of any discrepancies. Unless otherwise agreed in writing maximum total liability to Engineering West, L.L.C. will be limited to the dollar value of the engineering performed.
Note: The lateral forces (Wind and Seismic) used in the design of this project are the minimum required by the code. These minimum forces, and the resulting design, provide for a measure of safety for preventing structural conditions causing failure or collapse. The design does not guarantee the structure will not sustain damage during a seismic occurrence or high wind condition. Proper construction of the following lateral resisting elements is necessary to obtain the level of safety required by the code:

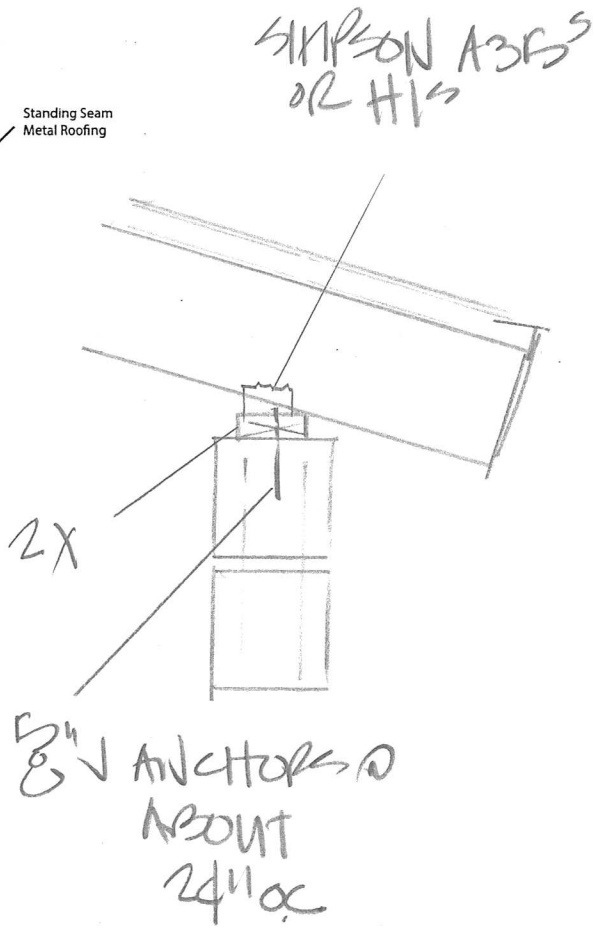
1) Roof and floor diaphragm construction and attachment to supporting members (shearwalls, beams, foundation)
2) Shearwalls - proper nailing, blocking, and construction.
3) Foundation holdowns, anchor bolts, between level straps. All straps and holdowns must be placed as shown on plans to work in conjunction with the shearwalls to prevent uplift and transfer all lateral and uplift forces to the foundation.


2X10 @16" o.c.
7'-0
8'-0
5'-0
8'-0
#4 VERTICAL @24" o.c. + #4 HORIZONTAL MIN.
VERTICALS INTO SLAB MIN 5" W/ HILTI HIT HY OR EQ
12" CONC
PER ENGR'D SHED
8'-0
12'-0
#4 @12" o.c. EU TOP (2" DOWN)
5'-0
13'-0
#4 @ 2" o.c. EU: BOTTOM (2" UP)



#4 VERTICALS @ ABOUT 24" O.C.
(3) #4's HORIZONTAL (MIN)
EMBED 5" MIN INTO LID
W/ HILTI HIT HY 200
OR EQ.


roof slope
2x10 Rafters
16" O C
Standing Seam
Metal Roofing
10'
7'


SIMPSON A35 OR H1
2X
5/8" ANCHORS @ ABOUT 24" OC

LOAD ON SHEAR WALL

ROOF DL 3(15) = 45

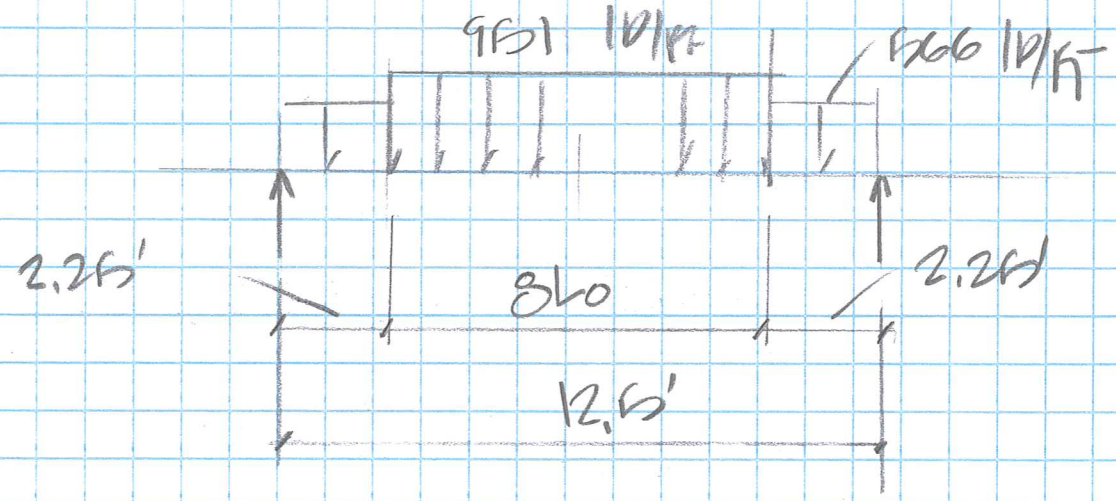
SNOW 3(76) = 228

CMU 8(66) = 528

801 LB/FT

FLOOR 150 LB/FT

SDL 1.5(125) = 188 LB/FT



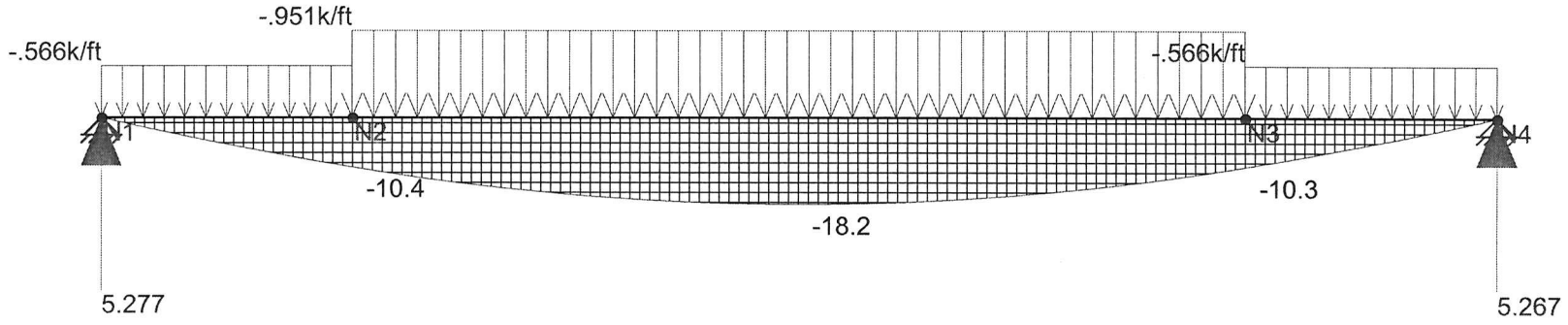
M_{max} = 18,194 FT LB

CHECK V/D

$$q = \frac{60(0.2)}{0.85(3)2} = 2.3529$$

$$M_{max} = 0.9(60{,}000)(6*0.2)\left[10 - \frac{2.3529}{2}\right] = 47{,}647 \text{ FT LB}$$

OK



Loads: BLC 1, DL + LL
Results for LC 1, DL + LL
Member z Bending Moments (k-ft)
Y-direction Reaction units are k and k-ft

Engineering West, L.L.C.	Perkins Cabin	SK - 1
Steven J Carlson		May 25, 2022 at 5:35 PM
		STEELBEAM.r3d

Member Section Forces (By Combination)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Mo...	z-z Mo...
1	1	M1	1	0	5.277	0	0	0	0
2			2	0	4.939	0	0	0	-2.873
3			3	0	4.6	0	0	0	-5.556
4			4	0	4.262	0	0	0	-8.048
5			5	0	3.923	0	0	0	-10.35
6	1	M2	1	0	3.923	0	0	0	-10.35
7			2	0	1.961	0	0	0	-16.235
8			3	0	-.001	0	0	0	-18.194
9			4	0	-1.963	0	0	0	-16.23
10			5	0	-3.925	0	0	0	-10.341
11	1	M3	1	0	-3.925	0	0	0	-10.341
12			2	0	-4.261	0	0	0	-8.039
13			3	0	-4.596	0	0	0	-5.548
14			4	0	-4.931	0	0	0	-2.868
15			5	0	-5.267	0	0	0	0

Beam Design

Simply Supported/Uniform Load

Beam Description: Roof Rafters

Uniform Load (lbs/ft):	121	(w)	Uniform Live Load:	76	(psf)
Beam Length (ft.):	5	(L)	Uniform Dead Load:	15	(psf)
Beam Dead Load (lb):	3.17	(bm)			
Reaction (lbs):	310.4				

Section Modulus:

b=	1.5	in
d=	9.5	in
S=	22.6	in^3

Moment of Inertia: I= 107.2 in^3

Area: A= 14.25 sq.in.

Modulus of Elasticity: E= 1.60E+06 (psi)

Steel Option

Fy =	50,000	
E =	29,000,000	
Smin =	0.2	
Imin =	0.23	L/240
Imin =	0.35	L/360

Bending

Moment: $(w+bm)*(L^2)/8$= 388.0 (ft-lbs)

Bending Stress= 206.37 (psi)

Size Factor Cf = 1.00 (Reduction in Allowable Bending Stress)

Shear

Shear Stress= 32.68 (psi)

Deflection

$5*w*(L^4)/(384*E*I)$

Deflection= 0.0102 (in)

Live Load Only

L/360 = 0.1667 (in)

Live Load Plus Dead Load

L/240 = 0.2500 (in)

Beam Design

Simply Supported/Uniform Load

Beam Description: Roof Rafters

Uniform Load (lbs/ft):		(w)	Uniform Live Load:	40	(psf)
Beam Length (ft.):		(L)	Uniform Dead Load:	15	(psf)
Beam Dead Load (lb):	0.0	(bm)			
Reaction (lbs):	0.0				

Section Modulus:

b=		in
d=		in
S=	0.0	in^3

Moment of Inertia: I= 0.0 in^3

Area: A= 0.00 sq.in.

Modulus of Elasticity: E= 1.60E+06 (psi)

Steel Option

Fy =	50,000	
E =	29,000,000	
Smin =	0.0	
Imin =	ERR	L/240
Imin =	ERR	L/360

Bending

Moment: $(w+bm)*(L^2)/8$= 0.0 (ft-lbs)

Bending Stress= ERR (psi)

Size Factor Cf = 1.00 (Reduction in Allowable Bending Stress)

Shear

Shear Stress= ERR (psi)

Deflection

$5*w*(L^4)/(384*E*I)$

Deflection= ERR (in)

Live Load Only

L/360 = 0.0000 (in)

Live Load Plus Dead Load

L/240 = 0.0000 (in)

Masonary Wall / Beam Design — *Ref: Wall*

(Design for Beam or Wall / Simply Supported)

Type S Masonary Cement Mortar

Beam ? (1) =		
Wall ? (1) =	1	
Block Width **(b)** =	5.625	
Vertical Wall Height / Beam Length **(ft)** =		
Beam / Wall Depth (in) **(d)** =	2.8125	***(Steel to Face of Beam)***
Assumed Grout Spacing (in) =	**24**	
Assumed Weight of Wall (psf) =	61	**(W_p)**
Seismic Response Coeff. **Cs** =	0.3	
Allowable Masonry Stress (f_m) =	1,900	*(psi)*
Allowable Steel Stress (F_s) =	24,000	

Seismic Load V = Cs * Wp = ***18.30*** *(psf)*

Wind Load (psf) = *26.0* ***Wind Governs***

Uniform Beam Live Load (lb/ft) =

Uniform Beam Dead Load (lb/ft) = *0.0*

Maximum ***Wall*** Moment = ***W * L² / 8 (ft-lbs) =*** ***0.00***

Maximum ***Beam*** Moment = ***W * L² / 8 (ft-lbs) =*** ***0***

Maximum ***Beam*** Shear (V) = ***W * L / 2 (lbs) =*** ***0***

E_s =	29,000,000	
E_m =	1,350,000	
n = E_s/E_m =	**21.5**	
Bar Area per Cell (in^2) =	**0.31**	Bar Designation =

(Bar Size and Spacing)

Assumed Steel Area **As** (in^2) = 0.155

ρ = ***0.00459***

nρ = ***0.0987***

k = $\sqrt{((n\rho)^2 + 2n\rho)} - n\rho$ = ***0.3564***

j = 1- k/3 = ***0.881***

Steel Stress

f_s = M / $A_s$jd = ***0*** *(psi)*

(Calculated Reinforcement Stress)

Masonry Stress ***OK***

f_m = 2 M / b(kd)(jd) ***0.0***

(Calculated Masonry Stress)

Fb = (1/3)*(f'_m) = ***633.33*** *(psi)*

(Allow. Masonry Stress) ***OK***

Steel Moment

M_s = A_s F_s jd = ***9,220*** *(in-lb)*

(Flexural Strength / When Reinforcement Controls)

Masonry Moment

M_m = b (kd) (Fb/2) (jd) = ***9,439*** *(in-lb)*

(Flexural Strength / When Masonry Controls)

Allowable Moment = ***9,220 (in-lb)***
768 (ft-lb)

Wall Adequate

Check Shear Considering No Shear Reinforcing

fv = V / bd = ***0.00*** psi

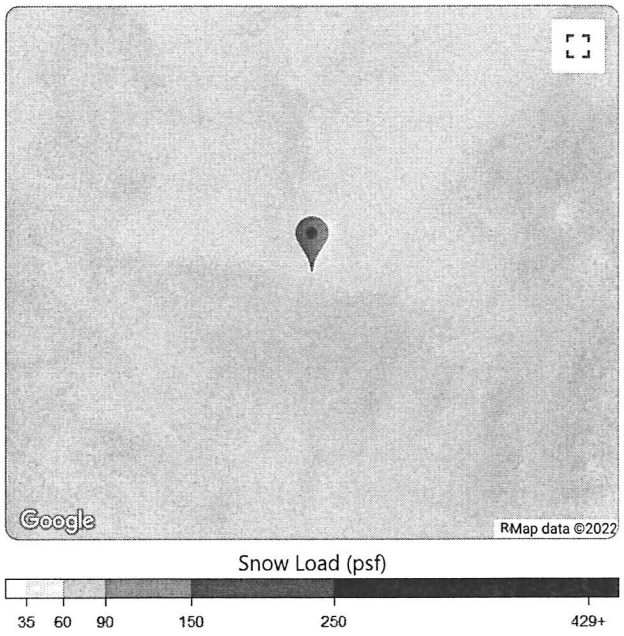
Maximum Allowable Shear = $\sqrt{f'_m}$ = ***43.6*** *(psi)*

Adequate

Utah Ground Snow Load Map

Latitude: 41.231
Longitude: -111.800
Elevation: 5,607 ft

Ground Snow Load:
76 psf / 3.66 kPa



*This document is not legally binding. The user is urged to verify ground snow load values with the local authority having jurisdiction.

These ground snow load values represent 50-year ground snow load estimated value at a 2% probability of exceedance for the location given. The grid used in the map is 3350ft by 3350ft. Elevations for these grid cells were estimated by aggregating data from 100ft by 100ft USGS digital elevation models and may not coincide with the actual site elevation. These predictions are calculated using the process outlined in The Utah Snow Load Study.[1]

Final predictions given are bounded at a lower limit for a minimum ground snow load of 21 psf to meet ASCE 7. Estimated values for snow loads at elevations significantly higher than all nearby stations lead to unreasonably high snow load estimates, therefore, the predictions in the map are not allowed to extend beyond the highest 50-year station ground snow load of 429 psf. Elevations over 9,000 ft are also considered less accurate due to the limited number of stations at these elevations. The results shown in this report have included a warning if the results have reached or exceeded the upper limit.

While great efforts have been made to ensure these predictions are as accurate as possible, designers must use expert judgement to ensure that such predictions are appropriate for their particular project. The SEAU and the authors cannot accept responsibility for prediction errors or any consequences resulting therefrom.

1 Bean, Brennan; Maguire, Marc; and Sun, Yan, "The Utah Snow Load Study" (2018). Civil and Environmental Engineering Faculty Publications. Paper 3589.