STRUCTURAL ENGINEERING CALCULATIONS

FOR

VANGUARD VILLAS
LEE'S SUMMIT, MISSOURI

PREPARED BY

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OF

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FOR

TR,i ARCHITECTS
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SEPTEMBER 2, 2021

Structural Design Criteria

Building Code:

International Building Code (IBC 2018 - *As adopted by the city of Lee's Summit, MO)*

Concrete:	*ACI 318-14*
Steel:	*AISC 360-16*
Wood:	*NDS 2015*
Connections:	*ASCE 7-16*

ANSI as approved in 2011

Basic Load Combinations - Allowable Stress Design (ASCE7-16)

D
D + L
D + (Lr or S or R)
D + 0.75L + 0.75(Lr or S of R)
D + (0.6W or 0.7E)
D + 0.75L + 0.75(0.6W) + 0.75(lR or S or R)
D + 0.75L + 0.75(0.7E) + 0.75S
0.6D + 0.6W
0.6D + 0.7E

Structural Design Loads

Live Loads:

Public Rooms	100	psf
Stairs	100	psf
Apartment Floors (Private Rooms)	40	psf
Corridors	100	psf
Storage Areas	125	psf
Decks/Balconies (Private)	60	psf
Decks/Balconies (Public)	100	psf
Roofs	20	psf

Geotechnical Report

Report #	20-5555
By:	CFS Engineers
Description:	2,500 psf allowable soil bearing

Materials

Steel:	Beams & Columns:	ASTM A992, Grade 50
	Miscellaneous steel:	ASTM A36
	Tubes & Pipes:	ASTM A500, Grade B

Concrete: 3500 psi (footings, foundations, grade beams)
4000 psi (interior slab)
4500 psi w/ 6% +/- 1% air entrainment (exterior flatwork)

Reinf. Steel: ASTM A615 or A706 Grade 60 steel

Wind Loads

International Building Code 2018 / ASCE7-16 *Spreadsheet password = bdc*

ASCE 7-16:

Chapter 26 - General Requirements

Occupancy Risk Category	II	Table 1.5-1, p. 4
Basic Wind Speed, V	109 mph	Figure 26.5-1A, B, C, D, pp. 250-257
Wind Directionality Factor, Kd	1.00	Table 26.6-1, p. 266
Exposure Category	C	26.7.3, p. 266
Topographic Factor, Kzt	1.00	26.8.2, p. 268
Gust Effect Factor, G	0.85	26.11.1, p. 269
Enclosure Classification	Enclosed	26.12
Internal Pressure Coefficient, Gcpi (Case 1)	0.18	Table 26.13-1, p. 271
Internal Pressure Coefficient, Gcpi (Case 2)	-0.18	Table 26.13-1, p. 271

Chapter 27 - Wind Loads on Buildings - MWFRS (Directional Procedure)

Windward Wall - Case 1 (Positive Internal Pressure)

z (ft)	Kz p. 261	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)
0-15	0.85	25.85	0.8	12.93 psf
16-20	0.90	27.37	0.8	13.69 psf
21-25	0.94	28.59	0.8	14.30 psf
26-30	0.98	29.81	0.8	14.90 psf
31-40	1.04	31.63	0.8	15.82 psf
41-50	1.09	33.15	0.8	16.58 psf
51-60	1.13	34.37	0.8	17.18 psf

Leeward Wall - Case 1 (Positive Internal Pressure)

z (ft)	Kz p. 261	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)	Design Wind Pressure Windward + Leeward
0-15	0.85	25.85	-0.5	-15.64 psf	**28.57 psf**
16-20	0.90	27.37	-0.5	-16.56 psf	**30.25 psf**
21-25	0.94	28.59	-0.5	-17.30 psf	**31.59 psf**
26-30	0.98	29.81	-0.5	-18.03 psf	**32.94 psf**
31-40	1.04	31.63	-0.5	-19.14 psf	**34.95 psf**
41-50	1.09	33.15	-0.5	-20.06 psf	**36.63 psf**
51-60	1.13	34.37	-0.5	-20.79 psf	**37.98 psf**

Windward Wall - Case 2 (Negative Internal Pressure)

z (ft)	Kz p. 261	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)
0-15	0.85	25.85	0.8	22.23 psf
16-20	0.90	27.37	0.8	23.54 psf
21-25	0.94	28.59	0.8	24.59 psf
26-30	0.98	29.81	0.8	25.63 psf
31-40	1.04	31.63	0.8	27.20 psf
41-50	1.09	33.15	0.8	28.51 psf
51-60	1.13	34.37	0.8	29.56 psf

Leeward Wall - Case 1 (Negative Internal Pressure)

z (ft)	Kz p. 261	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)	Design Wind Pressure Windward + Leeward
0-15	0.85	25.85	-0.5	-6.33 psf	**28.57 psf**
16-20	0.90	27.37	-0.5	-6.71 psf	**30.25 psf**
21-25	0.94	28.59	-0.5	-7.00 psf	**31.59 psf**
26-30	0.98	29.81	-0.5	-7.30 psf	**32.94 psf**
31-40	1.04	31.63	-0.5	-7.75 psf	**34.95 psf**
41-50	1.09	33.15	-0.5	-8.12 psf	**36.63 psf**
51-60	1.13	34.37	-0.5	-8.42 psf	**37.98 psf**

Roof Pressure

z (ft)	Kz p. 261	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)
0-15	0.85	25.85	-1.3	-23.91 psf
16-20	0.90	27.37	-1.3	-25.59 psf

Earthquake Loads

International Building Code 2018 / ASCE7-16 *Spreadsheet password = bdc*

Occupancy Risk Category	II	Table 1.5-1, p. 4
Ss	9.9 %g	(Figure 22-1) p. 211
S1	6.8 %g	(Figure 22-2) p. 213
Site Class (per soil report or assume D)	C	(Table 20.3-1) p. 204
Site Coefficient, Fa	1.3	(Table 11.4-1) p. 84
Site Coefficient, Fv	1.5	(Table 11.4-2) p. 84
Importance Factor, I	1.0	(Table 1.5-1) p. 5

11.4.3 Site coefficients and adjusted maximum considered earthquake response acceleration parameters

for short periods, Sms = Fa*Ss	0.129	(Equation 11.4-1)
at 1-second period, Sm1 = Fv*S1	0.102	(Equation 11.4-2)

11.4.4 Design spectral response acceleration parameters

Sds = (2/3)*Sms	0.086	(Equation 11.4-3)
Sd1 = (2/3)*Sm1	0.068	(Equation 11.4-4)
Seismic Design Category	B	(Tables 11.6-1 and 11.6-2) p. 85

12.8 Equivalent Lateral Force Procedure

Response Modification Factor, R	2.0	(Table 12.2-1) p.90
Cs = Sds/(R/I)	0.043	
Seismic Base Shear, V = CsW	**0.043 W**	(12.8-1)
W = Effective seismic weight per Section 12.7.2		

Snow Loads

International Building Code 2018 / ASCE7-16 *Spreadsheet password = bdc*

Occupancy Risk Category	II		Table 1.5-1, p. 4
Pg	20.0	psf	(Figure 7.2-1) p. 53
Ce	1.0		(Table 7.3-1), p. 58
Ct	1.0		(Table 7.3-2), p. 58
Is	1.0		(Table 1.5-2), p. 5

7.3 Flat Roof Snow Loads, pf

pf	14	psf	(Equation 7.3-1)
pm	20.00	psf	(7.3.4), p. 52

7.7 Drifts on Lower Roofs

Case 1: Typical Exterior Wall			
Lu	0.0		(Length of High Roof)
W	50.0		(Length of Low Roof)
γ	16.6	pcf	
Windward hd	1.66	ft	
Leeward hd	-1.50	ft	
hd	1.66	ft	
w	13.24	ft	
pd	27.48	psf	
Case 2: Internal Parapet Between Units			
Lu	0.0		(Length of High Roof)
W	23.0		(Length of Low Roof)
γ	15.8	pcf	
Windward hd	1.02	ft	
Leeward hd	-1.50	ft	
hd	1.02	ft	
w	8.17	ft	
pd	16.16	psf	
Case 3: Drift against Pop-Up Roof			
Lu	18.0		(Length of High Roof)
W	33.0		(Length of Low Roof)
γ	15.8	pcf	
Windward hd	1.30	ft	
Leeward hd	1.14	ft	
hd	1.30	ft	
w	10.37	ft	
pd	20.50	psf	

Hazards by Location

Search Information

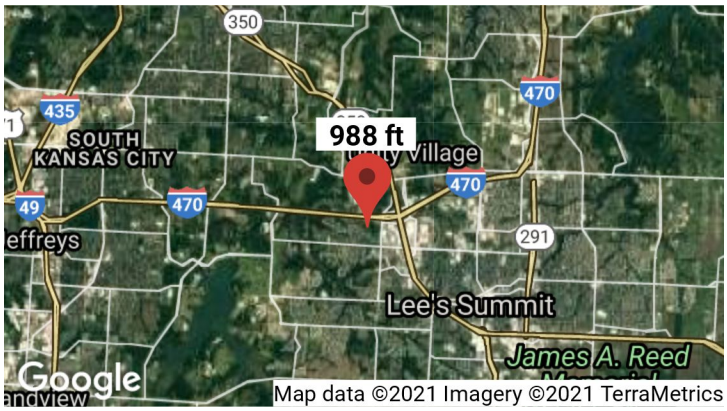
Address: NW Lowenstein Dr & Black Twig Ln, Lee's Summit, MO 64081, USA

Coordinates: 38.929927, -94.4179688

Elevation: 988 ft

Timestamp: 2021-09-01T02:15:36.038Z

Hazard Type: Wind



ASCE 7-16

MRI 10-Year	76 mph
MRI 25-Year	83 mph
MRI 50-Year	88 mph
MRI 100-Year	94 mph
Risk Category I	103 mph
Risk Category II	109 mph
Risk Category III	117 mph
Risk Category IV	122 mph

ASCE 7-10

MRI 10-Year	76 mph
MRI 25-Year	84 mph
MRI 50-Year	90 mph
MRI 100-Year	96 mph
Risk Category I	105 mph
Risk Category II	115 mph
Risk Category III-IV	120 mph

ASCE 7-05

ASCE 7-05 Wind Speed	90 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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Hazards by Location

Search Information

Address: NW Lowenstein Dr & Black Twig Ln, Lee's Summit, MO 64081, USA

Coordinates: 38.929927, -94.4179688

Elevation: 988 ft

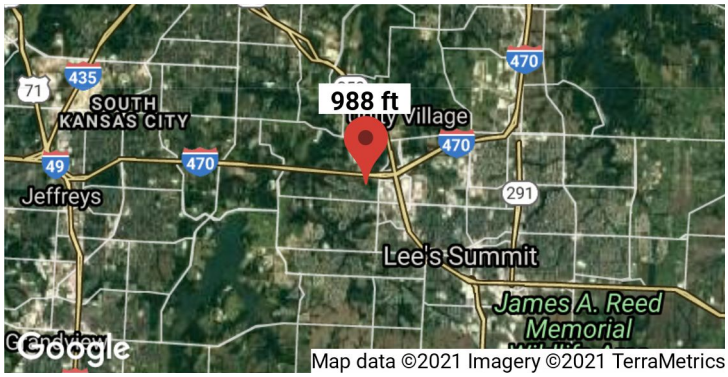
Timestamp: 2021-09-01T02:16:58.250Z

Hazard Type: Seismic

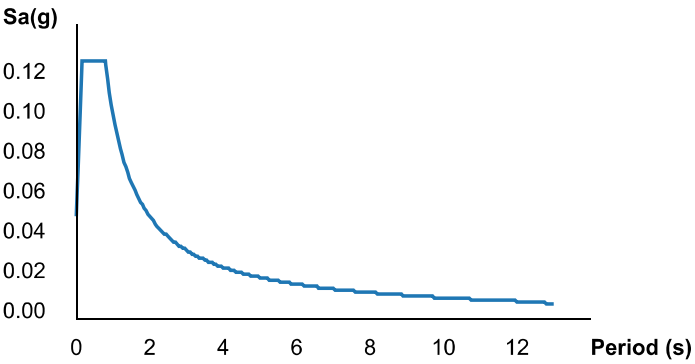
Reference Document: ASCE7-16

Risk Category: II

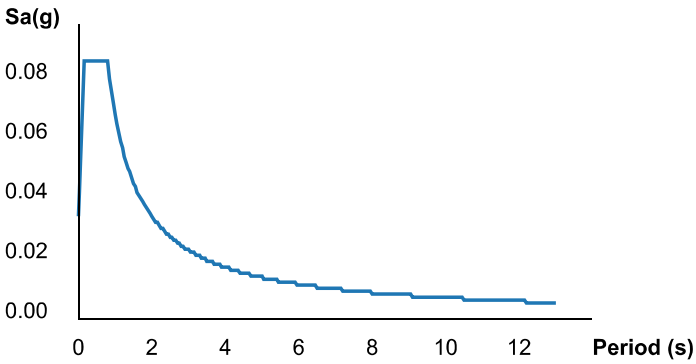
Site Class: C



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.099	MCE_R ground motion (period=0.2s)
S_1	0.068	MCE_R ground motion (period=1.0s)
S_{MS}	0.129	Site-modified spectral acceleration value
S_{M1}	0.102	Site-modified spectral acceleration value
S_{DS}	0.086	Numeric seismic design value at 0.2s SA
S_{D1}	0.068	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	B	Seismic design category
F_a	1.3	Site amplification factor at 0.2s
F_v	1.5	Site amplification factor at 1.0s

CR_S	0.927	Coefficient of risk (0.2s)
CR_1	0.877	Coefficient of risk (1.0s)
PGA	0.047	MCE_G peak ground acceleration
F_{PGA}	1.3	Site amplification factor at PGA
PGA_M	0.061	Site modified peak ground acceleration
T_L	12	Long-period transition period (s)
SsRT	0.099	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.107	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.068	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.078	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

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Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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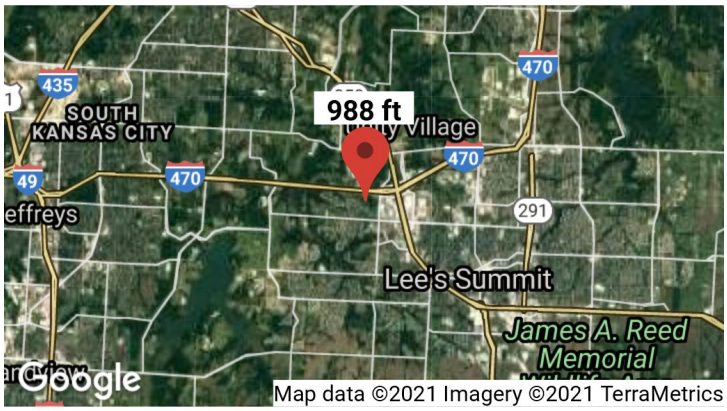
Address: NW Lowenstein Dr & Black Twig Ln, Lee's Summit, MO 64081, USA

Coordinates: 38.929927, -94.4179688

Elevation: 988 ft

Timestamp: 2021-09-01T02:16:38.501Z

Hazard Type: Snow



ASCE 7-16		ASCE 7-10		ASCE 7-05	
Ground Snow Load	20 lb/sqft	Ground Snow Load	20 lb/sqft	Ground Snow Load	20 lb/sqft

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TRI2102 Vanguard Villas

ASCE 7-16 - Main Wind Force Reinforcing System: Directional Procedure

ASCE 7-16 - Seismic Design Requirements for Building Structures

General Data

LONGITUDINAL =	51.0 ft	Dim Parallel to Wind
TRANSVERSE =	195.0 ft	Dim Normal to Wind

Parapet	23.8 ft
Roof	21.8 ft
2nd Floor	11.5 ft

Risk Category

Category =	II	
Importance Factor=	1.00	

Basic Wind Speed

V =	109 mph	

Wind Load Parameters

K_d =	0.85	Wind Directionality Factor
Exposure:	B	Exposure Category
K_{zt} =	1.00	Topographic Factor
G =	0.85	Gust Effect Factor
Classification:	Enclosed	Enclosure Classifcation
(GC_{pi}) =	+/- .18	Internal Pressure Coefficient

TRI2102 Vanguard Villas **Bob D. Campbell & Co.**

ASCE 7-16 - Main Wind Force Reinforcing System: Directional Procedure 9/1/2021

(Table 27.2-1)

General Data

L =	51 ft	Dim Parallel to Wind
B =	195 ft	Dim Normal to Wind

Risk Category

Category =	II	
Importance Factor=	1.00	

Basic Wind Speed

V = 109 mph

Wind Load Parameters

K_d =	0.85	Wind Directionality Factor
Exposure:	B	Exposure Category
K_{zt} =	1.00	Topographic Factor
G =	0.85	Gust Effect Factor
Classification:	Enclosed	Enclosure Classifcation
(GC_{pi}) =	+/- .18	Internal Pressure Coefficient

Velocity Pressure Exposure Coefficient

α =	7.0	(3 sec gust speed power law exponent)
z_g =	1200	(Nominal height of atmospheric bounday layer)

External Pressure Coefficient

	L/B	C_p	
		0.80	Windward
Wall	0.26	-0.50	Leeward
		-0.70	Side

	h/L =	0.00
Roof (θ<10˚)	C_p =	-1.04
	C_p =	-0.18
	C_p =	NA

Windward (min)
Windward (max)
Leeward

Parapet

h_p =	4.33 ft	Parapet Height
K_z =	0.57	Velocity Pressure Coefficient at Parapet Height
q_p =	14.86	Velocity Pressure at Parapet Height
GC_{pn}=	+ 1.5	Windward Combined Net Pressure Coefficient
GC_{pn}=	- 1	Leeward Combined Net Pressure Coefficient

Wind Pressure

WALL PRESSURE	h (ft)	K_h	q_z (psf)	$p_{windward}$ (psf)	$p_{leeward}$ (psf)	p_{total} (psf)	Area(T) (SF)	Area(L) (SF)	0.6*F_x (k) TRANS	0.6*F_x (k) LONG		
Parapet	23.75	0.66	16.94	11.52	0.00	11.52	390.00	102.00	2.7	0.7	0.0138254	0.0138254
Roof	21.75	0.64	16.52	11.24	0.00	11.24	1194.38	312.38	10.7	2.8	0.0551149	0.0551149
2nd Floor	11.5	0.57	14.86	10.10	0.00	10.10	2120.63	554.63	12.9	3.4	0.0659261	0.0659261

Seismic Load Distribution

Wood Shearwalls	
Site Class	C
Risk Category	II
R =	2
I_e =	1.00
S_{DS} =	0.0860
S_{D1} =	0.0680
T_a =	0.287794
T_L =	12
k	1

Seismic Response Coefficient	
$C_{s,min}$	0.010
C_s	0.043
$C_{s,max}$	0.118
	0.043

Building Dimensions	
L	51 ft
B	195 ft

Seismic Force Distribution

Floor	Height	Area (ft^2)	DL (psf)	Weight (k)	$W_xH_x^k$	C_{vx}	F_x	$0.7F_x$	
Parapet	23.75	0	25	0	0	0.00	0.0 k	0.0 k	0
Roof	21.75	9894	20	197.88	4303.89	0.52	12.2 k	8.5 k	0.02934
2nd Floor	11.5	9894	35	346.29	3982.335	0.48	11.2 k	7.9 k	0.02714
Total				544	8286	1.00	23.4 k	16.4 k	

Base V =	23.40 k

Controlling Lateral Loads

L			Floor	B		
Controls	Wind $0.6F_x$ (k)	Seismic $0.7F_x$ (k)		Seismic $0.7F_x$ (k)	Wind $0.6F_x$ (k)	Controls
Wind	0.0	0.0	**Parapet**	0.0	0.0	**Wind**
Seismic	2.8	8.5	**Roof**	8.5	10.7	**Wind**
Seismic	3.4	7.9	**2nd Floor**	7.9	12.9	**Wind**
	6.2	16.4		16.4	23.6	

Demising Wall

INPUT				OUTPUT				
L	22.5	(FT)	LENGTH OF SHEAR WALL	**PR**	658	(LBS)	LATERAL FORCE @ Level R	
W	7	(PSF)	WALL WEIGHT	**P_2**	794	(LBS)	LATERAL FORCE @ Level 2	
TW	1.0	(FT)	TRIBUTARY WIDTH	**VR**	29	(PLF)	WALL DESIGN SHEAR (Level R)	
V_R	10.7	(k)	DIAPHRAGM SHEAR (Level R)	**V_2**	46	(PLF)	WALL DESIGN SHEAR (Level 2)	
V_2	12.9	(k)	DIAPHRAGM SHEAR (Level 2)	**M_{OVR}**	14322	(LB-FT)	OVERTURNING MOMENT @ Level R	
H_R	21.75	(FT)	FLR HEIGHT	**M_{OV2}**	22792	(LB-FT)	OVERTURNING MOMENT @ Level 2	
H_2	10.67	(FT)	FLR HEIGHT	**$0.6(M_{RES})_R$**	11344	(LB-FT)	RESISTING MOMENT @ Level R	
DL_R	0	(PSF)	DEAD LOAD (Level R)	**$0.6(M_{RES})_2$**	23123	(LB-FT)	RESISTING MOMENT @ Level 2	
$Trib_R$	0	(FT)	TRIB WIDTH (Level R)	**T_R**	142	(LBS)	UPLIFT @ Level R	
DL_2	25	(PSF)	DEAD LOAD (Level 2)	**T_2**	-16	(LBS)	UPLIFT @ Level 2	
$Trib_2$	1	(FT)	TRIB WIDTH (Level 2)					

STORY	**SW**	**HOLDOWN**
2	5/8" GYPSUM W/ 7/7 BLOCKED 6D COOLER NAILS	HDU2
1	5/8" GYPSUM W/ 7/7 BLOCKED 6D COOLER NAILS	HDU2

SHEATHING	**PLF**
5/8" GYPSUM W/ 7/7 BLOCKED 6D COOLER NAILS	145
7/16" BLOCKED APA-RATED SHEATHING W/ 8D @6"oc	540
7/16" BLOCKED APA-RATED SHEATHING W/ 8D @4"oc	665
7/16" BLOCKED APA-RATED SHEATHING W/ 8D @3"oc	1015

HDU	**Tension Capacity (#)**	studs needed
HDU2	3075	2
HDU4	4565	2
HDU5	5645	2
HDU8	7870	3

Exterior Wall

INPUT				OUTPUT			
L	46.64	(FT)	LENGTH OF SHEAR WALL	**PR**	8500	(LBS)	LATERAL FORCE @ Level R
W	7	(PSF)	WALL WEIGHT	**P_2**	7900	(LBS)	LATERAL FORCE @ Level 2
TW	1.0	(FT)	TRIBUTARY WIDTH	**VR**	182	(PLF)	WALL DESIGN SHEAR (Level R)
V_R	8.5	(k)	DIAPHRAGM SHEAR (Level R)	**V_2**	352	(PLF)	WALL DESIGN SHEAR (Level 2)
V_2	7.9	(k)	DIAPHRAGM SHEAR (Level 2)	**M_{OVR}**	184875	(LB-FT)	OVERTURNING MOMENT @ Level R
H_R	21.75	(FT)	FLR HEIGHT	**M_{OV2}**	269168	(LB-FT)	OVERTURNING MOMENT @ Level 2
H_2	10.67	(FT)	FLR HEIGHT	**$0.6(M_{RES})_R$**	48742	(LB-FT)	RESISTING MOMENT @ Level R
DL_R	0	(PSF)	DEAD LOAD (Level R)	**$0.6(M_{RES})_2$**	99356	(LB-FT)	RESISTING MOMENT @ Level 2
$Trib_R$	0	(FT)	TRIB WIDTH (Level R)	**T_R**	3016	(LBS)	UPLIFT @ Level R
DL_2	25	(PSF)	DEAD LOAD (Level 2)	**T_2**	3762	(LBS)	UPLIFT @ Level 2
$Trib_2$	1	(FT)	TRIB WIDTH (Level 2)				

STORY	**SW**	**HOLDOWN**
2	7/16 BLOCKED APA-RATED SHEATHING W/ 8D @6oc	HDU4
1	7/16 BLOCKED APA-RATED SHEATHING W/ 8D @6oc	HDU4

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Vanguard Villas - West Pryor Phase III
Lee's Summit, MO
9/1/2021

Grade Beam Typical Exterior

This spreadsheet calculates the required width of a grade beam *Spreadsheet password = bdc*

Given:

Allowable soil bearing capacity (psf)	**2500**

Calculate Roof Load

	Load (psf)	Trib. Width (ft.)	Load (plf)
Roof Dead Load	25	12	300
Roof Live load	20	12	240
Roof Total Load			**540**

Calculate Floor Load

	Load (psf)	Trib. Width (ft.)	Load (plf)
Floor Dead Load	25	12	300
Floor Live load	40	12	480
Floor Total Load			**780**

Calculate Wall Load

Material	Load (psf)	Height (ft.)	Load (plf)
4" face brick	40	0	0
stud wall w/ sheathing	15	24	360
Wall Total Load			**360**

Calculate Self Load of Grade Beam

Width of grade beam (ft)	1.33
Depth of grade beam (ft)	2.67
Density (pcf)	150
G.B. Total Load (plf)	**533**

Calculate Load of Soil Displaced by Grade Beam

Width of grade beam (ft)	1.33
Depth of grade beam (ft)	2.67
Density (pcf)	115
Displaced Soil Total Load (plf)	**408**

Load Summary

Roof Total Load	540
Floor Total Load	780
Wall Total Load	360
G.B. Total Load (plf)	533
Displaced Soil Total Load (plf)	-408
Total Load	**1804**

Design Summary

Total Load (plf)	1804
Required width (ft)	0.72
Width of grade beam (ft)	**1.33**
Depth of grade beam (ft)	**2.67**
Bearing Pressure (psf)	1357

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Vanguard Villas - West Pryor Phase III
Lee's Summit, MO
9/1/2021

Grade Beam Unit Demising

This spreadsheet calculates the required width of a grade beam *Spreadsheet password = bdc*

Given:

Allowable soil bearing capacity (psf)	**2500**

Calculate Roof Load

	Load (psf)	Trib. Width (ft.)	Load (plf)
Roof Dead Load	25	24	600
Roof Live load	20	24	480
Roof Total Load			**1080**

Calculate Floor Load

	Load (psf)	Trib. Width (ft.)	Load (plf)
Floor Dead Load	25	24	600
Floor Live load	40	24	960
Floor Total Load			**1560**

Calculate Wall Load

Material	Load (psf)	Height (ft.)	Load (plf)
4" face brick	40	0	0
stud wall w/ sheathing	15	24	360
Wall Total Load			**360**

Calculate Self Load of Grade Beam

Width of grade beam (ft)	1.33
Depth of grade beam (ft)	1
Density (pcf)	150
G.B. Total Load (plf)	**200**

Calculate Load of Soil Displaced by Grade Beam

Width of grade beam (ft)	1.33
Depth of grade beam (ft)	1
Density (pcf)	115
Displaced Soil Total Load (plf)	**153**

Load Summary

Roof Total Load	1080
Floor Total Load	1560
Wall Total Load	360
G.B. Total Load (plf)	200
Displaced Soil Total Load (plf)	-153
Total Load	**3047**

Design Summary

Total Load (plf)	3047
Required width (ft)	1.22
Width of grade beam (ft)	**1.33**
Depth of grade beam (ft)	**1**
Bearing Pressure (psf)	2291

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Vanguard Villas - West Pryor Phase III
Lee's Summit, MO
Sep-21

Wood Beam 2x10 Deck Joist

1. Simple Beam - Uniformly Distributed Load
(Beam is laterally supported)

Spreadsheet password = bdc

Span	9.00	ft.	
Dead Load	40.00	psf	
Live Load	60.00	psf	
Tributary Width	1.33	ft.	
Superimposed uniform dead load	0	k/ft.	
Superimposed uniform live load	0	k/ft.	
Total Uniform Load, w	0.13	k/ft.	
Maximum Moment (at center), M	1.35	k*ft.	
End Reaction	0.60	k	
x	0	ft	
Shear at distance=x from support, Vx	0.60	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	1.05	ksi	
E Modulus of Elasticity	1500.00	ksi	
Sx Required = M/Fb	15.39	in.3	
Beam Width	**1.5**	**in.**	2x10
Beam Depth	**9.25**	**in.**	
Sx Section Modulus	21.39	in.3	
Ix Moment of Inertia	98.93	in.4	
Stress= M/S	0.76	ksi	
Total Load Deflection (at center)	0.13	in.	
Total Load Deflection = L/	816		
Live Load Deflection (at center)	0.08	in.	
Live Load Deflection = L/	1360		
Horizontal Shear = 3V/2bd	0.06	ksi	

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Wood Beam 2x10 Roof Joist

1. Simple Beam - Uniformly Distributed Load
(Beam is laterally supported)

Spreadsheet password = bdc

Span	12.50	ft.	
Dead Load	25.00	psf	
Live Load	20.00	psf	
Tributary Width	1.33	ft.	
Superimposed uniform dead load	0	k/ft.	
Superimposed uniform live load	0	k/ft.	
Total Uniform Load, w	0.06	k/ft.	
Maximum Moment (at center), M	1.17	k*ft.	
End Reaction	0.37	k	
x	0	ft	
Shear at distance=x from support, Vx	0.37	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	1.05	ksi	
E Modulus of Elasticity	1500.00	ksi	
Sx Required = M/Fb	13.36	in.3	
Beam Width	**1.5**	**in.**	2x10
Beam Depth	**9.25**	**in.**	
Sx Section Modulus	21.39	in.3	
Ix Moment of Inertia	98.93	in.4	
Stress= M/S	0.66	ksi	
Total Load Deflection (at center)	0.22	in.	
Total Load Deflection = L/	677		
Live Load Deflection (at center)	0.10	in.	
Live Load Deflection = L/	1523		
Horizontal Shear = 3V/2bd	0.04	ksi	

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Lee's Summit, MO
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Wood Beam 2x6 Stair Joist

1. Simple Beam - Uniformly Distributed Load *Spreadsheet password = bdc*
(Beam is laterally supported)

Span	4.00	ft.	
Dead Load	10.00	psf	
Live Load	100.00	psf	
Tributary Width	2.00	ft.	
Superimposed uniform dead load	0	k/ft.	
Superimposed uniform live load	0	k/ft.	
Total Uniform Load, w	0.22	k/ft.	
Maximum Moment (at center), M	0.44	k*ft.	
End Reaction	0.44	k	
x	0	ft	
Shear at distance=x from support, Vx	0.44	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	1.05	ksi	
E Modulus of Elasticity	1500.00	ksi	
Sx Required = M/Fb	5.03	in.3	
Beam Width	**1.5**	**in.**	2x6
Beam Depth	**5.5**	**in.**	
Sx Section Modulus	7.56	in.3	
Ix Moment of Inertia	20.80	in.4	
Stress= M/S	0.70	ksi	
Total Load Deflection (at center)	0.04	in.	
Total Load Deflection = L/	1182		
Live Load Deflection (at center)	0.04	in.	
Live Load Deflection = L/	1300		
Horizontal Shear = 3V/2bd	0.08	ksi	

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Wood Beam Stair Header

1. Simple Beam - Uniformly Distributed Load
(Beam is laterally supported)

Spreadsheet password = bdc

Span	6.67	ft.	
Dead Load	10.00	psf	
Live Load	100.00	psf	
Tributary Width	5.50	ft.	
Superimposed uniform dead load	0	k/ft.	
Superimposed uniform live load	0	k/ft.	
Total Uniform Load, w	0.61	k/ft.	
Maximum Moment (at center), M	3.36	k*ft.	
End Reaction	2.02	k	
x	0	ft	
Shear at distance=x from support, Vx	2.02	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	1.05	ksi	
E Modulus of Elasticity	1500.00	ksi	
Sx Required = M/Fb	38.45	in.3	
Beam Width	**3**	**in.**	(2) 2x12
Beam Depth	**11.25**	**in.**	
Sx Section Modulus	63.28	in.3	
Ix Moment of Inertia	355.96	in.4	
Stress= M/S	0.64	ksi	
Total Load Deflection (at center)	0.05	in.	
Total Load Deflection = L/	1586		
Live Load Deflection (at center)	0.05	in.	
Live Load Deflection = L/	1745		
Horizontal Shear = 3V/2bd	0.09	ksi	

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Vanguard Villas - West Pryor Phase III
Lee's Summit, MO
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Wood Beam Typical Non-Brg Roof

1. Simple Beam - Uniformly Distributed Load *Spreadsheet password = bdc*
(Beam is laterally supported)

Span	6.00	ft.	
Dead Load	25.00	psf	
Live Load	20.00	psf	
Tributary Width	1.00	ft.	
Superimposed uniform dead load	0.09	k/ft.	
Superimposed uniform live load	0	k/ft.	
Total Uniform Load, w	0.14	k/ft.	
Maximum Moment (at center), M	0.61	k*ft.	
End Reaction	0.41	k	
x	0	ft	
Shear at distance=x from support, Vx	0.41	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	1.05	ksi	
E Modulus of Elasticity	1500.00	ksi	
Sx Required = M/Fb	6.94	in.3	
Beam Width	**4.5**	**in.**	(3) 2x8
Beam Depth	**7.25**	**in.**	
Sx Section Modulus	39.42	in.3	
Ix Moment of Inertia	142.90	in.4	
Stress= M/S	0.18	ksi	
Total Load Deflection (at center)	0.02	in.	
Total Load Deflection = L/	3921		
Live Load Deflection (at center)	0.00	in.	
Live Load Deflection = L/	26464		
Horizontal Shear = 3V/2bd	0.02	ksi	

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Wood Beam Typical Brg Roof

1. Simple Beam - Uniformly Distributed Load *Spreadsheet password = bdc*
(Beam is laterally supported)

Span	6.00	ft.	
Dead Load	25.00	psf	
Live Load	20.00	psf	
Tributary Width	6.50	ft.	
Superimposed uniform dead load	0.09	k/ft.	
Superimposed uniform live load	0	k/ft.	
Total Uniform Load, w	0.38	k/ft.	
Maximum Moment (at center), M	1.72	k*ft.	
End Reaction	1.15	k	
x	0	ft	
Shear at distance=x from support, Vx	1.15	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	1.05	ksi	
E Modulus of Elasticity	1500.00	ksi	
Sx Required = M/Fb	19.67	in.3	
Beam Width	**4.5**	**in.**	(3) 2x8
Beam Depth	**7.25**	**in.**	
Sx Section Modulus	39.42	in.3	
Ix Moment of Inertia	142.90	in.4	
Stress= M/S	0.52	ksi	
Total Load Deflection (at center)	0.05	in.	
Total Load Deflection = L/	1384		
Live Load Deflection (at center)	0.02	in.	
Live Load Deflection = L/	4071		
Horizontal Shear = 3V/2bd	0.05	ksi	

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Wood Beam Typical Non-Brg Floor

1. Simple Beam - Uniformly Distributed Load
(Beam is laterally supported)

Spreadsheet password = bdc

Span	6.00	ft.	
Dead Load	25.00	psf	
Live Load	40.00	psf	
Tributary Width	1.00	ft.	
Superimposed uniform dead load	0.24	k/ft.	
Superimposed uniform live load	0	k/ft.	
Total Uniform Load, w	0.31	k/ft.	
Maximum Moment (at center), M	1.37	k*ft.	
End Reaction	0.92	k	
x	0	ft	
Shear at distance=x from support, Vx	0.92	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	1.05	ksi	
E Modulus of Elasticity	1500.00	ksi	
Sx Required = M/Fb	15.69	in.3	
Beam Width	**4.5**	**in.**	(3) 2x8
Beam Depth	**7.25**	**in.**	
Sx Section Modulus	39.42	in.3	
Ix Moment of Inertia	142.90	in.4	
Stress= M/S	0.42	ksi	
Total Load Deflection (at center)	0.04	in.	
Total Load Deflection = L/	1735		
Live Load Deflection (at center)	0.01	in.	
Live Load Deflection = L/	13232		
Horizontal Shear = 3V/2bd	0.04	ksi	

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Lee's Summit, MO
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Wood Beam Typical Brg Floor

1. Simple Beam - Uniformly Distributed Load
(Beam is laterally supported)

Spreadsheet password = bdc

Span	6.00	ft.	
Dead Load	25.00	psf	
Live Load	40.00	psf	
Tributary Width	6.00	ft.	
Superimposed uniform dead load	0.045	k/ft.	
Superimposed uniform live load	0	k/ft.	
Total Uniform Load, w	0.44	k/ft.	
Maximum Moment (at center), M	1.96	k*ft.	
End Reaction	1.31	k	
x	0	ft	
Shear at distance=x from support, Vx	1.31	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	1.05	ksi	
E Modulus of Elasticity	1500.00	ksi	
Sx Required = M/Fb	22.37	in.3	
Beam Width	**4.5**	**in.**	(3) 2x8
Beam Depth	**7.25**	**in.**	
Sx Section Modulus	39.42	in.3	
Ix Moment of Inertia	142.90	in.4	
Stress= M/S	0.60	ksi	
Total Load Deflection (at center)	0.06	in.	
Total Load Deflection = L/	1217		
Live Load Deflection (at center)	0.03	in.	
Live Load Deflection = L/	2205		
Horizontal Shear = 3V/2bd	0.06	ksi	

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Lee's Summit, MO
Sep-21

Microllam LVL Beam

Garage Header

1. Simple Beam - Uniformly Distributed Load
(Beam is laterally supported)

Spreadsheet password = bdc

Span	16.00	ft.	
Dead Load	25.00	psf	
Live Load	40.00	psf	
Tributary Width	4.00	ft.	
Superimposed uniform dead load	0.290	k/ft.	
Superimposed uniform live load	0.040	k/ft.	
Total Uniform Load, w	0.59	k/ft.	
Maximum Moment (at center), M	18.88	k*ft.	
End Reaction	4.72	k	
x	0	ft	
Shear at distance=x from support, Vx	4.72	k	
Moment at distance x from support, Mx	0.00	k*ft	
Fb Allowable Bending Stress	2.60	ksi	
E Modulus of Elasticity	1.90E+03	ksi	
Sx Required = M/Fb	87.14	in.3	
Beam Width	**5.25**	**in.**	(3) 11 7/8" LVL's
Beam Depth	**11.875**	**in.**	
Sx Section Modulus	123.39	in.3	
Ix Moment of Inertia	732.62	in.4	
Stress= M/S	1.84	ksi	
Total Load Deflection (at center)	0.63	in.	
Total Load Deflection = L/	307		
Live Load Deflection (at center)	0.21	in.	
Live Load Deflection = L/	906		
Horizontal Shear = 3V/2bd	0.11	ksi	