AVID BUILDING SYSTEMS
STRUCTURAL CALCULATIONS
STRICKLAND-LAKEWOOD STORAGE
LEE'S SUMMIT, MO

NOV 3, 2021

At your request, structural calculations were performed for Avid Building Systems, Strickland-Lakewood Storage, Lee's Summit, MO by Charles A. Witt, PE.

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If you have any questions after reviewing this report, please feel free to contact me.

Sincerely,

Charles A Witt III

Charles A. Witt, PE #2017022070
K&W Engineering Solutions, LLC.
650 Shell Stone Trail
Georgetown, TX 78628
C: 512-639-3131

Charles A Witt III

STATE OF MISSOURI
CHARLES A. WITT III
NUMBER PE-2017022070
PROFESSIONAL ENGINEER

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AVID BUILDING SYSTEMS
STRUCTURAL CALCULATIONS
STRICKLAND-LAKEWOOD STORAGE
LEE'S SUMMIT, MO

**Governing Codes:**

2018 International Building Code
ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures
AISI Cold-Formed Design Manual, 2012 Edition

**Building A:**

Lee's Summit, MO 64086
Jackson County

General Information:

Floor Area: BLDG A-
Length: 140'-0"
Width: 260'-0"
Building Height: Three Story, 29'-0"
Construction Type: Type II-B (Fully Sprinkled)
Group: S-1 & B (Mixed Use-Non Separated)
Stair Tower Rating with Sprinklers: 1 Hour

Roof Slope: 1/4" Per Foot (Flat)
Roof Live Load: 20 PSF
Roof Dead: 7 PSF
Collateral Load: 6 PSF
Floor Live Load: 125 PSF
Floor Dead Load: 45 PSF
Wind Speed: 115 mph
Exposure C
Ground Snow: 20 PSF

AVID BUILDING SYSTEMS
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Steel Calculations-Roof Purlins

Minimum Uniformly Distributed Live Load: Ordinary Flat, pitched = 20 psf

Vertical Loading on Flat Roof with building height of 29'-0":
End Zone of Windward Roof= -27.4 psf
Interior Zone of Windward Roof= -24.4 psf
End Zone Purlin Calculations:
L= 10'
*Wu*= [1.2(5x20)]/12,000 = 0.010 ki/in
S= [*Wu*L^2/8]/30 = 0.6in^3- Required

Typical Roof Purlin for this type of construction is 4x2-1/2-16ga with S= 0.68 in^3.-OK
Same Roof Purlin is permitted for use on interior columns.

Interior Columns:

Third Floor

Live Load= -27.4 psf
Dead Load= 7 psf
Column Load= 5' x 10' x 54.4 psf = 2.72 kips
Assumption: k=0.5; Lateral bracing from partitions- kl=5'
Use 4x2-1/2-16ga CEE with kl=5'- 5.76kips: Selected Section-OK

Purlin-Column Fasteners

753 lbs Pullout for #12/ 16 Ga metal
2,720lbs/753lbs= 3.61; Four (4) fasteners are required

Second Floor

Live Load = 27.4 + 125= 152.4 psf
Dead Load = 7 + 45 = 52 psf

Total Load = 204.4

Column Load = 2.5' x 10' x 204.4 psf = 5.11 kips

Use 4 x 2-1/2 16 Ga. CEE, with allowable load at KL=5' is 5.76 kips. Selected member- OK.

4BM-1 W24x131- 34'-11"
Bending: Mu(Demand) = 762.58k-ft < ϕMn(Capacity) = 1387.50k-ft-OK
Shear: Vu (Demand) = 68.99k< ϕVn(Capacity) = 444.68k-OK
Deflection: Max Dy = -0.98in = L/430-OK
14BM-1 W16x89- 17'-6"
Bending: Mu(Demand) = 225.89k-ft < ϕMn(Capacity) = 656.25k-ft-OK
Shear: Vu (Demand) = 53.63k< ϕVn(Capacity) = 264.60k-OK
Deflection: Max Dy = -0.22in = L/980-OK

Column 6- HSS 6x6x1/4" – KL=10', Pcr (Demand) = 68k< Pn (Capacity)=118k

<u>First Floor</u>

Live Load = 27.4 + 125 + 125 = 277.4 psf
Dead Load = 7 + 45 + 45 = 97 psf
Total Load = 374.4

Column Load = 2.5' x 10' x 374.4 psf = 9.3 kips

Use 6 x 2-1/2 16 Ga. CEE, with allowable load at 12.15 kips. Selected member- OK.

5BM-1 W16x89- 20'-0"
Bending: Mu (Demand) = 355.96k-ft < ϕMn (Capacity) = 656.25k-ft-OK
Shear: Vu (Demand) = 88.74k< ϕVn (Capacity) = 264.60k-OK
Deflection: Max Dy = -0.41in = L/590-OK
Column 1- HSS 6x6x1/4" – KL=10', Pcr (Demand)=88k< Pn (Capacity)=118k

AVID BUILDING SYSTEMS
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LEE'S SUMMIT, MO

**Building 1 Summary:**

**1st Floor Design:**

6"x2-1/2" CEE's 16GA @ 30"O.C.- DBL columns on each side of hallway(5'-4-1/2" steel to steel)
6"x2-1/2" CEE's 16GA @ 24" O.C. at perimeter w/ 26GA.
6"x2-12" CEE 16GA. DBL support headers at hallways, MAX span of 5'-4-1/2".
10"x2-1/2" CEE's 12GA DBL support headers at hallways, MAX span of 10'-4-1/2"
3"x6 1/8"x3" Channel 12 GA. Top Track.
2"x6 1/8"x2" Channel 14 GA. Base/Bottom Track.
Four (4) #12x3/4" Fasteners at bottom and top of Column.
26 Ga. 'PBU' Panel with Rib against Columns, #12x3/4" fasteners 12" on center at columns with 6" on center at ends and laps.
16 Ga. Sub-Girt Midspan at Far Side of panels.
Girt at each side of Hallway and 20'-0" on center.
4"x4"x12GA. Perimeter Angle Pour Stop.
18GA. CFD2 Composite Deck with 4" concrete by others.

5BM -1W16x89- 20'-0"
Column 6- HSS 6x6x1/4"

**2nd Floor Design:**

4"x2 1/2" CEE's 16 GA. @ 30"O.C, DBL columns on each side of hallway (5'-4-1/2" steel to steel).
4"x2 1/2" CEE's 16 GA. @ 24" O.C at perimeter.
6"x2 1/2" CEE's 16 GA. DBL support headers at hallways, MAX span 5'-4 1/2".
10"x2-1/2" CEE 12GA. DBL support headers at door openings in hallway. MAX span 10'-4-1/2".
3"x4-1/8"x3" Channel 12 GA. Top Track.
2"x4 -1/8"x2" Channel 14 GA. Base/Bottom Track.
Four (4) #12x3/4" Fasteners at bottom and top of Column.
26 Ga. 'PBU' Panel with Rib against Columns, #12x3/4" fasteners 12" on center at columns with 6" on center at ends and laps.

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16 Ga. Sub-Girt midspan at Far Side of panels.
Girt at each side of Hallway and 20'-0" on center.
4"x4"x12GA. Perimeter angle pour stop.
18GA. CFD2 composite deck with 4" concrete by others.

4BM -1– W24x131- 34'-11"
Column 6- HSS 6x6x1/4

14BM -1– W16x89- 17'-6"
Column 6- HSS 6x6x1/4

**3rd Floor Design:**

4"x2 1/2" CEE's 16 GA. @ 60"O.C, Single columns on each side of hallway (5'-4-1/2" steel to steel).
4"x2 1/2" CEE's 16 GA. 24" O.C. at perimeter.
4"x2 1/2" CEE's 16 GA Girts at 5' and 10' at Columns starting at 14'-0" tall.
4"x2 1/2" ZEE's 16. GA. Purlins at 60" on center. (Maximum Span 10'-0")

**Double Headers:**

6"x2-1/2" CEE 16GA. MAX span: 5'-4-1/2"
9"x2-1/2" CEE 12GA. MAX span: 10'-0"
10"x -1/2" CEE 12GA. MAX span: 10'-8"

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

# Hazards by Location

## Search Information

**Address:** Lee's Summit, MO, USA

**Coordinates:** 38.9108408, -94.3821724

**Elevation:** 1038 ft

**Timestamp:** 2022-11-03T18:44:24.063Z

**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.*

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## 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:** Lee's Summit, MO, USA

**Coordinates:** 38.9108408, -94.3821724

**Elevation:** 1038 ft

**Timestamp:** 2022-11-03T18:45:22.789Z

**Hazard Type:** Snow


### ASCE 7-16

Ground Snow Load ---------- 20 lb/sqft

### ASCE 7-10

Ground Snow Load ------ 20 lb/sqft

### ASCE 7-05

Ground Snow Load ---------- 20 lb/sqft

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# Hazards by Location

## Search Information

**Address:** Lee's Summit, MO, USA

**Coordinates:** 38.9108408, -94.3821724

**Elevation:** 1038 ft

**Timestamp:** 2022-11-03T18:45:47.030Z

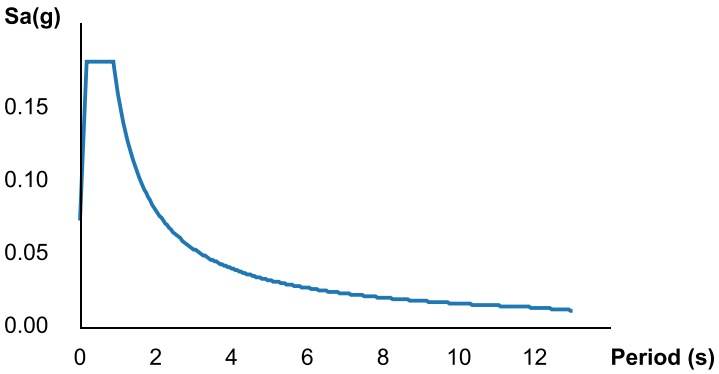
**Hazard Type:** Seismic

**Reference Document:** ASCE7-10

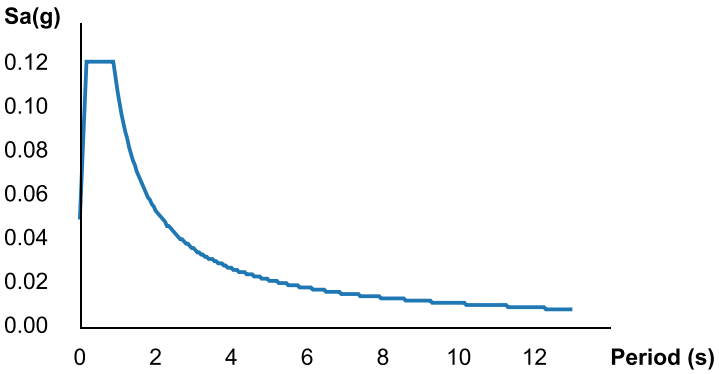
**Risk Category:** II

**Site Class:** D


## MCER Horizontal Response Spectrum




## Design Horizontal Response Spectrum




## Basic Parameters

| Name | Value | Description |
|---|---|---|
| $S_S$ | 0.114 | $MCE_R$ ground motion (period=0.2s) |
| $S_1$ | 0.067 | $MCE_R$ ground motion (period=1.0s) |
| $S_{MS}$ | 0.182 | Site-modified spectral acceleration value |
| $S_{M1}$ | 0.16 | Site-modified spectral acceleration value |
| $S_{DS}$ | 0.121 | Numeric seismic design value at 0.2s SA |
| $S_{D1}$ | 0.107 | Numeric seismic design value at 1.0s SA |

## Additional Information

| Name | Value | Description |
|---|---|---|
| SDC | B | Seismic design category |

| | | |
|---|---|---|
| $F_a$ | 1.6 | Site amplification factor at 0.2s |
| $F_v$ | 2.4 | Site amplification factor at 1.0s |
| $CR_S$ | 0.9 | Coefficient of risk (0.2s) |
| $CR_1$ | 0.846 | Coefficient of risk (1.0s) |
| PGA | 0.054 | $MCE_G$ peak ground acceleration |
| $F_{PGA}$ | 1.6 | Site amplification factor at PGA |
| $PGA_M$ | 0.087 | Site modified peak ground acceleration |
| $T_L$ | 12 | Long-period transition period (s) |
| SsRT | 0.114 | Probabilistic risk-targeted ground motion (0.2s) |
| SsUH | 0.126 | Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years) |
| SsD | 1.5 | Factored deterministic acceleration value (0.2s) |
| S1RT | 0.067 | Probabilistic risk-targeted ground motion (1.0s) |
| S1UH | 0.079 | 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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## Disclaimer

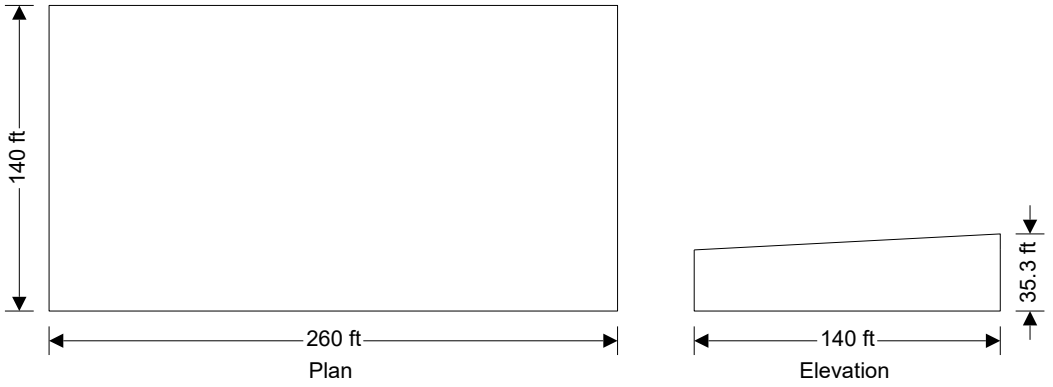
Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

## WIND LOADING

**In accordance with ASCE7-10**

**Using the components and cladding design method**

Tedds calculation version 2.1.07




### Building data

| | |
|---|---|
| Type of roof | Monoslope |
| Length of building | b = **260.00** ft |
| Width of building | d = **140.00** ft |
| Height to eaves | H = **28.00** ft |
| Pitch of roof | $\alpha_0$ = **3.0** deg |
| Mean height | h = **28.00** ft |

### General wind load requirements

| | |
|---|---|
| Basic wind speed | V = **115.0** mph |
| Risk category | II |
| Velocity pressure exponent coef (Table 26.6-1) | $K_d$ = **0.85** |
| Exposure category (cl 26.7.3) | C |
| Enclosure classification (cl.26.10) | Enclosed buildings |
| Internal pressure coef +ve (Table 26.11-1) | $GC_{pi\_p}$ = **0.18** |
| Internal pressure coef –ve (Table 26.11-1) | $GC_{pi\_n}$ = **-0.18** |

### Gust effect factor for rigid structures

| | |
|---|---|
| Terrain exposure constants (Table 26.9-1) | |
| Integral length scale factor | l = **500.0** ft |
| Turbulence intensity factor | c = **0.20** |
| Minimum equivalent height | $z_{min}$ = **15.0** ft |
| Peak factor for background response | $g_Q$ = **3.400** |
| Peak factor for wind response | $g_v$ = **3.400** |
| Integral length scale power law exponent | $\bar{\varepsilon}$ = **0.200** |
| Equivalent height of the structure | $\bar{z}$ = max (0.6 * h, $z_{min}$) = **16.80** ft |
| Intensity of turbulence (Eqn. 26.9-7) | $I_{\bar{z}}$ = c * (33 ft / $\bar{z}$)$^{1/6}$ = **0.22** |
| Integral length scale of turbulence (Eqn. 26.9-9) | $L_{\bar{z}}$ = l * ( $\bar{z}$ / 33 ft)$^{\bar{\varepsilon}}$ = **436.85** ft |
| Background response (Eqn. 26.9-8) | Q = $\sqrt{(1 / (1 + 0.63 * ((\min(B, L) + h) / L_{\bar{z}})^{0.63}))}$ = **0.862** |
| Gust effect factor (Eqn. 26.9-6) | G = $G_f$ = 0.925 * (1 + 1.7 * $g_Q$ * $I_{\bar{z}}$ * Q) / (1 + 1.7 * $g_v$ * $I_{\bar{z}}$) = **0.85** |

**Topography**

Topography factor not significant $K_{zt} = 1.0$

**Velocity pressure**

Velocity pressure coefficient (T.30.3-1) $K_z =$ **0.96**

Velocity pressure $q_h = 0.00256 * K_z * K_{zt} * K_d * V^2 * 1psf/mph^2 =$ **27.7** psf

**Peak velocity pressure for internal pressure**

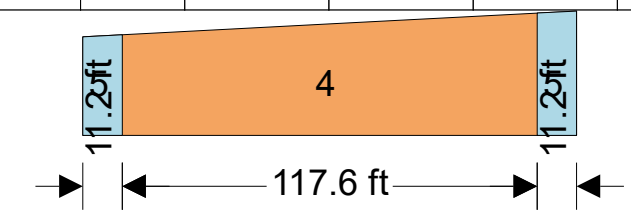
Peak velocity pressure – internal (as roof press.) $q_i =$ **27.74** psf

**Equations used in tables**

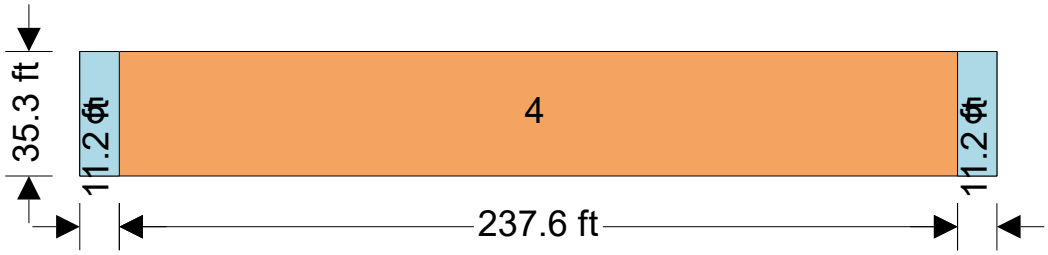
Net pressure $p = q_h * [GC_p - GC_{pi}]$

**Components and cladding pressures - Wall (Table 30.4-1)**

| Component | Zone | Length (ft) | Width (ft) | Eff. area ($ft^2$) | $+GC_p$ | $-GC_p$ | Pres (+ve) (psf) | Pres (-ve) (psf) |
|---|---|---|---|---|---|---|---|---|
| <=10 sf | 4 | - | - | 10.0 | 0.90 | -0.99 | 30.0 | -32.5 |
| 50 sf | 4 | - | - | 50.0 | 0.79 | -0.88 | 26.9 | -29.4 |
| 200 sf | 4 | - | - | 200.0 | 0.69 | -0.78 | 24.2 | -26.7 |
| >500 sf | 4 | - | - | 500.1 | 0.63 | -0.72 | 22.5 | -25.0 |
| <=10 sf | 5 | - | - | 10.0 | 0.90 | -1.26 | 30.0 | -39.9 |
| 50 sf | 5 | - | - | 50.0 | 0.79 | -1.04 | 26.9 | -33.8 |
| 200 sf | 5 | - | - | 200.0 | 0.69 | -0.85 | 24.2 | -28.5 |
| >500 sf | 5 | - | - | 500.1 | 0.63 | -0.72 | 22.5 | -25.0 |




Elevation of gable wall



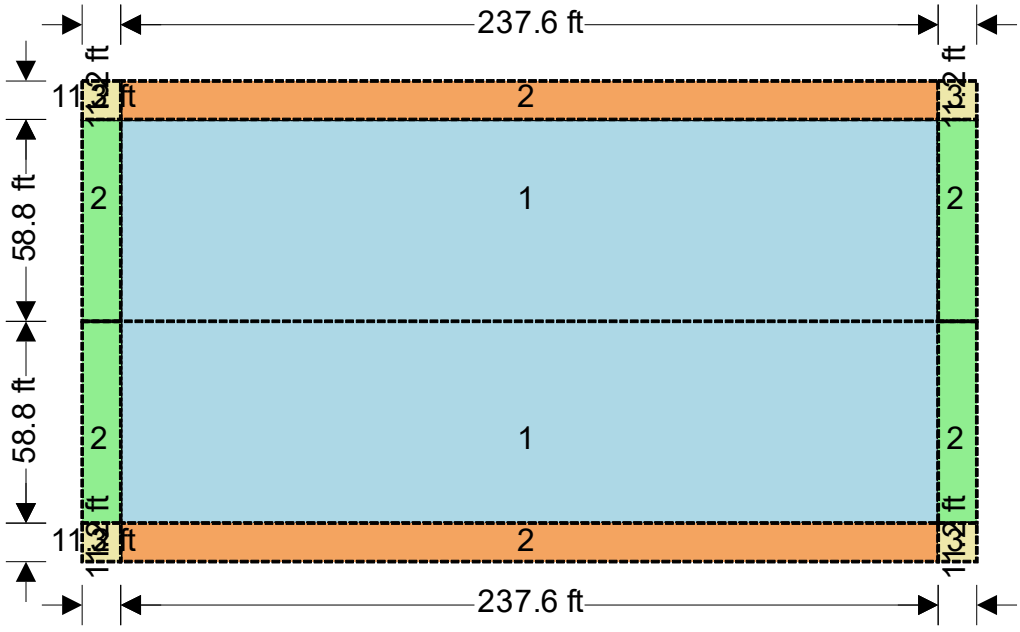

Elevation of side wall

**Components and cladding pressures - Roof (Figure 30.4-2A)**

| Component | Zone | Length (ft) | Width (ft) | Eff. area ($ft^2$) | $+GC_p$ | $-GC_p$ | Pres (+ve) (psf) | Pres (-ve) (psf) |
|---|---|---|---|---|---|---|---|---|
| <=10 sf | 1 | - | - | 10.0 | 0.30 | -1.00 | 13.3 # | -32.7 |
| 25 sf | 1 | - | - | 25.0 | 0.26 | -0.96 | 12.2 # | -31.6 |

| Component | Zone | Length (ft) | Width (ft) | Eff. area ($ft^2$) | $+GC_p$ | $-GC_p$ | Pres (+ve) (psf) | Pres (-ve) (psf) |
|---|---|---|---|---|---|---|---|---|
| 50 sf | 1 | - | - | 50.0 | 0.23 | -0.93 | 11.4 # | -30.8 |
| >100 sf | 1 | - | - | 100.1 | 0.20 | -0.90 | 10.5 # | -30.0 |
| <=10 sf | 2 | - | - | 10.0 | 0.30 | -1.80 | 13.3 # | -54.9 |
| 25 sf | 2 | - | - | 25.0 | 0.26 | -1.52 | 12.2 # | -47.2 |
| 50 sf | 2 | - | - | 50.0 | 0.23 | -1.31 | 11.4 # | -41.4 |
| >100 sf | 2 | - | - | 100.1 | 0.20 | -1.10 | 10.5 # | -35.5 |
| <=10 sf | 3 | - | - | 10.0 | 0.30 | -2.80 | 13.3 # | -82.7 |
| 25 sf | 3 | - | - | 25.0 | 0.26 | -2.12 | 12.2 # | -63.9 |
| 50 sf | 3 | - | - | 50.0 | 0.23 | -1.61 | 11.4 # | -49.7 |
| >100 sf | 3 | - | - | 100.1 | 0.20 | -1.10 | 10.5 # | -35.5 |

# The final net design wind pressure, including all permitted reductions, used in the design shall not be less than 16psf acting in either direction



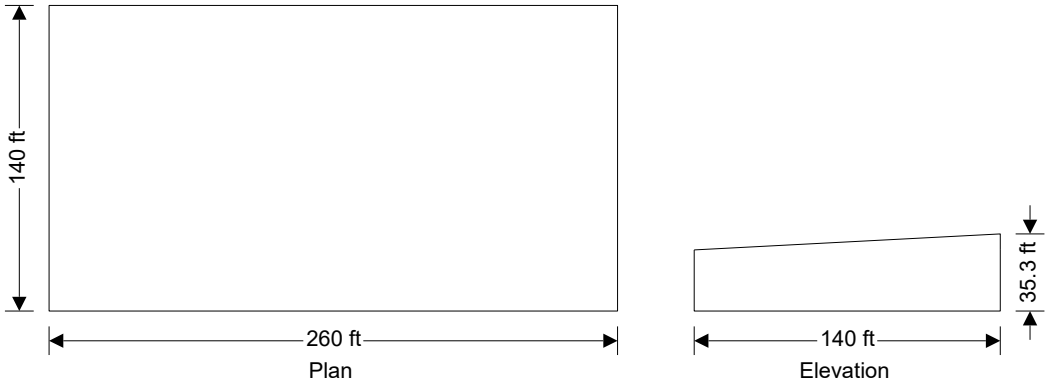

Plan on roof

## WIND LOADING

**In accordance with ASCE7-16**

**Using the directional design method**

Tedds calculation version 2.1.07




**Building data**

| | |
|---|---|
| Type of roof | Monoslope |
| Length of building | b = **260.00** ft |
| Width of building | d = **140.00** ft |
| Height to eaves | H = **28.00** ft |
| Pitch of roof | $\alpha_0$ = **3.0** deg |
| Mean height | h = **28.00** ft |

**General wind load requirements**

| | |
|---|---|
| Basic wind speed | V = **115.0** mph |
| Risk category | II |
| Velocity pressure exponent coef (Table 26.6-1) | $K_d$ = **0.85** |
| Ground elevation above sea level | $z_{gl}$ = **1038** ft |
| Ground elevation factor | $K_e = \exp(-0.0000362 * z_{gl}/1ft)$ = **0.96** |
| Exposure category (cl 26.7.3) | C |
| Enclosure classification (cl.26.12) | Enclosed buildings |
| Internal pressure coef +ve (Table 26.13-1) | $GC_{pi\_p}$ = **0.18** |
| Internal pressure coef –ve (Table 26.13-1) | $GC_{pi\_n}$ = **-0.18** |
| Gust effect factor | $G_f$ = **0.85** |
| Minimum design wind loading (cl.27.4.7) | $p_{min\_r}$ = **8** lb/ft$^2$ |

**Topography**

| | |
|---|---|
| Topography factor not significant | $K_{zt}$ = 1.0 |
| Velocity pressure equation | $q = 0.00256 * K_z * K_{zt} * K_d * V^2 * 1psf/mph^2$ |

**Velocity pressures table**

| z (ft) | $K_z$ (Table 26.10-1) | $q_z$ (psf) |
|---|---|---|
| 15.00 | 0.85 | 23.56 |
| 20.00 | 0.90 | 24.94 |
| 25.00 | 0.94 | 26.05 |

| z (ft) | $K_z$ (Table 26.10-1) | $q_z$ (psf) |
|---|---|---|
| 28.00 | 0.96 | 26.72 |
| 35.34 | 1.01 | 28.05 |

**Peak velocity pressure for internal pressure**

Peak velocity pressure – internal (as roof press.) $q_i$ = **26.72** psf

**Pressures and forces**

Net pressure $p = q * G_f * C_{pe} - q_i * GC_{pi}$

Net force $F_w = p * A_{ref}$

**Roof load case 1 - Wind 0, $GC_{pi}$ 0.18, $-c_{pe}$**

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| A (-ve) | 28.00 | -0.90 | 26.72 | -25.25 | 3645.00 | -92.03 |
| B (-ve) | 28.00 | -0.90 | 26.72 | -25.25 | 3645.00 | -92.03 |
| C (-ve) | 28.00 | -0.50 | 26.72 | -16.16 | 7289.99 | -117.84 |
| D (-ve) | 28.00 | -0.30 | 26.72 | -11.62 | 21869.97 | -254.19 |

Total vertical net force $F_{w,v}$ = **-555.33** kips

Total horizontal net force $F_{w,h}$ = **-29.10** kips

**Walls load case 1 - Wind 0, $GC_{pi}$ 0.18, $-c_{pe}$**

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| $A_1$ | 15.00 | 0.80 | 23.56 | 11.21 | 3900.00 | 43.72 |
| $A_2$ | 20.00 | 0.80 | 24.94 | 12.15 | 1300.00 | 15.80 |
| $A_3$ | 28.00 | 0.80 | 26.72 | 13.36 | 2080.00 | 27.79 |
| B | 28.00 | -0.50 | 26.72 | -16.16 | 9187.64 | -148.52 |
| C | 28.00 | -0.70 | 26.72 | -20.71 | 4433.60 | -91.81 |
| D | 28.00 | -0.70 | 26.72 | -20.71 | 4433.60 | -91.81 |

**Overall loading**

Projected vertical plan area of wall $A_{vert\_w\_0} = b * H$ = **7280.00** $ft^2$

Projected vertical area of roof $A_{vert\_r\_0} = b * d * \tan(\alpha_0)$ = **1907.64** $ft^2$

Minimum overall horizontal loading $F_{w,total\_min} = p_{min\_w} * A_{vert\_w\_0} + p_{min\_r} * A_{vert\_r\_0}$ = **131.74** kips

Leeward net force $F_l = F_{w,wB}$ = **-148.5** kips

Windward net force $F_w = F_{w,wA\_1} + F_{w,wA\_2} + F_{w,wA\_3}$ = **87.3** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total\_min})$ = **206.7** kips

**Roof load case 2 - Wind 0, $GC_{pi}$ -0.18, $+c_{pe}$**

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| A (+ve) | 28.00 | -0.18 | 26.72 | 0.72 | 3645.00 | 2.63 |
| B (+ve) | 28.00 | -0.18 | 26.72 | 0.72 | 3645.00 | 2.63 |

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| C (+ve) | 28.00 | -0.18 | 26.72 | 0.72 | 7289.99 | 5.26 |
| D (+ve) | 28.00 | -0.18 | 26.72 | 0.72 | 21869.97 | 15.78 |

Total vertical net force $F_{w,v}$ = **26.26** kips

Total horizontal net force $F_{w,h}$ = **1.38** kips

**Walls load case 2 - Wind 0, $GC_{pi}$ -0.18, $+c_{pe}$**

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| $A_1$ | 15.00 | 0.80 | 23.56 | 20.83 | 3900.00 | 81.23 |
| $A_2$ | 20.00 | 0.80 | 24.94 | 21.77 | 1300.00 | 28.30 |
| $A_3$ | 28.00 | 0.80 | 26.72 | 22.98 | 2080.00 | 47.79 |
| B | 28.00 | -0.50 | 26.72 | -6.55 | 9187.64 | -60.14 |
| C | 28.00 | -0.70 | 26.72 | -11.09 | 4433.60 | -49.16 |
| D | 28.00 | -0.70 | 26.72 | -11.09 | 4433.60 | -49.16 |

**Overall loading**

Projected vertical plan area of wall $A_{vert\_w\_0} = b * H$ = **7280.00** $ft^2$

Projected vertical area of roof $A_{vert\_r\_0} = b * d * \tan(\alpha_0)$ = **1907.64** $ft^2$

Minimum overall horizontal loading $F_{w,total\_min} = p_{min\_w} * A_{vert\_w\_0} + p_{min\_r} * A_{vert\_r\_0}$ = **131.74** kips

Leeward net force $F_l = F_{w,wB}$ = **-60.1** kips

Windward net force $F_w = F_{w,wA\_1} + F_{w,wA\_2} + F_{w,wA\_3}$ = **157.3** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total\_min})$ = **218.9** kips

**Roof load case 3 - Wind 90, $GC_{pi}$ 0.18, $-c_{pe}$**

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| A (-ve) | 28.00 | -0.90 | 26.72 | -25.25 | 1962.69 | -49.56 |
| B (-ve) | 28.00 | -0.90 | 26.72 | -25.25 | 1962.69 | -49.56 |
| C (-ve) | 28.00 | -0.50 | 26.72 | -16.16 | 3925.38 | -63.45 |
| D (-ve) | 28.00 | -0.30 | 26.72 | -11.62 | 28599.19 | -332.40 |

Total vertical net force $F_{w,v}$ = **-494.28** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

**Walls load case 3 - Wind 90, $GC_{pi}$ 0.18, $-c_{pe}$**

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| $A_1$ | 15.00 | 0.80 | 23.56 | 11.21 | 2100.00 | 23.54 |
| $A_2$ | 25.00 | 0.80 | 26.05 | 12.91 | 1400.00 | 18.07 |
| $A_3$ | 35.34 | 0.80 | 28.05 | 14.26 | 933.80 | 13.32 |

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| B | 28.00 | -0.33 | 26.72 | -12.27 | 4433.60 | -54.41 |
| C | 28.00 | -0.70 | 26.72 | -20.71 | 7280.00 | -150.75 |
| D | 28.00 | -0.70 | 26.72 | -20.71 | 9187.64 | -190.25 |

**Overall loading**

Projected vertical plan area of wall $A_{vert\_w\_90} = d * (H + d * \tan(\alpha_0) / 2) =$ **4433.60** $ft^2$

Projected vertical area of roof $A_{vert\_r\_90} =$ **0.00** $ft^2$

Minimum overall horizontal loading $F_{w,total\_min} = p_{min\_w} * A_{vert\_w\_90} + p_{min\_r} * A_{vert\_r\_90} =$ **70.94** kips

Leeward net force $F_l = F_{w,wB} =$ **-54.4** kips

Windward net force $F_w = F_{w,wA\_1} + F_{w,wA\_2} + F_{w,wA\_3} =$ **54.9** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total\_min}) =$ **109.3** kips

**Roof load case 4 - Wind 90, $GC_{pi}$ -0.18, $+c_{pe}$**

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| A (+ve) | 28.00 | -0.18 | 26.72 | 0.72 | 1962.69 | 1.42 |
| B (+ve) | 28.00 | -0.18 | 26.72 | 0.72 | 1962.69 | 1.42 |
| C (+ve) | 28.00 | -0.18 | 26.72 | 0.72 | 3925.38 | 2.83 |
| D (+ve) | 28.00 | -0.18 | 26.72 | 0.72 | 28599.19 | 20.63 |

Total vertical net force $F_{w,v} =$ **26.26** kips

Total horizontal net force $F_{w,h} =$ **0.00** kips

**Walls load case 4 - Wind 90, $GC_{pi}$ -0.18, $+c_{pe}$**

| Zone | Ref. height (ft) | Ext pressure coefficient $c_{pe}$ | Peak velocity pressure $q_p$ (psf) | Net pressure p (psf) | Area $A_{ref}$ ($ft^2$) | Net force $F_w$ (kips) |
|---|---|---|---|---|---|---|
| $A_1$ | 15.00 | 0.80 | 23.56 | 20.83 | 2100.00 | 43.74 |
| $A_2$ | 25.00 | 0.80 | 26.05 | 22.53 | 1400.00 | 31.54 |
| $A_3$ | 35.34 | 0.80 | 28.05 | 23.88 | 933.80 | 22.30 |
| B | 28.00 | -0.33 | 26.72 | -2.65 | 4433.60 | -11.76 |
| C | 28.00 | -0.70 | 26.72 | -11.09 | 7280.00 | -80.72 |
| D | 28.00 | -0.70 | 26.72 | -11.09 | 9187.64 | -101.87 |

**Overall loading**

Projected vertical plan area of wall $A_{vert\_w\_90} = d * (H + d * \tan(\alpha_0) / 2) =$ **4433.60** $ft^2$

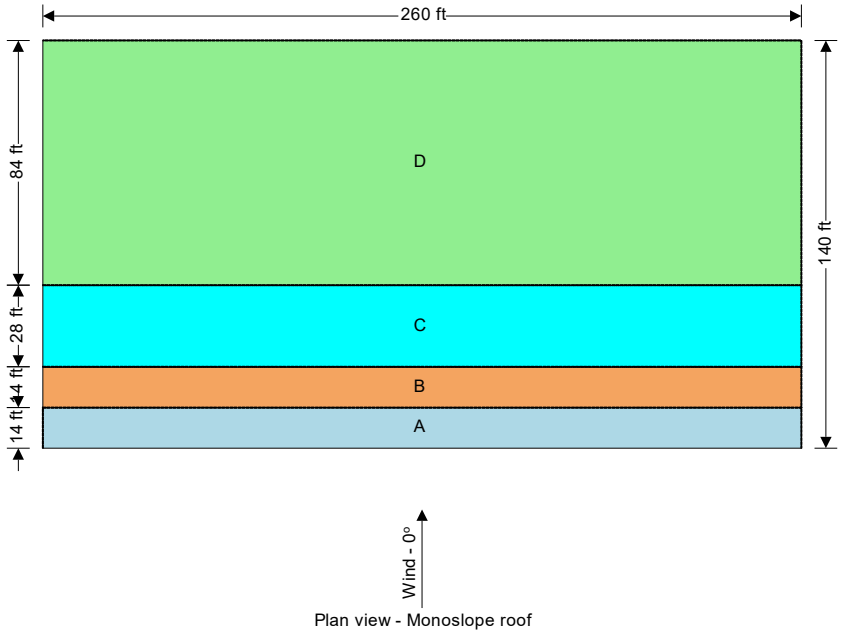
Projected vertical area of roof $A_{vert\_r\_90} =$ **0.00** $ft^2$

Minimum overall horizontal loading $F_{w,total\_min} = p_{min\_w} * A_{vert\_w\_90} + p_{min\_r} * A_{vert\_r\_90} =$ **70.94** kips

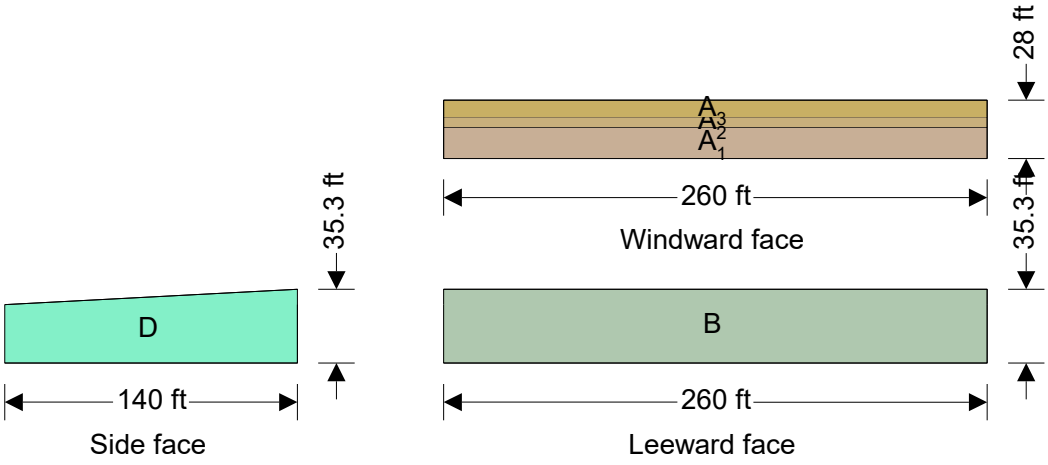
Leeward net force $F_l = F_{w,wB} =$ **-11.8** kips

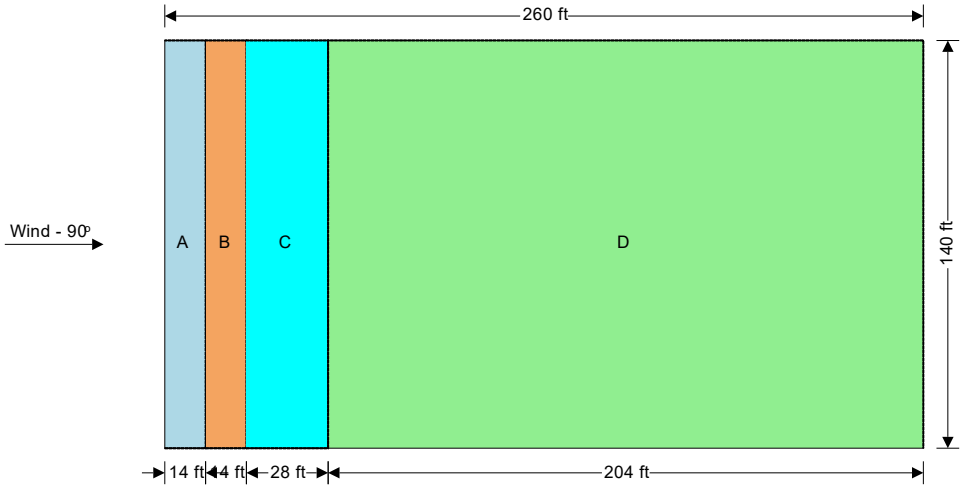
Windward net force $F_w = F_{w,wA\_1} + F_{w,wA\_2} + F_{w,wA\_3} =$ **97.6** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total\_min}) =$ **109.3** kips




Plan view - Monoslope roof






Plan view - Monoslope roof