# Structural Calculations

## For

## Cascade Public Library

## 105 N Front St

## Cascade (100), Idaho

## PE Job #: 2023-14473

PROFESSIONAL ENGINEER
REGISTERED
19089
8/10/2023
STATE OF IDAHO
VANCE LEAVITT



| Expiration: | *8/10/2024* |
|---|---|

# *Design Criteria*

Governing Code: *2018 IBC*

**Snow Criteria**

| | | |
|---|---|---|
| Roof Snow Load ($P_f$) | 100 psf | |
| Ground Load ($P_g$) | 100 psf | |
| Exposure Factor ($C_e$) | 1.0 | Partially |
| Thermal Factor ($C_t$) | 1.0 | Typical |
| Importance ($I_s$) | 1.0 | |

**Wind Criteria**

| | | |
|---|---|---|
| Wind Speed ($V_3$) | 115 mph | |
| Wind Exposure | C | Open Terrain |
| Wind Importance ($I_w$) | 1.0 | |
| Building Category | II | |

**Seismic Criteria**

| | | | | |
|---|---|---|---|---|
| Site Class | D | Stiff Soil | | |
| Ss | 0.49 | | Fa | 1.41 |
| S1 | 0.15 | | Fv | 2.19 |
| $S_{DS}$ | 0.46 | | $S_{D1}$ | 0.22 |
| Risk Category | II | Other | | |
| Seismic Importance ($I_E$) | 1.0 | | | |
| Seismic Design Category (SDC) | D | | | |

| Wall Material | Design Base Shear | Seismic Response Coefficient, R | |
|---|---|---|---|
| OSB | .07Wp | 6.5 | Typ @ Ext |
| GYP | .23Wp | 2 | Typ @ Int |
| e-Inf. CMU | .23Wp | 2 | |
| | | | |

**Live Loads**

| | |
|---|---|
| Lobbies | 100 psf |
| | - |
| | - |

**Soil Bearing**

| | |
|---|---|
| Typical | 1500 psf |
| Frost Depth | 24 in |

**Roof Dead Loads:**

| | |
|---|---|
| Deck | *1.5* |
| Insulation | *2.0* |
| Roofing | *3.0* |
| Joist | *2.5* |
| Ceiling | *3.0* |
| Misc | *4.5* |
| **TOTAL** | **17 psf** |

**Floor Dead Loads:**

| | |
|---|---|
| | |
| Deck | 2.5 |
| Joist | 2.0 |
| Ceiling | 2.0 |
| Flooring | 2.5 |
| Misc | 3.0 |
| **TOTAL** | **12 psf** |

**Exterior Wall Dead Loads:**

| | |
|---|---|
| Studs | *2.0* |
| Siding | *2.5* |
| Insulation | *0.5* |
| Gyp. Board | *2.5* |
| Sheating | *1.5* |
| Misc | *3.0* |
| **TOTAL** | **12 psf** |

**Interior Wall Dead Loads:**

| | |
|---|---|
| Studs | *2.0* |
| Gyp. Board | *2.5* |
| - | - |
| - | - |
| - | - |
| Misc | *3.0* |
| **TOTAL** | **8 psf** |

# *OSB Seismic Loading Analysis*

| | | | | |
|---|---|---|---|---|
| $S_s$ = | *0.493* | $C_T$ = | *0.020* | |
| $S_1$ = | *0.152* | $h_n$ = | *10.00* | ft |
| $F_a$ = | *1.4* | | | |
| $F_v$ = | *2.2* | | | |
| R = | *6.5* | | | |
| $I_E$ = | *1.0* | | | |

| | | |
|---|---|---|
| $S_{MS} = F_aS_s$ = | 0.6927 | |
| $S_{M1} = F_vS_1$ = | 0.3332 | |
| | | Seismic Design Category |
| $S_{DS}$ = 2/3 $S_{MS}$ = | 0.4618 | *C* |
| $S_{D1}$ = 2/3 $S_{M1}$ = | 0.2221 | *D* |
| $C_s = S_{DS}/(R/I_E)$ = | 0.0710 | **Controls** |
| $T_a = C_Th_n^{3/4}$ = | 0.1125 | |
| $C_s < S_{D1}/[(R/I_E)T]$ = | 0.3038 | |
| $C_s > 0.044S_{DS}I_E$ = | 0.0203 | |
| $C_s > 0.5S_1/(R/I_E)$ = | 0.0117 | |

$V = C_sW$ = **0.0710** W

0.7*V = **0.0497** W

# *OSB Seismic Component Loading*

| | | | |
|---|---|---|---|
| $w_p$ = | *1* | psf | weight of element |
| $V_{px}$ = | *0* | plf | Portion of seismic shear load at the level of the diaphragm, required to be transferred to the components of the vertical seismic-force-resisting system beacause of the offsets or changes in the stiffness of the vertical components above of below the diaphragm. |
| $w_w$ = | *12* | psf | weight of wall |
| $L_b$ = | *51* | ft | length of the building |

*NOTE: Use 1 for unit weight to achieve an answer per element unit weight*

**Connections**

| | | | | |
|---|---|---|---|---|
| $F_p = 0.133\ S_{DS}\ w_p$ = | **0.06** | psf | | |
| or | | | | |
| $F_p = 0.05\ w_p$ = | **0.05** | psf | | |

**Diaphragm**

| | | | | |
|---|---|---|---|---|
| $F_p = 0.2\ I_E\ S_{DS}\ w_p + V_{px}$ = | **0.09** | psf | | |
| $F_{p,max} = 0.4\ I_E\ S_{DS}\ w_p + V_{px}$ = | **0.18** | psf | | |

**Bearing Walls & Shear Walls**

**Out of Plane Forces**

| | | | | |
|---|---|---|---|---|
| $F_p = 0.40\ I_E\ S_{DS}\ w_w$ = | **2.21** | psf | **Controls** | *12.11.1* |
| $F_p = 0.10\ w_w$ = | **1.20** | psf | | *12.11.1* |

**Anchorage**

| | | | | |
|---|---|---|---|---|
| $F_p = 0.40\ I_E\ S_{DS}\ w_w\ k_a$ = | **3.3** | psf | | *12.11-1* |
| $F_p = 0.2\ I_E\ k_a\ w_w$ = | **3.6060** | psf | **Controls** | |
| $k_a = 1.0 + L_b / 100$ = | **1.5050** | | | *12.11-2* |

Note: *12.11.2.2.2* The strength design forces for steel elements of the structural wall anchorage system, with exception of anchor bolts and reinforcing steel, shall be increased by 1.4 times the forces otherwise noted above.

## *Re-Inf. CMU Seismic Loading Analysis*

| | | | | |
|---|---|---|---|---|
| $S_s$ = | *0.493* | $C_T$ = | *0.020* | |
| $S_1$ = | *0.152* | $h_n$ = | *10.00* | ft |
| $F_a$ = | *1.4* | | | |
| $F_v$ = | *2.2* | | | |
| R = | *2.0* | | | |
| $I_E$ = | *1.0* | | | |

| | | |
|---|---|---|
| $S_{MS} = F_aS_s$ = | 0.6927 | |
| $S_{M1} = F_vS_1$ = | 0.3332 | |
| | | Seismic Design Category |
| $S_{DS}$ = 2/3 $S_{MS}$ = | 0.4618 | *C* |
| $S_{D1}$ = 2/3 $S_{M1}$ = | 0.2221 | *D* |
| $C_s = S_{DS}/(R/I_E)$ = | 0.2309 | **Controls** |
| $T_a = C_Th_n^{3/4}$ = | 0.1125 | |
| $C_s < S_{D1}/[(R/I_E)T]$ = | 0.9875 | |
| $C_s > 0.044S_{DS}I_E$ = | 0.0203 | |
| $C_s > 0.5S_1/(R/I_E)$ = | 0.0380 | |

$V = C_sW$ = **0.2309** W

0.7*V = **0.1616** W

## *Re-Inf. CMU Seismic Component Loading*

| | | | |
|---|---|---|---|
| $w_p$ = | *1* | psf | weight of element |
| $V_{px}$ = | *0* | plf | Portion of seismic shear load at the level of the diaphragm, required to be transferred to the components of the vertical seismic-force-resisting system beacause of the offsets or changes in the stiffness of the vertical components above of below the diaphragm. |
| $w_w$ = | *12* | psf | weight of wall |
| $L_b$ = | *51* | ft | length of the building |

*NOTE: Use 1 for unit weight to achieve an answer per element unit weight*

**Connections**

$F_p = 0.133\ S_{DS}\ w_p$ = **0.06** psf

or

$F_p = 0.05\ w_p$ = **0.05** psf

**Diaphragm**

$F_p = 0.2\ I_E\ S_{DS}\ w_p + V_{px}$ = **0.09** psf

**Bearing Walls & Shear Walls**
**Out of Plane Forces**

| | | | | |
|---|---|---|---|---|
| $F_p = 0.40\ I_E\ S_{DS}\ w_w$ = | **2.21** | psf | **Controls** | *12.11.1* |
| $F_p = 0.10\ w_w$ = | **1.20** | psf | | *12.11.1* |

**Anchorage**

| | | | | |
|---|---|---|---|---|
| $F_p = 0.40\ I_E\ S_{DS}\ w_w\ k_a$ = | **3.3** | psf | | *12.11-1* |
| $F_p = 0.2\ I_E\ k_a\ w_w$ = | **3.6060** | psf | **Controls** | |
| $k_a = 1.0 + L_b / 100$ = | **1.5050** | | | *12.11-2* |

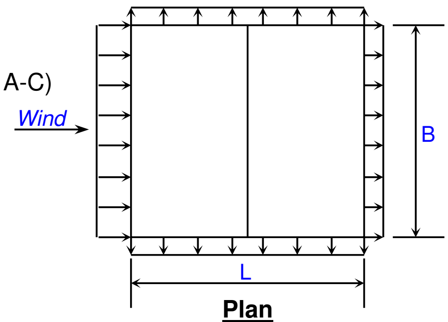
Note: *12.11.2.2.2* The strength design forces for steel elements of the structural wall anchorage system, with exception of anchor bolts and reinforcing steel, shall be increased by 1.4 times the forces otherwise noted above.

## WIND LOADING ANALYSIS - Main Wind-Force Resisting System

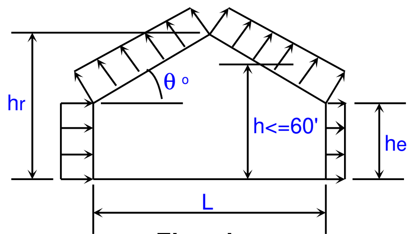
**Per ASCE 7-16 Code for Enclosed or Partially Enclosed Buildings**
**Using Part 1 of ASCE Chapter 28 for Low-Rise Buildings (Envelope Procedure)**

**Input Data:**

| | | |
|---|---|---|
| Wind Speed, V = | 115 | mph (Wind Map, Figure 26.5-1A-C) |
| Bldg. Classification = | II | (Table 1.5-1 Risk Category) |
| Exposure Category = | C | (Sect. 26.7) |
| Ridge Height, hr = | 10.00 | ft. (hr >= he) |
| Eave Height, he = | 9.00 | ft. (he <= hr) |
| Building Width = | 20.00 | ft. (Normal to Building Ridge) |
| Building Length = | 50.50 | ft. (Parallel to Building Ridge) |
| Roof Type = | Gable | (Gable or Monoslope) |
| Topo. Factor, Kzt = | 1.00 | (Sect. 26.8.2 & Figure 26.8-1) |
| Direct. Factor, Kd = | 0.85 | (Table 26.6-1) |
| Enclosed? (Y/N) | Y | (Sect. 26.2) |
| Hurricane Region? | N | |




**Plan**




**Elevation**

**Resulting Parameters and Coefficients:**

| | | |
|---|---|---|
| Roof Angle, θ = | 5.71 | deg. |
| Mean Roof Ht., h = | 9.00 | ft. (h = he, for angle <=10 deg.) |

Check Criteria for a Low-Rise Building: (Section 26.2)
1. Is h <= 60' ? Yes, O.K.
2. Is h <= Lesser of L or B? Yes, O.K.

External Pressure Coeff's., GCpf (Fig. 28.3-1):
(For values, see following wind load tabulations.)
Positive & Negative Internal Pressure Coefficients, GCpi (Table 26.13-1):

| | | |
|---|---|---|
| +GCpi Coef. = | 0.18 | (positive internal pressure) |
| -GCpi Coef. = | -0.18 | (negative internal pressure) |

If h < 15 then: Kh = 2.01*(15/zg)^(2/α) (Table 26.10-1, Footnote 1)
If h >= 15 then: Kh = 2.01*(z/zg)^(2/α) (Table 26.10-1, Footnote 1)

| | | |
|---|---|---|
| α = | 9.50 | (Table 26.11-1) |
| zg = | 900 | (Table 26.11-1) |
| Kh = | 0.85 | (Kh = Kz evaluated at z = h) |

Velocity Pressure: qz = 0.00256*Kz*Kzt*Kd*V^2 (Sect. 26.10.2, Eq. 26.10-1)
qh = 24.43 psf     qh = 0.00256*Kh*Kzt*Kd*V^2 (qz evaluated at z = h)
Design Net External Wind Pressures (Sect. 28.3.1):
p = qh*[(GCpf) - (+/-GCpi)] (psf, Eq. 28.3-1)

Wall and Roof End Zone Widths 'a' and '2*a' (Fig. 28.3-1):

| | | |
|---|---|---|
| a = | 3.00 | ft. |
| 2*a = | 6.00 | ft. |

| MWFRS Wind Load for Load Case A | | | | MWFRS Wind Load for Load Case B | | | |
|---|---|---|---|---|---|---|---|
| Surface | GCpf | p = Net Pressures (psf) | | Surface | *GCpf | p = Net Pressures (psf) | |
| | | (w/ +GCpi) | (w/ -GCpi) | | | (w/ +GCpi) | (w/ -GCpi) |
| Zone 1 | 0.41 | 5.52 | 14.32 | Zone 1 | -0.45 | -15.39 | -6.60 |
| Zone 2 | -0.69 | -21.25 | -12.46 | Zone 2 | -0.69 | -21.25 | -12.46 |
| Zone 3 | -0.38 | -13.56 | -4.77 | Zone 3 | -0.37 | -13.44 | -4.64 |
| Zone 4 | -0.30 | -11.64 | -2.85 | Zone 4 | -0.45 | -15.39 | -6.60 |
| Zone 5 | --- | --- | --- | Zone 5 | 0.40 | 5.37 | 14.17 |
| Zone 6 | --- | --- | --- | Zone 6 | -0.29 | -11.48 | -2.69 |
| Zone 1E | 0.62 | 10.72 | 19.52 | Zone 1E | -0.48 | -16.12 | -7.33 |
| Zone 2E | -1.07 | -30.54 | -21.74 | Zone 2E | -1.07 | -30.54 | -21.74 |
| Zone 3E | -0.54 | -17.53 | -8.74 | Zone 3E | -0.53 | -17.34 | -8.55 |
| Zone 4E | -0.44 | -15.14 | -6.35 | Zone 4E | -0.48 | -16.12 | -7.33 |
| Zone 5E | --- | --- | --- | Zone 5E | 0.61 | 10.50 | 19.30 |
| Zone 6E | --- | --- | --- | Zone 6E | -0.43 | -14.90 | -6.11 |

*Note: Use roof angle θ = 0 degrees for Longitudinal Direction.

For Case A when GCpf is neg. in Zones 2/2E: Zones 2/2E dist. = 10.00 ft. (Fig. 28.3-1)

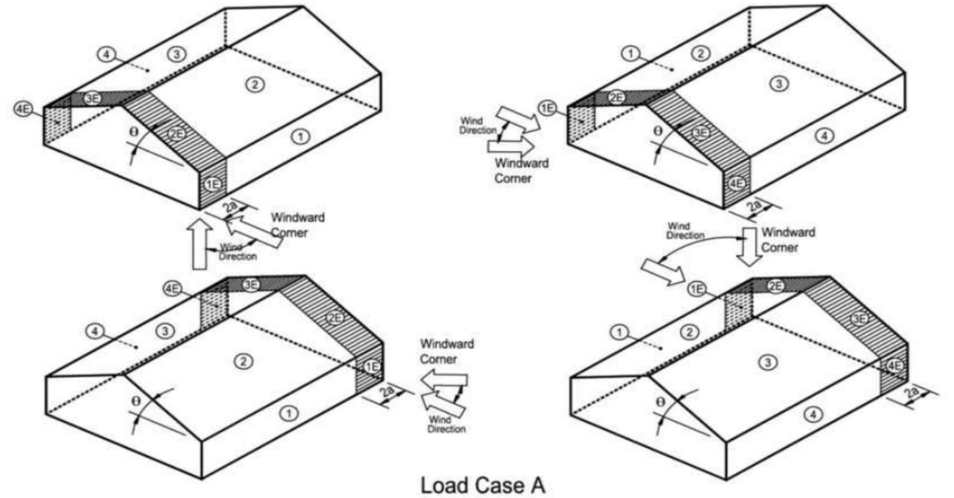
For Case B when GCpf is neg. in Zones 2/2E: Zones 2/2E dist. = 22.50 ft. (Fig. 28.3-1)

Remainder of roof Zones 2/2E extending to ridge line shall use roof Zones 3/3E pressure coefficients.

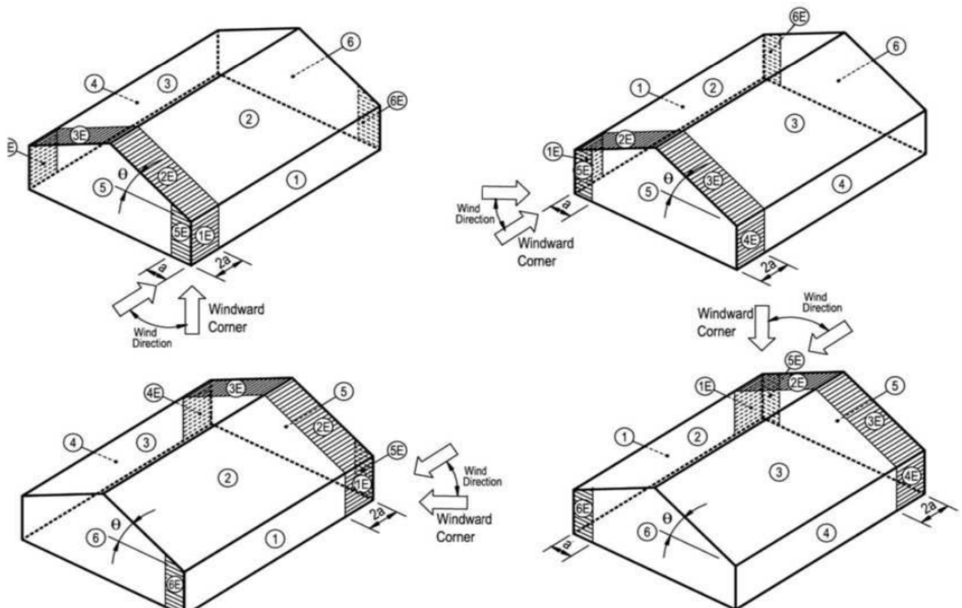
| MWFRS Wind Load for Load Case A, Torsional Case | | | | MWFRS Wind Load for Case B, Torsional Case | | | |
|---|---|---|---|---|---|---|---|
| Surface | GCpf | p = Net Pressure (psf) | | Surface | GCpf | p = Net Pressure (psf) | |
| | | (w/ +GCpi) | (w/ -GCpi) | | | (w/ +GCpi) | (w/ -GCpi) |
| Zone 1T | --- | 1.38 | 3.58 | Zone 1T | --- | -3.85 | -1.65 |
| Zone 2T | --- | -5.31 | -3.11 | Zone 2T | --- | -5.31 | -3.11 |
| Zone 3T | --- | -3.39 | -1.19 | Zone 3T | --- | -3.36 | -1.16 |
| Zone 4T | --- | -2.91 | -0.71 | Zone 4T | --- | -3.85 | -1.65 |
| Zone 5T | --- | --- | --- | Zone 5T | --- | 1.34 | 3.54 |
| Zone 6T | --- | --- | --- | Zone 6T | --- | -2.87 | -0.67 |

Notes:
1. For Load Case A (Transverse), Load Case B (Longitudinal), and Torsional Cases:
   Zone 1 is windward wall for interior zone.
   Zone 2 is windward roof for interior zone.
   Zone 3 is leeward roof for interior zone.
   Zone 4 is leeward wall for interior zone.
   Zones 5 and 6 are sidewalls.
   Zone 1T is windward wall for torsional case
   Zone 3T is leeward roof for torsional case
   Zones 5T and 6T are sidewalls for torsional case.
   Zone 1E is windward wall for end zone.
   Zone 2E is windward roof for end zone.
   Zone 3E is leeward roof for end zone.
   Zone 4E is leeward wall for end zone.
   Zone 5E & 6E is sidewalls for end zone.
   Zone 2T is windward roof for torsional case.
   Zone 4T is leeward wall for torsional case.
2. (+) and (-) signs signify wind pressures acting toward & away from respective surfaces.
3. Building must be designed for all wind directions using the 8 load cases shown below. The load cases are applied to each building corner in turn as the reference corner.
4. Wind loads for torsional cases are 25% of respective transverse or longitudinal zone load values. Torsional loading shall apply to all 8 basic load cases applied at each reference corner.
   Exception: One-story buildings with "h" <= 30', buildings <= 2 stories framed with light frame construction, and buildings <=2 stories designed with flexible diaphragms need not be designed for torsional load cases.
5. Per Code Section 28.3.4, the minimum wind load for MWFRS shall not be less than 16 psf. for wall pressure and 8psf for roof pressure

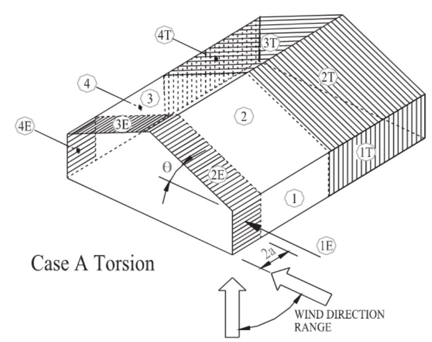
**Low-Rise Buildings h <= 60'**



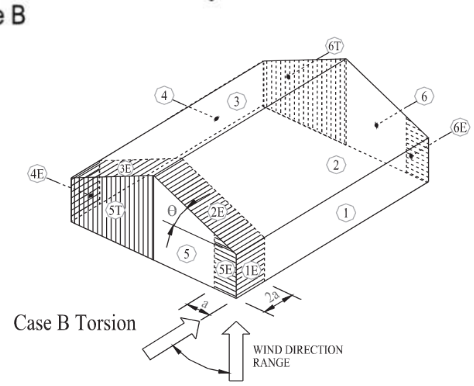

Load Case A




Load Case B




Transverse Direction




Longitudinal Direction

# WIND LOADING ANALYSIS - Wall Components and Cladding

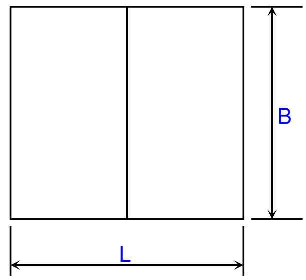
**Per ASCE 7-16 Code for Buildings of Any Height**

**Using Part 1 & 3: Analytical Procedure (Section 30.3 & 30.5)**

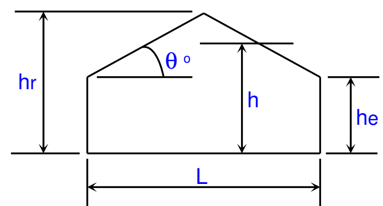
**Input Data:**

| | | |
|---|---|---|
| Wind Speed, V = | 115 | mph (Wind Map, Figure 26.5-1A-C) |
| Bldg. Classification = | II | (Table 1.5-1 Risk Category) |
| Exposure Category = | C | (Sect. 26.7) |
| Ridge Height, hr = | 10 | ft. (hr >= he) |
| Eave Height, he = | 9 | ft. (he <= hr) |
| Building Width = | 20 | ft. (Normal to Building Ridge) |
| Building Length = | 50.5 | ft. (Parallel to Building Ridge) |
| Roof Type = | Gable | (Gable or Monoslope) |
| Topo. Factor, Kzt = | 1 | (Sect. 26.8.2 & Figure 26.8-1) |
| Direct. Factor, Kd = | 0.85 | (Table 26.6-1) |
| Enclosed? (Y/N) | Y | (Sect. 26.2) |
| Hurricane Region? | N | |
| Component Name = | Wall | (Girt, Siding, Wall, or Fastener) |
| Effective Area, Ae = | 27 | ft.^2 (Area Tributary to C&C) |

Note: Worst Case Ae = Span Length * Length/3 (Sec 26.2)




**Plan**




**Elevation**

**Resulting Parameters and Coefficients:**

| | | |
|---|---|---|
| Roof Angle, θ = | 5.71 | deg. |
| Mean Roof Ht., h = | 9.00 | ft. (h = he, for roof angle <=10 deg.) |

Wall External Pressure Coefficients, GCp:

| | | |
|---|---|---|
| GCp Zone 4 Pos. = | 0.83 | (Fig. 30.3-1, GCp is reduced by 10% for roof angle <=10 deg. ) |
| GCp Zone 5 Pos. = | 0.83 | (Fig. 30.3-1, GCp is reduced by 10% for roof angle <=10 deg. ) |
| GCp Zone 4 Neg. = | -0.92 | (Fig. 30.3-1, GCp is reduced by 10% for roof angle <=10 deg. ) |
| GCp Zone 5 Neg. = | -1.12 | (Fig. 30.3-1, GCp is reduced by 10% for roof angle <=10 deg. ) |

Positive & Negative Internal Pressure Coefficients, GCpi (Table 26.13-1):

| | | |
|---|---|---|
| +GCpi Coef. = | 0.18 | (positive internal pressure) |
| -GCpi Coef. = | -0.18 | (negative internal pressure) |

If z <= 15 then: Kz = 2.01*(15/zg)^(2/α) , If z > 15 then: Kz = 2.01*(z/zg)^(2/α) (Table 26.10-1, Footnote 1)

| | | |
|---|---|---|
| α = | 9.50 | (Table 26.11-1) |
| zg = | 900 | (Table 26.11-1) |
| Kh = | 0.85 | (Kh = Kz evaluated at z = h) |

Velocity Pressure: qz = 0.00256*Kz*Kzt*Kd*V^2 (Sect. 26.10.2, Eq. 26.10-1)

qh = 24.43 psf  qh = 0.00256*Kh*Kzt*Kd*V^2 (qz evaluated at z = h)

Design Net External Wind Pressures (Sect. 30.3.2 or 30.5.2):

For h <= 60 ft.: p = qh*((GCp) - (+/-GCpi)) (psf)

For h > 60 ft.: p = q*(GCp) - qi*(+/-GCpi) (psf)

where: q = qz for windward walls, q = qh for leeward walls and side walls

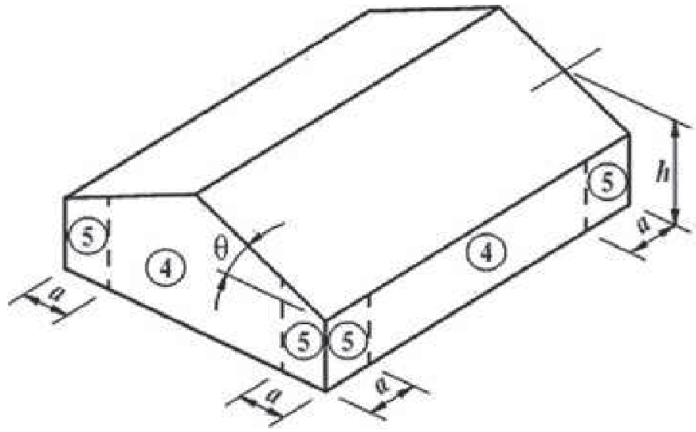
qi = qh for all walls (conservatively assumed per Sect. 30.5.2)

**Wind Load Tabulation for Wall Components & Cladding**

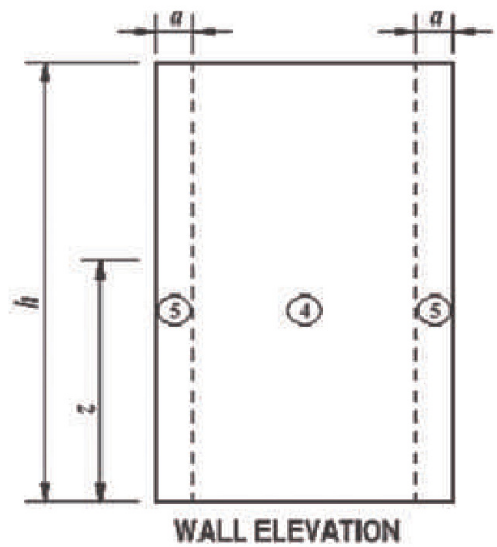
| Component | z (ft.) | Kh | qh (psf) | p = Net Design Pressures (psf) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Zone 4 (+) | Zone 4 (-) | Zone 5 (+) | Zone 5 (-) |
| Wall | 0 | 0.85 | 24.43 | 24.71 | -26.91 | 24.71 | -31.83 |
| For z = hr: | 10.00 | 0.85 | 24.43 | 24.71 | -26.91 | 24.71 | -31.83 |
| For z = he: | 9.00 | 0.85 | 24.43 | 24.71 | -26.91 | 24.71 | -31.83 |
| For z = h: | 9.00 | 0.85 | 24.43 | 24.71 | -26.91 | 24.71 | -31.83 |

Notes: 1. (+) and (-) signs signify wind pressures acting toward & away from respective surfaces.
2. Width of Zone 5 (end zones), 'a' = 3.00 ft. (Fig. 30.3-1)
3. Per Code Section 30.2.2, the minimum wind load for C&C shall not be less than 16 psf.
4. References : a. ASCE 7-16, "Minimum Design Loads for Buildings and Other Structures".
b. "Guide to the Use of the Wind Load Provisions of ASCE 7-02"
by: Kishor C. Mehta and James M. Delahay (2004).

## Wall Components and Cladding:




**Wall Zones for Buildings with h <= 60 ft.**




**Wall Zones for Buildings with h > 60 ft.**

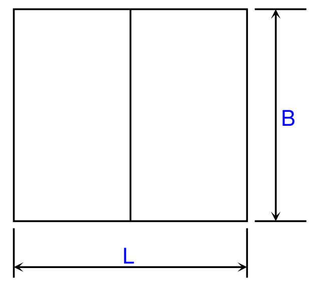
## WIND LOADING ANALYSIS - Roof Components and Cladding

**Per ASCE 7-16 Code for Bldgs. of Any Height with Gable Roof θ <= 45° or Monoslope Roof θ <= 3°**
**Using Part 1 & 3: Analytical Procedure (Section 30.3 & 30.5)**

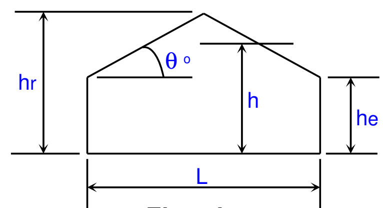
**Input Data:**

| | | |
|---|---|---|
| Wind Speed, V = | 115 | mph (Wind Map, Figure 26.5-1A-C) |
| Bldg. Classification = | II | (Table 1-1 Occupancy Category) |
| Exposure Category = | C | (Sect. 26.7) |
| Ridge Height, hr = | 10 | ft. (hr >= he) |
| Eave Height, he = | 9 | ft. (he <= hr) |
| Building Width = | 20 | ft. (Normal to Building Ridge) |
| Building Length = | 50.5 | ft. (Parallel to Building Ridge) |
| Roof Type = | Gable | (Gable or Monoslope) |
| Topo. Factor, Kzt = | 1 | (Sect. 26.8.2 & Figure 26.8-1) |
| Direct. Factor, Kd = | 0.85 | (Table 26.6-1) |
| Enclosed? (Y/N) | Y | (Sect. 26.2) |
| Hurricane Region? | N | |
| Component Name = | Joist | (Purlin, Joist, Decking, or Fastener) |
| Effective Area, Ae = | 133.3333 | ft.^2 (Area Tributary to C&C) |
| Overhangs? (Y/N) | Y | (if used, overhangs on all sides) |

Note: Worst Case Ae = Span Length * Length/3 (Sec 26.2)




**Plan**




**Elevation**

**Resulting Parameters and Coefficients:**

| | | |
|---|---|---|
| Roof Angle, θ = | 5.71 | deg. |
| Mean Roof Ht., h = | 9.00 | ft. (h = he, for roof angle <=10 deg.) |

Roof External Pressure Coefficients, GCp:

| | | |
|---|---|---|
| GCp Zone 1-3 Pos. = | 0.20 | (Fig. 30.3-2A) |
| GCp Zone 1 Neg. = | -1.51 | (Fig. 30.3-2A) |
| GCp Zone 2 Neg. = | -1.51 | (Fig. 30.3-2A) |
| GCp Zone 3 Neg. = | -0.80 | (Fig. 30.3-2A) |

Positive & Negative Internal Pressure Coefficients, GCpi (Table 26.13-1):

| | | |
|---|---|---|
| +GCpi Coef. = | 0.18 | (positive internal pressure) |
| -GCpi Coef. = | -0.18 | (negative internal pressure) |

If z <= 15 then: Kz = 2.01*(15/zg)^(2/α) , If z > 15 then: Kz = 2.01*(z/zg)^(2/α) (Table 26.10-1, Footnote 1)

| | | |
|---|---|---|
| α = | 9.50 | (Table 26.11-1) |
| zg = | 900 | (Table 26.11-1) |
| Kh = | 0.85 | (Kh = Kz evaluated at z = h) |

Velocity Pressure: qz = 0.00256*Kz*Kzt*Kd*V^2 (Sect. 26.10.2, Eq. 26.10-1)

qh = 24.43 psf    qh = 0.00256*Kh*Kzt*Kd*V^2 (qz evaluated at z = h)

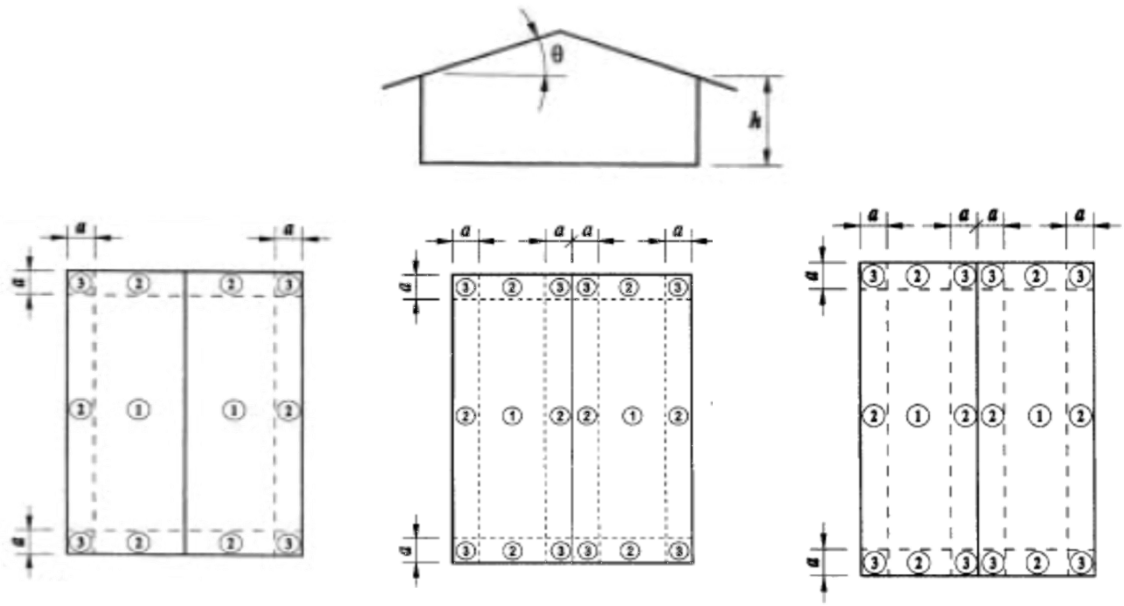
Design Net External Wind Pressures (Sect. 30.3.2 or 30.5.2):
For h <= 60 ft.: p = qh*((GCp) - (+/-GCpi)) (psf)
For h > 60 ft.: p = q*(GCp) - qi*(+/-GCpi) (psf)
where: q = qh for roof
qi = qh for all walls (conservatively assumed per Sect. 30.5.2)

**Wind Load Tabulation for Roof Components & Cladding**

| Component | z | Kh | qh | p = Net Design Pressures (psf) | | | |
|---|---|---|---|---|---|---|---|
| | (ft.) | | (psf) | Zone 1,2,3 (+) | Zone 1 (-) | Zone 2 (-) | Zone 3 (-) |
| Joist | 0 | 0.85 | 24.43 | 9.28 | -41.30 | -41.30 | -23.94 |
| For z = hr: | 10.00 | 0.85 | 24.43 | 9.28 | -41.30 | -41.30 | -23.94 |
| For z = he: | 9.00 | 0.85 | 24.43 | 9.28 | -41.30 | -41.30 | -23.94 |
| For z = h: | 9.00 | 0.85 | 24.43 | 9.28 | -41.30 | -41.30 | -23.94 |

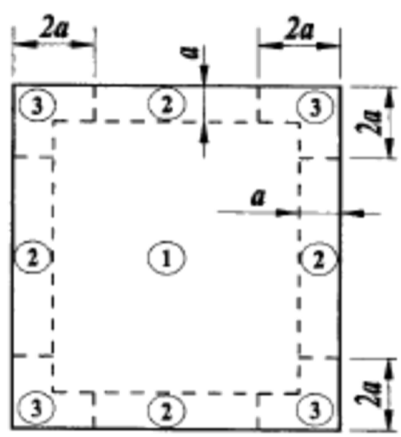
Notes: 1. (+) and (-) signs signify wind pressures acting toward & away from respective surfaces.
2. Width of Zone 2 (edge), 'a' = 3.00 ft.
3. Width of Zone 3 (corner), 'a' = 3.00 ft.
4. For monoslope roofs with θ <= 3 degrees, use Fig. 30.4-2A for 'GCp' values with 'qh'.
5. For buildings with h > 60' and θ > 10 degrees, use Fig. 30.6-1 for 'GCpi' values with 'qh'.
6. For all buildings with overhangs, use Fig. 30.4-2B for 'GCp' values per Sect. 30.10.
7. If a parapet >= 3' in height is provided around perimeter of roof with θ <= 10 degrees, Zone 3 shall be treated as Zone 2.
8. Per Code Section 30.2.2, the minimum wind load for C&C shall not be less than 16 psf.
9. References : a. ASCE 7-16, "Minimum Design Loads for Buildings and Other Structures".
b. "Guide to the Use of the Wind Load Provisions of ASCE 7-02"
by: Kishor C. Mehta and James M. Delahay (2004).

## Roof Components and Cladding:



θ <= 7 deg. | 7 deg. < θ <= 27 deg. | 27 deg. < θ <= 45 deg.

**Roof Zones for Buildings with h <= 60 ft.**
**(for Gable Roofs <= 45° and Monoslope Roofs <= 3°)**



ROOF PLAN

**Roof Zones for Buildings with h > 60 ft.**
**(for Gable Roofs <= 10° and Monoslope Roofs <= 3°)**

EXAMPLE 3 (Continued):

Distance of applied force above footing "c" = 0.5H + 0.05H =0.55 x 12’ = 6.60’

Applied Force "P" = (1/Cf1) x Net Area of Fence x Wind Pressure where Cf1 is the Mesh and Fabric Size Coefficient from Table 9 and the Wind Pressure is the Design Wind Pressure from Table 13.

P = (0.16 sf/sf) (120 sf) (45.99 lb/sf) = 883 lbs

Diameter of footing b = 30" = 2.50'

Solving for "D" D $= 0.5A * \{ 1 + [ 1 + (4.36 * c ) / A ) ]^{1/2} \}$ *(2009 IBC Eq. 18-1)*

.

where A = 2.34P/S1*b = 2.34 * ( 883 lbs ) / 150 psf * 2.5
= 5.51

D $= ( 0.5 )( 5.51 ) * \{ 1 + [ 1 + (4.36 * 6.60 / 5.51 )]^{1/2} \}$
= 9.63'

This required depth is less than the maximum embedment depth of 12.0” specified in the **2009 International Building Code** and also exceeds the minimum footing depth as set by **ASTM F-567** which is 24" + [ 3" X ( 12'- 4.0' ) ] = **24" + 24" = 48"**.

Use a footing depth of 10.00'

*Assumed allowable soil bearing pressure; actual value should be determined by appropriate means. Allowable lateral soil bearing pressure (S1) is permitted to be increased under specific conditions for embedded depth and application. Such increases should only be applied under the supervision of a professional knowledgeable and familiar with the conditions specific to the site and application.

Source: Chain Link Fence Wind Load Guide for the Selection of Line Post and Line Post Spacing (WLG 2445), By the **Chain Link Fence Manufacturers Institute,** Dated June 2016
Link: https://www.chainlinkinfo.org/wp-content/uploads/2016/06/WLG-Updated-61316.pdf

| TABLE 9 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Mesh and Fabric Size Coefficients ($Cf_1$)*** | | | | | | | | | |
| **FABRIC WIRE SIZE (O.D.)** | | 3/8” | 1/2 | 5/8" | 1” | 1 ¼” | 1 ¾” | 2” | 2 ¼” |
| **metric equiv. (mm) =>** | | 9.5 | 12.7 | 15.8 | 25.4 | 31.8 | 44.5 | 50.8 | 57.1 |
| **diam. (in)** | **diam.(mm)** | | | | | | | | |
| *.#5 (0.207)* | 5.26 | | | | 2.92 | 3.52 | 4.73 | 5.33 | 5.92 |
| *#6 (0.192)* | 4.88 | | | | 3.30 | 3.75 | 5.06 | 5.71 | 6.37 |
| *#8 (0.162)* | 4.11 | | | | 3.58 | 4.36 | 5.89 | 6.67 | 7.44 |
| *#9 (0.148)* | 3.76 | 1.77 | 2.20 | 2.60 | 3.87 | 4.73 | 6.40 | 7.26 | 8.09 |
| *10 (0.135)* | 3.43 | 1.88 | 2.36 | 2.80 | 4.19 | 5.13 | 6.96 | 7.90 | 8.82 |
| *11 (0.120)* | 3.0 | 2.06 | 2.60 | 3.10 | 4.65 | 5.71 | 7.77 | 8.83 | 9.86 |
| *12 (0.113)* | 2.87 | 2.16 | 2.72 | 3.25 | 4.91 | 6.04 | 8.22 | 9.35 | 10.44 |
| *** - ($Cf_1$) =1 for solid panel fence** | | | | | | | | | |

26.91 psf / 5.89 = 4.56 psf ∴ Use 5psf wind load against area of fence

All options highlighted in Yellow are OK

Source: Chain Link Fence Wind Load Guide for the Selection of Line Post and Line Post Spacing (WLG 2445), By the **Chain Link Fence Manufacturers Institute,** Dated June 2016
Link: https://www.chainlinkinfo.org/wp-content/uploads/2016/06/WLG-Updated-61316.pdf

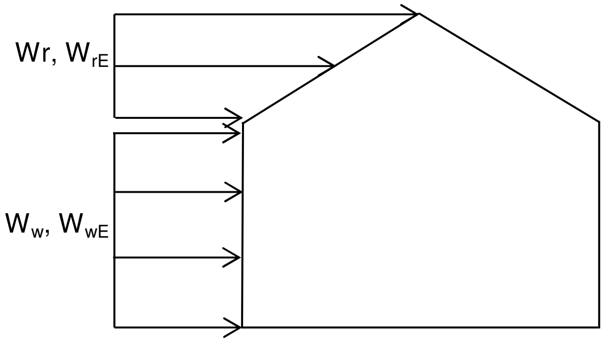
# Wind Shear Force Calculations

From 'ASCE 7-16 Wind Loading Analysis':

| LOAD CASE 'A' | |
|---|---|
| a = 3.00 feet | 2a = 6.00 feet |
| Z1 = 5.52 psf | Z1E = 10.72 psf |
| Z2 = -21.25 psf | Z2E = -30.54 psf |
| Z3 = -13.56 psf | Z3E = -17.53 psf |
| Z4 = -11.64 psf | Z4E = -15.14 psf |

| LOAD CASE 'B' | |
|---|---|
| a = 3.00 psf | 2a = 6.00 feet |
| Z1 = -15.39 psf | Z1E = -16.12 psf |
| Z2 = -21.25 psf | Z2E = -30.54 psf |
| Z3 = -13.44 psf | Z3E = -17.34 psf |
| Z4 = -15.39 psf | Z4E = -16.12 psf |

| 'A' FACTORED LOADS | |
|---|---|
| $0.6 * W_r = (Z_2 + Z_3) * 0.6 =$ | **4.6 psf** |
| $0.6 * W_{rE} = (Z_{2E} + Z_{3E}) * 0.6 =$ | **7.8 psf** |
| $0.6 * W_w = (Z_1 + Z_4) * 0.6 =$ | **10.3 psf** |
| $0.6 * W_{wE} = (Z_{1E} + Z_{4E}) * 0.6 =$ | **15.5 psf** |




| 'B' FACTORED LOADS | |
|---|---|
| $0.6 * W_r = (Z_2 + Z_3) * 0.6 =$ | **4.7 psf** |
| $0.6 * W_{rE} = (Z_{2E} + Z_{3E}) * 0.6 =$ | **7.9 psf** |
| $0.6 * W_w = (Z_1 + Z_4) * 0.6 =$ | **0.0 psf** |
| $0.6 * W_{wE} = (Z_{1E} + Z_{4E}) * 0.6 =$ | **0.0 psf** |

| Wall Line | Wind Force (psf) | Wall ht (ft) | Parapet (W/ 2.25 mult.) | wall line dist. (ft) | + | Wind Force (psf) | Truss Depth | Wr, We truss trib (ft) | wall line dist (ft) | + | Shear, Upper (#) | = | **Wind Force (kips)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X1-1 | 9.60 | 9 | 6.75 | 50.50 | + | 9.60 | 0 | 1.50 | 50.5 | + | 0.00 | = | **3.09** |
| X2-1 | 9.60 | 9 | 6.75 | 50.50 | + | 9.60 | 0 | 1.50 | 50.5 | + | 0.00 | = | **3.09** |
| Y1-1 | 11.09 | 9 | 6.75 | 39.50 | + | 9.60 | 0 | 1.50 | 39.5 | + | 0.00 | = | **2.75** |

## Seismic Shear Force Calculations

From 'ASCE7-16 Seismic Loading Analysis':

| Wall Line | Roof (psf) | Area W (ft) | Area L (ft) | + | Floor (psf) | Area W (ft) | Area L (ft) | + | Wall Type | Wall (psf) | Wall Height (ft) | Perp Wall length (ft) | $*C_s$ | + | Shear upper (kips) | = | **Shear Force (kips)** | **Lateral Control** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X1-1 | 42 | 50.5 | 39.5 | + | 18 | 0 | 0 | + | OSB | 12.0 | 9 | 50.50 | .05Wp | + | 0 | = | **2.35** | **Wind** |
| X2-1 | 42 | 50.5 | 39.5 | + | 18 | 0 | 0 | + | OSB | 12.0 | 9 | 50.50 | .05Wp | + | 0 | = | **2.35** | **Wind** |
| Y1-1 | 42 | 39.5 | 50.5 | + | 18 | 0 | 0 | + | OSB | 12.0 | 9 | 39.50 | .05Wp | + | 0 | = | **2.30** | **Wind** |

## Description: *X1-1* *Shear Wall*

Perforated Shear Wall Calculation Sheet: This spreadsheet is made in conformance to the IBC Chapters 2305-2308 and AFPA's "SDPWS: Lateral Force Resisting Systems".

***Shear Wall Forces***

| Symbol | Value | Unit | Description |
|---|---|---|---|
| | 19.75 | ft | Total length of wall |
| $L =$ | 19.75 | ft | Total length of shear wall |
| $L_w =$ | 10.66 | ft | Total length of full height segments |
| $H =$ | 9.00 | ft | height of shear wall |
| $H' =$ | 0.00 | ft | Maximum opening height |
| $V_1 =$ | 3091 | lbs | Total Wind force at top of wall |
| $w_{DL\ self} =$ | 108 | plf | Self weight |
| $w_{DL\ above} =$ | 40.80 | plf | Applied dead load |
| | 7/16 | in | Prefered OSB thickness |
| | 1/2 | in | Prefered Gyp thickness |
| | Y | y/n | Wall Connected to Concrete |
| | Y | y/n | Wall Connected to Truss or Joist |
| | N | y/n | Wall Connected to Gable / Drag Truss or Rim |

| SHEARWALL SEGMENTS | Aspect Ratio | Adjusted Length |
|---|---|---|
| 5.33 | 1.69 | 5.33 |
| 5.33 | 1.69 | 5.33 |

***Unit Base Shear***

| Symbol | Value | Unit | Description |
|---|---|---|---|
| $\%_{fh} = L_w/L =$ | 0.540 | | Percent of full height segments |
| $\%_{oh} = H'/H =$ | 0.000 | | Percent of maximum opening height |
| SCAF = | 1.00 | | Shear capacity adjustment factors (NDS SDPWS Table ) |
| $v_{base} = V_1/L_w =$ | 290 | plf | Unit base shear |
| $v_{req} = v_{base}/SCAF$ | 290 | plf | Effective unit base shear |
| OTM = | 27,815 | lb ft | Overturning moment of total length of wall |

***Shear wall adjustment factor***

| Symbol | Value | Unit | Description |
|---|---|---|---|
| RM = | 29,021 | lb ft | Resisting moment of total length of wall |
| r= | 1.0000 | | |
| $C_O$= | 1.8527 | | |
| | 156 plf | | Blocking Unit Shear |
| | 289.92 | | Force Calculated |

***Shear Transfer to Concrete:***

1/2 Anchor Bolts @ 72 " O.C. (3) Minimum

| | | Holdown | Ta | Type |
|---|---|---|---|---|
| T = 976 | lbs | Simpson LSTHD8 | 2145 | Strap |
| | OR: | Simpson DTT2Z | 2145 | Holdown |

***OSB Wall Sheathing attachment***

Min Shear Wall Segment: *2.57 ft*

Provide: 7/16" OSB W/ 8d Nails @ 6" O.C. Va= 336

OR: 7/16" OSB W/ 1½ 16 Gage Staples @ 3" O.C. Va= 434

**W1**

***Blocking / Nailing Framing Attachment***

"No Blocking Required"

## Description: *X2-1 Shear Wall*

Perforated Shear Wall Calculation Sheet: This spreadsheet is made in conformance to the IBC Chapters 2305-2308 and AFPA's "SDPWS: Lateral Force Resisting Systems".

***Shear Wall Forces***

| | Value | Unit | Description |
|---|---|---|---|
| | 19.75 | ft | Total length of wall |
| L = | 19.75 | ft | Total length of shear wall |
| $L_w$ = | 10.32 | ft | Total length of full height segments |
| H = | 9.00 | ft | height of shear wall |
| H' = | 0.00 | ft | Maximum opening height |
| $V_1$ = | 3091 | lbs | Total Wind force at top of wall |
| $w_{DL\ self}$ = | 108 | plf | Self weight |
| $w_{DL\ above}$ = | 40.80 | plf | Applied dead load |
| | 7/16 | in | Prefered OSB thickness |
| | 1/2 | in | Prefered Gyp thickness |
| | Y | y/n | Wall Connected to Concrete |
| | Y | y/n | Wall Connected to Truss or Joist |
| | N | y/n | Wall Connected to Gable / Drag Truss or Rim |

| SHEARWALL SEGMENTS | Aspect Ratio | Adjusted Length |
|---|---|---|
| 5.16 | 1.74 | 5.16 |
| 5.16 | 1.74 | 5.16 |

***Unit Base Shear***

| | Value | Unit | Description |
|---|---|---|---|
| $\%_{fh} = L_w/L$ = | 0.523 | | Percent of full height segments |
| $\%_{oh}$ = H'/H = | 0.000 | | Percent of maximum opening height |
| SCAF = | 1.00 | | Shear capacity adjustment factors (NDS SDPWS Table ) |
| $v_{base} = V_1/L_w$ = | 299 | plf | Unit base shear |
| $v_{req} = v_{base}$/SCAF | 299 | plf | Effective unit base shear |
| OTM = | 27,815 | lb ft | Overturning moment of total length of wall |

***Shear wall adjustment factor***

| | Value | Unit | Description |
|---|---|---|---|
| RM = | 29,021 | lb ft | Resisting moment of total length of wall |
| r= | 1.0000 | | |
| $C_O$= | 1.9138 | | |
| | 156 plf | | Blocking Unit Shear |
| | 299.48 | | Force Calculated |

***Shear Transfer to Concrete:***

1/2 Anchor Bolts @ 72 " O.C. (3) Minimum

| | | | Holdown | Ta | Type |
|---|---|---|---|---|---|
| T = | 1008 | lbs | Simpson LSTHD8 | 2145 | Strap |
| | | OR: | Simpson DTT2Z | 2145 | Holdown |

***OSB Wall Sheathing attachment***

Min Shear Wall Segment: *2.57 ft*

Provide: 7/16" OSB W/ 8d Nails @ 6" O.C. Va= 336

OR: 7/16" OSB W/ 1½ 16 Gage Staples @ 3" O.C. Va= 434

**W1**

***Blocking / Nailing Framing Attachment***

"No Blocking Required"

# Description: *Y1-1* *Shear Wall*

Perforated Shear Wall Calculation Sheet: This spreadsheet is made in conformance to the IBC Chapters 2305-2308 and AFPA's "SDPWS: Lateral Force Resisting Systems".

| SHEARWALL SEGMENTS | Aspect Ratio | Adjusted Length |
|---|---|---|
| 12.00 | 0.75 | 12.00 |
| 12 | 0.75 | 12.00 |

***Shear Wall Forces***

| | | | |
|---|---|---|---|
| | *50.38* | ft | Total length of wall |
| L = | *47.38* | ft | Total length of shear wall |
| $L_w$ = | *24.00* | ft | Total length of full height segments |
| H = | *9.00* | ft | height of shear wall |
| H' = | *8.00* | ft | Maximum opening height |
| $V_1$ = | *2749* | lbs | Total Wind force at top of wall |
| $w_{DL\ self}$ = | *108* | plf | Self weight |
| $w_{DL\ above}$ = | *40.80* | plf | Applied dead load |
| | *7/16* | in | Prefered OSB thickness |
| | *1/2* | in | Prefered Gyp thickness |
| | Y | y/n | Wall Connected to Concrete |
| | N | y/n | Wall Connected to Truss or Joist |
| | Y | y/n | Wall Connected to Gable / Drag Truss or Rim |

***Unit Base Shear***

| | | | |
|---|---|---|---|
| $\%_{fh}$ = $L_w/L$ = | 0.507 | | Percent of full height segments |
| $\%_{oh}$ = H'/H = | 0.889 | | Percent of maximum opening height |
| SCAF = | *0.55* | | Shear capacity adjustment factors (NDS SDPWS Table ) |
| $v_{base}$ = $V_1/L_w$ = | 115 | plf | Unit base shear |
| $v_{req}$ = $v_{base}$/SCAF | **209** | plf | Effective unit base shear |
| OTM = | **45,092** | lb ft | Overturning moment of total length of wall |

***Shear wall adjustment factor***

| | | | |
|---|---|---|---|
| RM = | **166,983** | lb ft | Resisting moment of total length of wall |
| r= | 0.5360 | | |
| $C_O$= | 0.5487 | | |
| | 55 plf | | Blocking Unit Shear |
| | 208.76 | | Force Calculated |

***Shear Transfer to Concrete:***

1/2 Anchor Bolts @ 72 " O.C. (3) Minimum

T = **Not Req'd** lbs

***OSB Wall Sheathing attachment***

Min Shear Wall Segment: *2.57 ft*

Provide: 7/16" OSB W/ 8d Nails @ 6" O.C. Va= 336

OR: 7/16" OSB W/ 1½ 16 Gage Staples @ 3" O.C. Va= 434

**W1**

***Blocking / Nailing Framing Attachment***

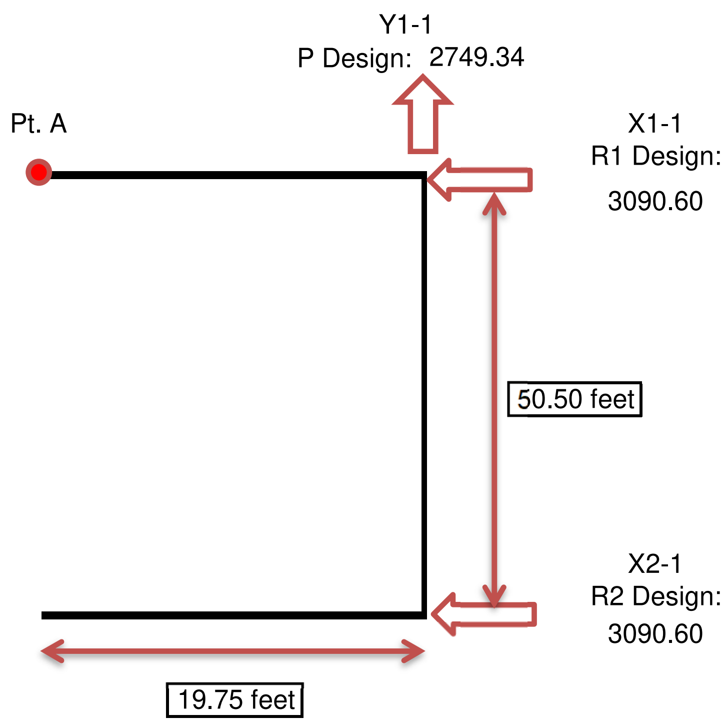
"Typ. Gable / Drag Truss or Rim Nailing"

# Three Sided Diaphragm Calculations

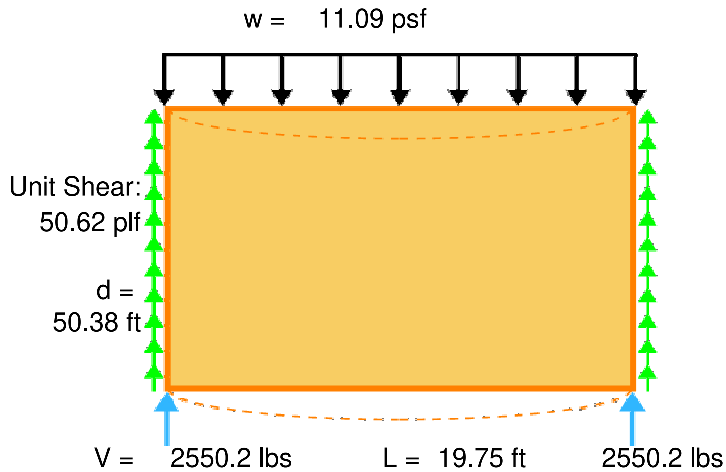
From NDS Wind & Seismic 'Special Design Provisions for Wind & Seismic " Section 4.2.5.2

| Design Criteria | |
|---|---|
| Diaphragm Length | Diaphragm Width |
| L 19.75 feet | W 50.50 feet |
| Check For Length<35' | **OK** |
| Length To Width Ratio | 0.391 |
| Check For <1:1 Length Ratio | **OK** |

| Forces in R1 & R2 Due to Rotation | | |
|---|---|---|
| P Design | = | 2749 # |
| R1 Due to Rotation | = | 538 # |
| R1 Due to Transverse Load | = | 3091 # |
| Governing Inplane Load R1 | = | **3091** # |
| R2 Due to Rotation | = | 538 # |
| R2 Due to Transverse Load | = | 3091 # |
| Governing Inplane Load R2 | = | **3091** # |

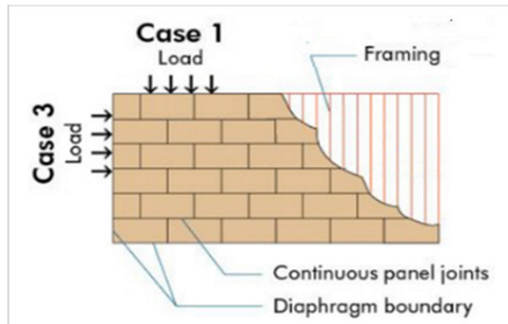


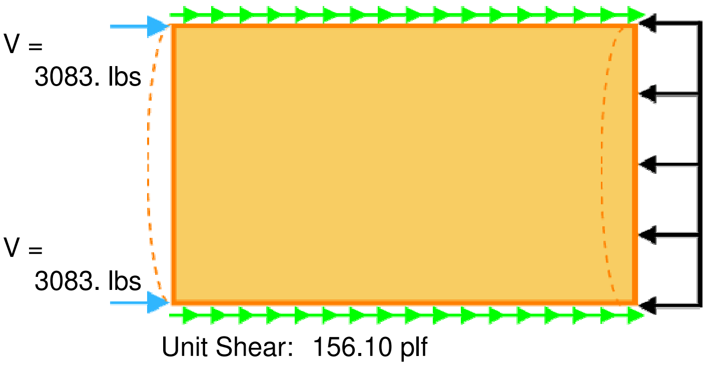
# Wood Diaphragm Design (2018 NDS & 2021 SDPWS)




**Load/Panel Case**

| | |
|---|---|
| Framing/Panels: | Perpendicular |
| Panels Staggered?: | Y |
| Framing Orient. In short direction: | Vertical |
| Blocked?: | N |




wt =
9.60 psf

Roof Pressure = 9.6 psf

**Diaphragm Criteria:**

| | | |
|---|---|---|
| Diaphragm Location: | Roof | |
| Wind Force MWFRS, w: | 11.09 | psf |
| Wind Force MWFRS, wt: | 9.60 | psf |
| Diaphragm Width, L: | 19.75 | ft |
| Diaphragm Depth, d: | 50.375 | ft |
| Height of Top Story: | 9 | ft |
| Height of Roof: | 8.25 | ft |
| Panel Thickness | 19/32 | inches |
| Sheathing Grade: | Sheathing and Single Floor | |
| Nail Size: | 10d | |
| Framing Memebr Nom. Width: | 2 | |
| Nail Spacing: | 6 | |

**Diaphragm Check:**

| | | | |
|---|---|---|---|
| Max Shear Force: | 2550 | lbs | (Short Side) |
| Max Unit Shear: | 51 | plf | (Short Side) |
| Max Shear Force: | 3083 | lbs | (Long Side) |
| Max Unit Shear: | 156 | plf | (Long Side) |
| Case 1 Nom. Cap: | 800 | plf | |
| Case 3 Nom. Cap: | 600 | plf | |
| ASD Wind Factor: | 2 | | |
| Case 1 Adj. Cap: | 400 | plf | |
| Case 3 adj. Cap: | 300 | plf | |

**Chord Force:**

| | | |
|---|---|---|
| Long Side: | 93 | lbs |
| Short Side: | 1537 | lbs |

**Lap/Splice Dbl Top Plate w/
(9) 16d nails on ea. side of splice**

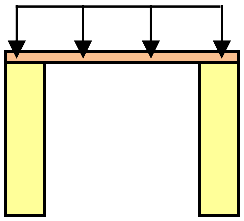
*Short Side Check:*

| Capacity: | | Actual: | |
|---|---|---|---|
| 400 | > | 51 | plf |
| | OK | | |

*Long Side Check:*

| Capacity: | | Actual: | |
|---|---|---|---|
| 300 | > | 156 | plf |
| | OK | | |

## Design of Roof Panels for Gravity Loads


w = 117 psf

S = 16 in o.c.

**Input Design Data:**

| | | |
|---|---|---|
| Framing Member Spacing, S: | 16 | in O.C. |
| Roof Dead Load: | 17 | psf |
| Roof Snow Load: | 100 | psf |
| Roof Live Load: | 0 | psf |

| | |
|---|---|
| Transient Deflection Limit: | L/360 |
| Total Deflection Limit: | L/180 |

**Sheathing Capacity (OSB):**

| | |
|---|---|
| Span Rating: | 40/20 |
| Thickness: | 19/32 |
| Max Load, L/360: | 368 psf |
| Max Load, L/240: | 552 psf |
| Max Load, L/180: | 736 psf |
| Max Load, Bending: | 352 psf |
| Max Load, Shear | 283 psf |

**Check Panel Design (OSB):**

| | Allowable | | Actual |
|---|---|---|---|
| Transient Deflection: | 368 psf | > | 100 psf |
| Total Deflection: | 736 psf | > | 117 psf |
| Bending : | 405 psf | > | 117 psf |
| Shear : | 325 psf | > | 117 psf |

**OK**

(OSB Capacity Obtained from APA Q225G)

**Check Edge Support Requirements:**

**Table M9.4-1 Panel Edge Support²**

| Sheathing Span Rating | Maximum Recommended Span (in.) With Edge Support | Without Edge Support |
|---|---|---|
| 24/0 | 24 | 19.2[1] |
| 24/16 | 24 | 24 |
| 32/16 | 32 | 28 |
| 40/20 | 40 | 32 |
| 48/24 | 48 | 36 |

1. 20 in. for 3/8 and 7/16 performance category panels, 24 in. for 15/32 and 1/2 performance category panels.
2. Additional edge support is recommended when panel widths are less than 24 inches. Edge support requirements should be obtained from the manufacturer.

**No Edge Support Required**

# Masonry Slender Wall



**DESCRIPTION:** cmu wall

## *Code References*

Calculations per TMS 402-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

## General Information

**Calculations per TMS 402-16, IBC 2018, CBC 2019, ASCE 7-16**

Construction Type : Grouted Hollow Concrete Masonry

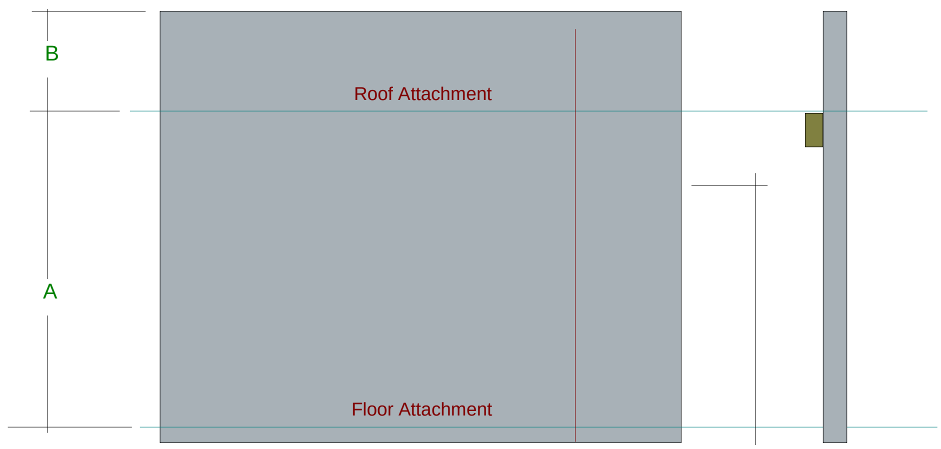
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| F'm | = | 1.50 ksi | Nom. Wall Thickness | 8 | in | Temp Diff across thickness | = | 0.0 deg F |
| Fy - Yield | = | 60.0 ksi | Actual Thickness | 7.625 | in | Min Allow Out-of-plane Defl Ra | = | 0.0 |
| Fr - Rupture | = | 127.0 psi | Rebar "d" distance | 3.8125 | in | | | |
| Em = f'm * | = | 900.0 | Lower Level Rebar . . . | | | Minimum Vertical Steel % | = | 0.0020 |
| Max % of ρ bal. | = | 0.007135 | Bar Size # | 4 | | | | |
| Grout Density | = | 140 pcf | Bar Spacing | 48 | in | | | |
| Block Weight | | Normal Weight | | | | | | |
| Wall Weight | = | 47.0 psf | | | | | | |

Wall is grouted at rebar cells only

## One-Story Wall Dimensions

| | | | |
|---|---|---|---|
| A | Clear Height | = | 6 ft |
| B | Parapet height | = | 0.0 ft |

Wall Support Condition Top Free, Bottom Fix




## Lateral Loads

Wind Loads :

Full area WIND load 26.9 psf

Seismic Loads :

Wall Weight Seismic Load Input Method : Factor applied to wall weight entered

Seismic factor to be applied to wall weight 0.23

Fp = Wall Wt. * 0.230 = 10.810 psf

## Masonry Slender Wall



**DESCRIPTION:** cmu wall

### *DESIGN SUMMARY*

**Results reported for "Strip Width" of 12.0 in**

| | Governing Load Combination . . . | Actual Values . . . | | Allowable Values . . . | |
|---|---|---|---|---|---|
| PASS | Moment Capacity Check | Maximum Bending Stress Rat | **0.5883** | | |
| | +0.90D+W | Max Mu | -0.4843 k-ft | Phi * Mn | 0.8232 k-ft |
| PASS | Service Deflection Check | Actual Defl. Ratio L/ | 8,743 | Allowable Defl. Ratio | 180.0 |
| | W Only | Max. Deflection | 0.01647 in | | /2 for Cantilever |
| PASS | Axial Load Check | Max Pu / Ag | 8.319 psi | Max. Allow. Defl. | 0.80 in |
| | +1.20D+W | Location | 0.10 ft | 0.2 * f'm | 300.0 psi |
| | Reinforcing Limit Check | Actual As/bd | 0.001093 | Max Allow As/bd | 0.007135 |

| Maximum Reactions | *for Load Combination...* | |
|---|---|---|
| Top Horizontal | | 0.0 k |
| Base Horizontal | W Only | 0.1614 k |
| Vertical Reaction | +D+0.5250E | 0.2820 k |

### Design Maximum Combinations - Moments

**Results reported for "Strip Width" = 12 in.**

| Load Combination | Axial Load Pu k | Axial Load 0.2*f'm*b*t k | Moment Values Mcr k-ft | Moment Values Mu k-ft | Phi | Phi Mn k-ft | As in^2 | As Ratio | 0.6 * rho bal | Bar 'd' |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.0000 | 0.0000 | 0.00 |
| | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.0000 | 0.0000 | 0.00 |
| +1.20D+0.50W at 0.00 to 0.20 | 0.338 | 12.204 | 0.92 | 0.24 | 0.90 | 0.85 | 0.050 | 0.0011 | 0.0070 | 0.00 |
| +1.20D+W at 0.00 to 0.20 | 0.338 | 12.204 | 0.92 | 0.48 | 0.90 | 0.85 | 0.050 | 0.0011 | 0.0070 | 0.00 |
| +1.20D+E at 0.00 to 0.20 | 0.338 | 12.204 | 0.92 | 0.19 | 0.90 | 0.85 | 0.050 | 0.0011 | 0.0070 | 0.00 |
| +0.90D+W at 0.00 to 0.20 | 0.254 | 12.204 | 0.92 | 0.48 | 0.90 | 0.82 | 0.050 | 0.0011 | 0.0070 | 0.00 |
| +0.90D+E at 0.00 to 0.20 | 0.254 | 12.204 | 0.92 | 0.19 | 0.90 | 0.82 | 0.050 | 0.0011 | 0.0070 | 0.00 |

### Design Maximum Combinations - Deflections

**Results reported for "Strip Width" = 12 in.**

| Load Combination | Axial Load Pu k | Moment Values Mcr k-ft | Moment Values Mactual k-ft | Stiffness I gross in^4 | Stiffness I cracked in^4 | Stiffness I effective in^4 | Deflections Deflection in | Deflections Defl. Ratio |
|---|---|---|---|---|---|---|---|---|
| | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 | 0.000 | 0.0 |
| +D+0.60W at 5.80 to 6.00 | 0.009 | 0.92 | 0.00 | 331.10 | 11.79 | 331.100 | 0.010 | 14,566.7 |
| +D+0.70E at 5.80 to 6.00 | 0.009 | 0.92 | 0.00 | 331.10 | 11.79 | 331.100 | 0.005 | 31,070.1 |
| +D+0.450W at 5.80 to 6.00 | 0.009 | 0.92 | 0.00 | 331.10 | 11.79 | 331.100 | 0.007 | 19,422.3 |
| +D+0.5250E at 5.80 to 6.00 | 0.009 | 0.92 | 0.00 | 331.10 | 11.79 | 331.100 | 0.003 | 41,426.8 |
| +0.60D+0.60W at 5.80 to 6.00 | 0.006 | 0.92 | 0.00 | 331.10 | 11.78 | 331.100 | 0.010 | 14,569.0 |
| +0.60D+0.70E at 5.80 to 6.00 | 0.006 | 0.92 | 0.00 | 331.10 | 11.78 | 331.100 | 0.005 | 31,074.9 |
| W Only at 5.80 to 6.00 | 0.000 | 0.92 | 0.00 | 331.10 | 11.76 | 331.100 | 0.016 | 8,743.5 |
| E Only at 5.80 to 6.00 | 0.000 | 0.92 | 0.00 | 331.10 | 11.76 | 331.100 | 0.007 | 21,757.6 |

### Reactions - Vertical & Horizontal

| Load Combination | Base Horizontal | Top Horizontal | Vertical @ Wall Base |
|---|---|---|---|
| D Only | 0.0 k | 0.00 k | 0.282 k |
| +D+0.60W | 0.1 k | 0.00 k | 0.282 k |
| +D+0.70E | 0.0 k | 0.00 k | 0.282 k |
| +D+0.450W | 0.1 k | 0.00 k | 0.282 k |
| +D+0.5250E | 0.0 k | 0.00 k | 0.282 k |
| +0.60D+0.60W | 0.1 k | 0.00 k | 0.169 k |
| +0.60D+0.70E | 0.0 k | 0.00 k | 0.169 k |
| W Only | 0.2 k | 0.00 k | 0.000 k |

**DESCRIPTION:** cmu wall

| | | | |
|---|---|---|---|
| E Only | 0.1 k | 0.00 k | 0.000 k |

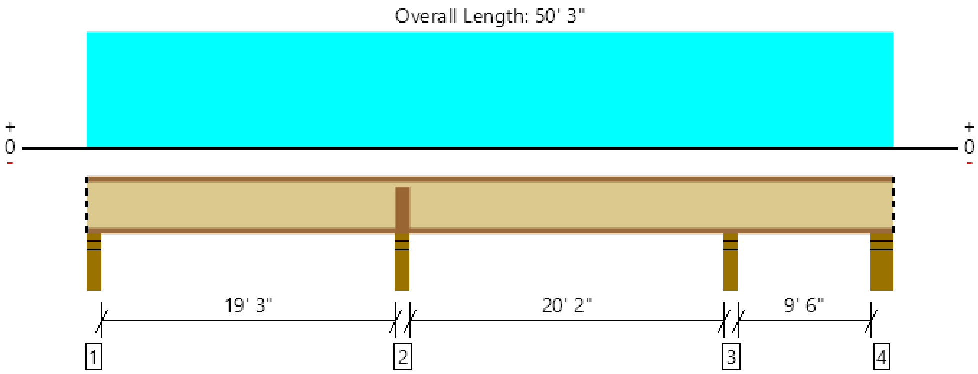
FORTEWEB

MEMBER REPORT

PASSED

Roof, Roof Joist

1 piece(s) 11 7/8" TJI® 560 @ 16" OC




All locations are measured from the outside face of left support (or left cantilever end). All dimensions are horizontal.

| Design Results | Actual @ Location | Allowed | Result | LDF | Load: Combination (Pattern) |
|---|---|---|---|---|---|
| Member Reaction (lbs) | 3632 @ 19' 8 1/4" | 3996 (3.50") | Passed (91%) | 1.15 | 1.0 D + 1.0 S (Adj Spans) |
| Shear (lbs) | 1709 @ 19' 6 1/2" | 2358 | Passed (73%) | 1.15 | 1.0 D + 1.0 S (Adj Spans) |
| Moment (Ft-lbs) | -6883 @ 19' 8 1/4" | 10925 | Passed (63%) | 1.15 | 1.0 D + 1.0 S (Adj Spans) |
| Live Load Defl. (in) | 0.488 @ 9' 3/4" | 0.974 | Passed (L/479) | -- | 1.0 D + 1.0 S (Alt Spans) |
| Total Load Defl. (in) | 0.558 @ 9' 1/16" | 1.299 | Passed (L/419) | -- | 1.0 D + 1.0 S (Alt Spans) |

- Deflection criteria: LL (L/240) and TL (L/180).
- Allowed moment does not reflect the adjustment for the beam stability factor.

System : Roof
Member Type : Joist
Building Use : Residential
Building Code : IBC 2018
Design Methodology : ASD
Member Pitch : 0/12

| | Bearing Length | | | Loads to Supports (lbs) | | | |
|---|---|---|---|---|---|---|---|
| Supports | Total | Available | Required | Dead | Snow | Factored | Accessories |
| 1 - Stud wall - DF | 3.50" | 3.50" | 1.75" | 175 | 1094 | 1269 | Blocking |
| 2 - Stud wall - DF | 3.50" | 3.50" | 3.50" | 525 | 3107 | 3632 | Web Stiffeners |
| 3 - Stud wall - DF | 3.50" | 3.50" | 3.50" | 378 | 2392 | 2770 | None |
| 4 - Stud wall - DF | 5.50" | 5.50" | 1.75" | 62 | 561/-16 | 623 | Blocking |

• Blocking Panels are assumed to carry no loads applied directly above them and the full load is applied to the member being designed.

| Lateral Bracing | Bracing Intervals | Comments |
|---|---|---|
| Top Edge (Lu) | 8' o/c | |
| Bottom Edge (Lu) | 6' 7" o/c | |

•TJI joists are only analyzed using Maximum Allowable bracing solutions.
•Maximum allowable bracing intervals based on applied load.

| Vertical Load | Location | Spacing | Dead (0.90) | Snow (1.15) | Comments |
|---|---|---|---|---|---|
| 1 - Uniform (PSF) | 0 to 50' 3" | 16" | 17.0 | 100.0 | Default Load |

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The product application, input design loads, dimensions and support information have been provided by ForteWEB Software Operator

| ForteWEB Software Operator | Job Notes |
|---|---|
| Cameron Price<br>Performance Engineers<br>(208) 475-0040<br>cprice@inteframe.com | |

Weyerhaeuser

CALC: H-101

| | | | | | |
|---|---|---|---|---|---|
| Wood Type: | Dim Lumber | | | | |
| Species/Grade | DF-L #2 | | Nom: | | |
| Width | 1.5 | in | 2 | | |
| Depth | 5.5 | in | 6 | | |
| Span | 2 | ft | # of Plies: | | |
| High Moisture? | N | Trib: | 2 | | |
| Dead | 17 | psf | 5.0 ft | | |
| Live | 0 | psf | 0.0 ft | # of 2x Trimmers: | |
| Snow | 100 | psf | 5.0 ft | 1 | |
| Wind | 0 | psf | 0.0 ft | | |
| Controllong Comb: | Snow | | | | |
| Total Line Load: | 585 | plf | | | |

| | Fb | Fv | Fc perp | E | Emin |
|---|---|---|---|---|---|
| Reference: | 900 | 180 | 625 | 1600000 | 580000 |
| Cd | 1.15 | 1.15 | - | - | - |
| Cm | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ct | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cf | 1.30 | - | - | - | - |
| Cb | - | - | 1.25 | - | - |
| Adjusted: | 1346 psi | 207 psi | 781 psi | 1600 ksi | 580 ksi |

**Check Shear:**
V = w*t*L*0.5 V = 585 lbs
fv = 3V / 2A fv = 53.18 psi
F'v > fv F'v = 207 psi > 53.18 psi
**F'v OK** (0.26)

**Check Bending:**
M = w*L^2/8 M = 292.5 ft-lbs
fb = 6M / bd^2 fb = 232.07 psi
F'b > fb F'b = 1346 psi > 232.07 psi
**F'b OK** (0.17)

**Check Deflection**
δ = 5wL^4 / 384EI δt = 0.003 in (Total)
δL = 0.003 in (Transient)
δt < L/180 δt = SPAN/ 7584 **δt OK**
δL < L/240 δL = SPAN/ 8873 **δL OK**

**Check Bearing**
P = V = w*t*L*0.5 P = 585 lbs
fc perp = P/A fc perp = 130 psi
F'c perp>fc perp
F'c perp = 781 psi > 130 psi
**F'c perp OK** (0.17)

Calculations based off 2018 NDS
Deflection Criteria based off IBC 1604.3
ASD Design Methodology Used

CALC: H-102

| | | | | | |
|---|---|---|---|---|---|
| Wood Type: | Dim Lumber | | | | |
| Species/Grade | DF-L #2 | | Nom: | | |
| Width | 1.5 | in | 2 | | |
| Depth | 7.25 | in | 8 | | |
| Span | 3.25 | ft | # of Plies: | | |
| High Moisture? | N | Trib: | 2 | | |
| Dead | 17 | psf | 15.0 ft | | |
| Live | 0 | psf | 0.0 ft | # of 2x Trimmers: | |
| Snow | 100 | psf | 15.0 ft | 1 | |
| Wind | 0 | psf | 0.0 ft | | |
| Controllong Comb: | Snow | | | | |
| Total Line Load: | 1755 | plf | | | |

| | Fb | Fv | Fc perp | E | Emin |
|---|---|---|---|---|---|
| Reference: | 900 | 180 | 625 | 1600000 | 580000 |
| Cd | 1.15 | 1.15 | - | - | - |
| Cm | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ct | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cf | 1.20 | - | - | - | - |
| Cb | - | - | 1.25 | - | - |
| Adjusted: | 1242 psi | 207 psi | 781 psi | 1600 ksi | 580 ksi |

**Check Shear:**
V = w*t*L*0.5 V = 2851.88 lbs
fv = 3V / 2A fv = 196.68 psi
F'v > fv F'v = 207 psi > 196.68 psi
**F'v OK** (0.95)

**Check Bending:**
M = w*L^2/8 M = 2317.15 ft-lbs
fb = 6M / bd^2 fb = 1058.01 psi
F'b > fb F'b = 1242 psi > 1058.01 psi
**F'b OK** (0.85)

**Check Deflection**
δ = 5wL^4 / 384EI δt = 0.029 in (Total)
δL = 0.025 in (Transient)
δt < L/180 δt = SPAN/ 1349 **δt OK**
δL < L/240 δL = SPAN/ 1579 **δL OK**

**Check Bearing**
P = V = w*t*L*0.5 P = 2851.88 lbs
fc perp = P/A fc perp = 633.75 psi
F'c perp>fc perp
F'c perp = 781 psi > 633.75 psi
**F'c perp OK** (0.81)

Calculations based off 2018 NDS
Deflection Criteria based off IBC 1604.3
ASD Design Methodology Used

## CALC: H-103

| | | | | | |
|---|---|---|---|---|---|
| Wood Type: | Dim Lumber | | | | |
| Species/Grade | DF-L #2 | | Nom: | | |
| Width | 1.5 | in | 2 | | |
| Depth | 9.25 | in | 10 | | |
| Span | 3.16 | ft | # of Plies: | | |
| High Moisture? | N | Trib: | 2 | | |
| Dead | 17 | psf | 19.83 ft | | |
| Live | 0 | psf | 0.0 ft | # of 2x Trimmers: | |
| Snow | 100 | psf | 19.83 ft | 2 | |
| Wind | 0 | psf | 0.0 ft | | |
| Controllong Comb: | Snow | | | | |
| Total Line Load: | 2320.11 | plf | | | |

| | Fb | Fv | Fc perp | E | Emin |
|---|---|---|---|---|---|
| Reference: | 900 | 180 | 625 | 1600000 | 580000 |
| Cd | 1.15 | 1.15 | - | - | - |
| Cm | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ct | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cf | 1.10 | - | - | - | - |
| Cb | - | - | 1.13 | - | - |
| Adjusted: | 1139 psi | 207 psi | 703 psi | 1600 ksi | 580 ksi |

**Check Shear:**

| | | | | | |
|---|---|---|---|---|---|
| V = w*t*L*0.5 | | V = | 3665.77 | lbs | |
| fv = 3V / 2A | | fv = | 198.15 | psi | |
| F'v > fv | F'v = | 207 psi | > | 198.15 | psi |
| | | | F'v OK | (0.96) | |

**Check Bending:**

| | | | | | |
|---|---|---|---|---|---|
| M = w*L^2/8 | | M = | 2895.96 | ft-lbs | |
| fb = 6M / bd^2 | | fb = | 812.31 | psi | |
| F'b > fb | F'b = | 1139 psi | > | 812.31 | psi |
| | | | F'b OK | (0.71) | |

**Check Deflection**

| | | | | |
|---|---|---|---|---|
| δ = 5wL^4 / 384EI | | δt = | 0.016 | in (Total) |
| | | δL = | 0.014 | in (Transient) |
| δt < L/180 | δt = | SPAN/ 2306 | δt OK | |
| δL < L/240 | δL = | SPAN/ 2698 | δL OK | |

**Check Bearing**

| | | | | | |
|---|---|---|---|---|---|
| P = V = w*t*L*0.5 | | P = | 3665.77 | lbs | |
| fc perp = P/A | | fc perp = | 407.308 | psi | |
| F'c perp>fc perp | | | | | |
| | F'c perp = | 703 psi | > | 407.308 | psi |
| | | | F'c perp OK | (0.58) | |

Calculations based off 2018 NDS
Deflection Criteria based off IBC 1604.3
ASD Design Methodology Used

## CALC: H-104

| | | | | | |
|---|---|---|---|---|---|
| Wood Type: | Dim Lumber | | | | |
| Species/Grade | DF-L #2 | | Nom: | | |
| Width | 1.5 | in | 2 | | |
| Depth | 5.5 | in | 6 | | |
| Span | 2 | ft | # of Plies: | | |
| High Moisture? | N | Trib: | 2 | | |
| Dead | 17 | psf | 3.0 ft | | |
| Live | 0 | psf | 0.0 ft | # of 2x Trimmers: | |
| Snow | 100 | psf | 3.0 ft | 1 | |
| Wind | 0 | psf | 0.0 ft | | |
| Controllong Comb: | Snow | | | | |
| Total Line Load: | 351 | plf | | | |

| | Fb | Fv | Fc perp | E | Emin |
|---|---|---|---|---|---|
| Reference: | 900 | 180 | 625 | 1600000 | 580000 |
| Cd | 1.15 | 1.15 | - | - | - |
| Cm | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ct | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cf | 1.30 | - | - | - | - |
| Cb | - | - | 1.25 | - | - |
| Adjusted: | 1346 psi | 207 psi | 781 psi | 1600 ksi | 580 ksi |

**Check Shear:**

| | | | | | |
|---|---|---|---|---|---|
| V = w*t*L*0.5 | | V = | 351 | lbs | |
| fv = 3V / 2A | | fv = | 31.91 | psi | |
| F'v > fv | F'v = | 207 psi | > | 31.91 | psi |
| | | | F'v OK | (0.15) | |

**Check Bending:**

| | | | | | |
|---|---|---|---|---|---|
| M = w*L^2/8 | | M = | 175.5 | ft-lbs | |
| fb = 6M / bd^2 | | fb = | 139.24 | psi | |
| F'b > fb | F'b = | 1346 psi | > | 139.24 | psi |
| | | | F'b OK | (0.1) | |

**Check Deflection**

| | | | | |
|---|---|---|---|---|
| δ = 5wL^4 / 384EI | | δt = | 0.002 | in (Total) |
| | | δL = | 0.002 | in (Transient) |
| δt < L/180 | δt = | SPAN/ 12640 | δt OK | |
| δL < L/240 | δL = | SPAN/ 14789 | δL OK | |

**Check Bearing**

| | | | | | |
|---|---|---|---|---|---|
| P = V = w*t*L*0.5 | | P = | 351 | lbs | |
| fc perp = P/A | | fc perp = | 78 | psi | |
| F'c perp>fc perp | | | | | |
| | F'c perp = | 781 psi | > | 78 | psi |
| | | | F'c perp OK | (0.1) | |

Calculations based off 2018 NDS
Deflection Criteria based off IBC 1604.3
ASD Design Methodology Used

CALC: H-105

| | | | | | |
|---|---|---|---|---|---|
| Wood Type: | Dim Lumber | | | | |
| Species/Grade | DF-L #2 | | | Nom: | |
| Width | 1.5 | in | | 2 | |
| Depth | 7.25 | in | | 8 | |
| Span | 6 | ft | | # of Plies: | |
| High Moisture? | N | Trib: | | 2 | |
| Dead | 17 | psf | 4.0 ft | | |
| Live | 0 | psf | 0.0 ft | # of 2x Trimmers: | |
| Snow | 100 | psf | 4.0 ft | 2 | |
| Wind | 0 | psf | 0.0 ft | | |
| Controllong Comb: | Snow | | | | |
| Total Line Load: | 468 | plf | | | |

| | Fb | Fv | Fc perp | E | Emin |
|---|---|---|---|---|---|
| Reference: | 900 | 180 | 625 | 1600000 | 580000 |
| Cd | 1.15 | 1.15 | - | - | - |
| Cm | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ct | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cf | 1.20 | - | - | - | - |
| Cb | - | - | 1.13 | - | - |
| Adjusted: | 1242 psi | 207 psi | 703 psi | 1600 ksi | 580 ksi |

**Check Shear:**

| | | | | |
|---|---|---|---|---|
| V = w*t*L*0.5 | | V = | 1404 | lbs |
| fv = 3V / 2A | | fv = | 96.83 | psi |
| F'v > fv | F'v = | 207 psi | > | 96.83 psi |
| | | | **F'v OK** | (0.47) |

**Check Bending:**

| | | | | |
|---|---|---|---|---|
| M = w*L^2/8 | | M = | 2106 | ft-lbs |
| fb = 6M / bd^2 | | fb = | 961.60 | psi |
| F'b > fb | F'b = | 1242 psi | > | 961.60 psi |
| | | | **F'b OK** | (0.77) |

**Check Deflection**

| | | | |
|---|---|---|---|
| δ = 5wL^4 / 384EI | δt = | 0.090 | in (Total) |
| | δL = | 0.077 | in (Transient) |
| δt < L/180 | δt = | SPAN/ 804 | **δt OK** |
| δL < L/240 | δL = | SPAN/ 941 | **δL OK** |

**Check Bearing**

| | | | | |
|---|---|---|---|---|
| P = V = w*t*L*0.5 | | P = | 1404 | lbs |
| fc perp = P/A | | fc perp = | 156 | psi |
| F'c perp>fc perp | | | | |
| | F'c perp = | 703 psi | > | 156 psi |
| | | | **F'c perp OK** | (0.22) |

Calculations based off 2018 NDS
Deflection Criteria based off IBC 1604.3
ASD Design Methodology Used

CALC: H-106

| | | | | | |
|---|---|---|---|---|---|
| Wood Type: | Dim Lumber | | | | |
| Species/Grade | DF-L #2 | | | Nom: | |
| Width | 1.5 | in | | 2 | |
| Depth | 9.25 | in | | 10 | |
| Span | 8 | ft | | # of Plies: | |
| High Moisture? | N | Trib: | | 2 | |
| Dead | 17 | psf | 4.0 ft | | |
| Live | 0 | psf | 0.0 ft | # of 2x Trimmers: | |
| Snow | 100 | psf | 4.0 ft | 1 | |
| Wind | 0 | psf | 0.0 ft | | |
| Controllong Comb: | Snow | | | | |
| Total Line Load: | 468 | plf | | | |

| | Fb | Fv | Fc perp | E | Emin |
|---|---|---|---|---|---|
| Reference: | 900 | 180 | 625 | 1600000 | 580000 |
| Cd | 1.15 | 1.15 | - | - | - |
| Cm | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ct | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Cf | 1.10 | - | - | - | - |
| Cb | - | - | 1.25 | - | - |
| Adjusted: | 1139 psi | 207 psi | 781 psi | 1600 ksi | 580 ksi |

**Check Shear:**

| | | | | |
|---|---|---|---|---|
| V = w*t*L*0.5 | | V = | 1872 | lbs |
| fv = 3V / 2A | | fv = | 101.19 | psi |
| F'v > fv | F'v = | 207 psi | > | 101.19 psi |
| | | | **F'v OK** | (0.49) |

**Check Bending:**

| | | | | |
|---|---|---|---|---|
| M = w*L^2/8 | | M = | 3744 | ft-lbs |
| fb = 6M / bd^2 | | fb = | 1050.18 | psi |
| F'b > fb | F'b = | 1139 psi | > | 1050.18 psi |
| | | | **F'b OK** | (0.92) |

**Check Deflection**

| | | | |
|---|---|---|---|
| δ = 5wL^4 / 384EI | δt = | 0.136 | in (Total) |
| | δL = | 0.116 | in (Transient) |
| δt < L/180 | δt = | SPAN/ 705 | **δt OK** |
| δL < L/240 | δL = | SPAN/ 824 | **δL OK** |

**Check Bearing**

| | | | | |
|---|---|---|---|---|
| P = V = w*t*L*0.5 | | P = | 1872 | lbs |
| fc perp = P/A | | fc perp = | 416 | psi |
| F'c perp>fc perp | | | | |
| | F'c perp = | 781 psi | > | 416 psi |
| | | | **F'c perp OK** | (0.53) |

Calculations based off 2018 NDS
Deflection Criteria based off IBC 1604.3
ASD Design Methodology Used

## Tall Wall Calculations

This spreadsheet is used for designing a stud wall according to the NDS.
Inputs are in *ITALICS* and outputs are in **BOLDFACE**.

| Description: | 9' Tall Wall | | | 9' Tall Wall | | |
|---|---|---|---|---|---|---|
| | Type: *2x Lumber (2"-4")* | | | Type: *2x Lumber (2"-4")* | | |
| | Species: *DF-L* | | | Species: *DF-L* | | |
| | Grade: *No. 2* | | | Grade: *No. 2* | | |
| nominal width | t = *2* | in | 1.50 in | t = *2* | in | 1.50 in |
| nominal depth | d = *6* | in | 5.50 in | d = *6* | in | 5.50 in |
| Span | L = *9* | ft | 8.750 ft | L = *9* | ft | 8.750 ft |
| stud spacing | s = *16* | in | w/o Plates | s = *16* | in | w/o Plates |
| Lateral pressure | $w_{wind}$ = 16.14 | psf | | $w_{wind}$ = 16.14 | psf | |
| axial load | P = *1872* | lbs | | P = *3432* | lbs | |
| eccentricity | e = *0* | in | | e = *0* | in | |
| | $K_{cE}$ = *0.822* | | | $K_{cE}$ = *0.822* | | |
| Buckling and crushing | c = *0.8* | | | c = *0.8* | | |
| interaction factor for | w = 21.5 | plf | | w = 21.5 | plf | |

| | Fb | Fv | Fc-prll | Fc-perp | Fb | Fv | Fc-prll | Fc-perp |
|---|---|---|---|---|---|---|---|---|
| | 900 psi | 180 psi | 1,350 psi | 625 psi | 900 psi | 180 psi | 1,350 psi | 625 psi |
| $C_d$ = | *1.60* | *1.60* | *1.60* | | *1.60* | *1.60* | *1.60* | |
| $C_F$ = | *1.30* | | *1.10* | | *1.30* | | *1.10* | |
| $C_r$ = | *1.15* | | | | *1.15* | | | |
| $C_p$ = | | | 0.47 | | | | 0.47 | |
| $C_{fu}$ = | *1.00* | | | | *1.00* | | | |
| $C_b$ = | | | | *1.07* | | | | *1.07* |

| | E | Emin | E | Emin |
|---|---|---|---|---|
| | 1,600,000 psi | 580,000 psi | 1,600,000 psi | 580,000 psi |

| Allowable Stress: | | | | | |
|---|---|---|---|---|---|
| $F'_b$ = | $F_b C_d C_F C_r$ = | **2,153** psi | | $F_b C_d C_F C_r$ = | **2,153** psi |
| $F'_v$ = | $F'_v C_d$ = | **288** psi | | $F'_v C_d$ = | **288** psi |
| $F^*_c$ = | $F_c C_d C_F$ = | 2,376 psi | | $F_c C_d C_F$ = | 2,376 psi |
| $F_{cE}$ = | $(K_{cE} E')/(l_e/d)2$ = | 1,308 psi | | $(K_{cE} E')/(l_e/d)2$ = | 1,308 psi |
| $F'_c$ = | $F_c C_d C_F C_p$ = | **1,112** psi | | $F_c C_d C_F C_p$ = | **1,112** psi |
| $F'_{c\,perp}$ = | $F_{c\,perp}$ Cb = | **668** psi | | $F_{c\,perp}$ Cb = | **668** psi |
| E' = | E = | **1,600,000** psi | | E = | **1,600,000** psi |
| le/d | | **19 < 50 OK** | | | **19 < 50 OK** |
| **Bending:** | | | | | |
| M = | $w L^2/8 + P e/12$ = | 206 lb ft | | $w L^2/8 + P e/12$ = | 206 lb ft |
| $f_b$ = | M/S = | **327** psi | **< F'b OK** | M/S = | **327** psi | **< F'b OK** |
| | S = | 7.56 $in^3$ | | S = | 7.56 $in^3$ |
| **Shear:** | | | | | |
| V = | w L/2 = | 94 lbs | | w L/2 = | 94 lbs |
| $f_v$ = | 1.5 V/A = | **17.12** psi | **< F'v OK** | 1.5 V/A = | **17.12** psi | **< F'v OK** |
| | A = | 8.25 $in^2$ | | A = | 8.25 $in^2$ |
| **Compression:** | | | | | |
| $f_c$ = | P/A = | **226.9** psi | **< F'c OK** | P/A = | **416.0** psi | **< F'c OK** |
| $f_{c\,perp}$ = | P/A = | **226.9** psi | **< F'c OK** | P/A = | **416.0** psi | **< F'c OK** |
| **Combined:** | | | | | |
| | (fc/Fc)2 + {fb/[Fb(1-(fc/FcE)]} = | 0.23 | **< 1.0 OK** | (fc/Fc)2 + {fb/[Fb(1-(fc/FcE)]} = | 0.36 | **< 1.0 OK** |
| **Deflection:** | | | | | |
| Δ = | $22.5 w L^4/E' I$ = | **0.09** in = | **SPAN 1231** | $22.5 w L^4/E' I$ = | **0.09** in = | **SPAN 1231** |
| | I = | 20.80 $in^4$ | **> 120 OK** | I = | 20.80 $in^4$ | **> 120 OK** |

# Pole Footing Embedded in Soil




**DESCRIPTION:** Fence Pole

## Code References

Calculations per IBC 2018 1807.3, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2021

## General Information

| | |
|---|---|
| Pole Footing Shape | Circular |
| Pole Footing Diameter . . . . . . . . . | 16.0 in |
| Calculate Min. Depth for Allowable Pressures | |
| No Lateral Restraint at Ground Surface | |
| Allow Passive . . . . . . . . . . . . . . . | 250.0 pcf |
| Max Passive . . . . . . . . . . . . . . . . | 1,500.0 psf |

**Controlling Values**

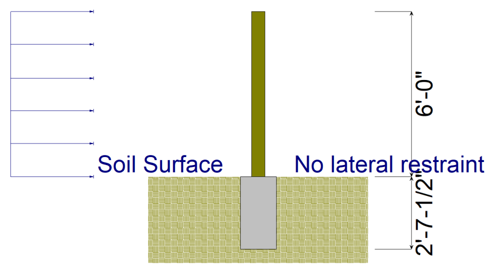
| | |
|---|---|
| Governing Load Combination | +D+0.60W |
| Lateral Load | 0.1314 k |
| Moment | 0.3942 k-ft |

NO Ground Surface Restraint

| | |
|---|---|
| Pressures at 1/3 Depth | |
| Actual | **209.526** psf |
| Allowable | **210.468** psf |

| | |
|---|---|
| **Minimum Required Depth** | **2.625 ft** |

| | |
|---|---|
| Footing Base Area | 1.396 ft^2 |
| Maximum Soil Pressure | 0.1432 ksf |




## Applied Loads

| Lateral Concentrated Load (k) | | Lateral Distributed Loads (k | | Vertical Load (k) |
|---|---|---|---|---|
| D : Dead Load | 0.0 k | | k/ft | 0.20 k |
| Lr : Roof Live | k | | k/ft | k |
| L : Live | k | | k/ft | k |
| S : Snow | k | | k/ft | k |
| W : Wind | k | 0.03650 | k/ft | k |
| E : Earthquake | k | | k/ft | k |
| H : Lateral Earth | k | | k/ft | k |
| Load distance above ground surface | 6.0 ft | TOP of Load above ground surface 6.0 | ft | |
| | | BOTTOM of Load above ground surface 0.0 | ft | |

## Load Combination Results

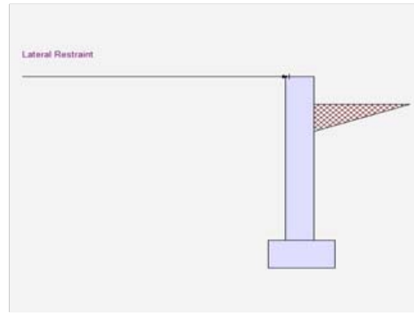
| | Forces @ Ground Surface | | Required | Pressure at 1/3 Depth | | Soil Increase |
|---|---|---|---|---|---|---|
| Load Combination | Loads - (k) | Moments - (ft-k) | Depth - (ft) | Actual - (psf) | Allow - (psf) | Factor |
| D Only | 0.000 | 0.000 | 0.13 | 0.0 | 0.0 | 1.000 |
| +D+0.60W | 0.131 | 0.394 | 2.63 | 209.5 | 210.5 | 1.000 |
| +D+0.450W | 0.099 | 0.296 | 2.38 | 186.7 | 188.7 | 1.000 |
| +0.60D+0.60W | 0.131 | 0.394 | 2.63 | 209.5 | 210.5 | 1.000 |
| +0.60D | 0.000 | 0.000 | 0.13 | 0.0 | 0.0 | 1.000 |

**Restrained Retaining Wall**

Code: IBC 2015,ACI 318-14,ACI 530-13

## Criteria

| | | | |
|---|---|---|---|
| Retained Height | = | 3.33 | ft |
| Wall height above soil | = | 0.67 | ft |
| Total Wall Height | = | 4.00 | ft |
| Top Support Height | = | 4.00 | ft |
| Slope Behind Wall | = | 0.00 | |
| Height of Soil over Toe | = | 0.00 | in |




## Load Factors

| | |
|---|---|
| Building Code | IBC 2015,ACI 318-14,ACI 530-13 |
| Dead Load | 1.200 |
| Live Load | 1.600 |
| Earth, H | 1.600 |
| Wind, W | 1.000 |
| Seismic, E | 1.000 |

## Soil Data

| | | | |
|---|---|---|---|
| Allow Soil Bearing | = | 1,500.0 | psf |
| Equivalent Fluid Pressure Method | | | |
| At-rest Heel Pressure | = | 32.0 | psf/ft |
| | = | | |
| Passive Pressure | = | 250.0 | psf/ft |
| Soil Density | = | 110.00 | pcf |
| Footing\|\|Soil Frictior | = | 0.400 | |
| Soil height to ignore for passive pressure | = | 12.00 | in |

## Surcharge Loads

| | | | |
|---|---|---|---|
| Surcharge Over Heel | = | 40.0 | psf |
| >>>Used To Resist Sliding & Overturning | | | |
| Surcharge Over Toe | = | 0.0 | psf |
| Used for Sliding & Overturning | | | |

## Axial Load Applied to Stem

| | | | |
|---|---|---|---|
| Axial Dead Load | = | 1,160.0 | lbs |
| Axial Live Load | = | 0.0 | lbs |
| Axial Load Eccentricity | = | 0.0 | in |

## Uniform Lateral Load Applied to Stem

| | | | |
|---|---|---|---|
| Lateral Load | = | 0.0 | #/ft |
| ...Height to Top | = | 0.00 | ft |
| ...Height to Bottom | = | 0.00 | ft |
| Load Type | = | Wind (W)<br>(Strength Level) | |
| Wind on Exposed Stem | = | 20.0 | psf |

## Adjacent Footing Load

| | | | |
|---|---|---|---|
| Adjacent Footing Load | = | 0.0 | lbs |
| Footing Width | = | 0.00 | ft |
| Eccentricity | = | 0.00 | in |
| Wall to Ftg CL Dist | = | 0.00 | ft |
| Footing Type | Line Load | | |
| Base Above/Below Soil at Back of Wall | = | 0.0 | ft |
| Poisson's Ratio | = | 0.300 | |

## Earth Pressure Seismic Load

| | | | |
|---|---|---|---|
| $K_h$ Soil Density Multiplier | = | 0.200 | g |
| Added seismic per unit area | = | 0.0 | psf |

## Stem Weight Seismic Load

| | | | |
|---|---|---|---|
| $F_p$ / $W_p$ Weight Multiplier | = | 0.000 | g |
| Added seismic per unit area | = | 0.0 | psf |

## Design Summary

| | | |
|---|---|---|
| Total Bearing Load | = | 1,764 lbs |
| ...resultant ecc. | = | 0.27 in |
| Soil Pressure @ Toe | = | 1,451 psf OK |
| Soil Pressure @ Heel | = | 1,183 psf OK |
| Allowable | = | 1,500 psf |
| Soil Pressure Less Than Allowable | | |
| ACI Factored @ Toe | = | 1,741 psf |
| ACI Factored @ Heel | = | 1,419 psf |
| Footing Shear @ Toe | = | 0.1 psi OK |
| Footing Shear @ Heel | = | 5.2 psi OK |
| Allowable | = | 75.0 psi |
| **Reaction at Top** | = | 46.7 lbs |
| **Reaction at Bottom** | = | 267.4 lbs |

| | | |
|---|---|---|
| **Sliding Stability Ratio** | = | 2.38 OK |
| **Sliding Calcs** | | |
| Lateral Sliding Force | = | 267.4 lbs |
| less 100% Passive Force | = - | 69.4 lbs |
| less 100% Friction Force | = - | 705.8 lbs |
| Added Force Req'd | = | 0.0 lbs OK |
| ....for 1.5 Stability | = | 0.0 lbs OK |

Vertical component of active lateral soil pressure IS considered in the calculation of Sliding Resistance.

## Concrete Stem Construction

| | | |
|---|---|---|
| Thickness | = | 6.00 in |
| Wall Weight | = | 75.0 psf |
| Fy | = | 60,000 psi |
| f'c | = | 2,500 psi |

Stem is FIXED to top of footing

| | | @ Top Support | Mmax Between Top & Base | @ Base of Wall |
|---|---|---|---|---|
| | | **Stem OK** | **Stem OK** | **Stem OK** |
| **Design Height Above Ftg** | = | 4.00 ft | 2.18 ft | 0.00 ft |
| Rebar Size | = | # 4 | # 4 | # 4 |
| Rebar Spacing | = | 18.00 in | 18.00 in | 18.00 in |
| Rebar Placed at | = | Center | Center | Center |
| Rebar Depth 'd' | = | 3.00 in | 3.00 in | 3.00 in |
| **Design Data** | | | | |
| fb/FB + fa/Fa | = | 0.000 | 0.048 | 0.110 |
| Mu....Actual | = | 0.0 ft-# | 81.7 ft-# | 188.4 ft-# |
| Mn * Phi.....Allowable | = | 1,705.6 ft-# | 1,705.6 ft-# | 1,705.6 ft-# |
| Shear Force @ this height | = | 69.8 lbs | | 289.5 lbs |
| Shear.....Actual | = | 1.94 psi | | 8.04 psi |
| Shear.....Allowable | = | 75.00 psi | | 75.00 psi |

**Other Acceptable Sizes & Spacings:**

Toe: None Spec'd -or- Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Heel: None Spec'd -or- Not req'd: Mu < phi*5*lambda*sqrt(f'c)*Sm
Key: No key defined -or- No key defined

## Concrete Stem Rebar Area Details

| Top Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0 in2/ft | | |
| (4/3) * As : | 0 in2/ft | Min Stem T&S Reinf Area 0.576 in2 | |
| 200bd/fy : 200(12)(3)/60000 : | 0.12 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft | |
| 0.0018bh : 0.0018(12)(6) : | 0.1296 in2/ft | Horizontal Reinforcing Options : | |
| | ============ | One layer of : | Two layers of : |
| Required Area : | 0.1296 in2/ft | #4@ 16.67 in | #4@ 33.33 in |
| Provided Area : | 0.1333 in2/ft | #5@ 25.83 in | #5@ 51.67 in |
| Maximum Area : | 0.4064 in2/ft | #6@ 36.67 in | #6@ 73.33 in |

| Mmax Between Ends | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.0068 in2/ft | | |
| (4/3) * As : | 0.009 in2/ft | Min Stem T&S Reinf Area 0.261 in2 | |
| 200bd/fy : 200(12)(3)/60000 : | 0.12 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft | |
| 0.0018bh : 0.0018(12)(6) : | 0.1296 in2/ft | Horizontal Reinforcing Options : | |
| | ============ | One layer of : | Two layers of : |
| Required Area : | 0.1296 in2/ft | #4@ 16.67 in | #4@ 33.33 in |
| Provided Area : | 0.1333 in2/ft | #5@ 25.83 in | #5@ 51.67 in |
| Maximum Area : | 0.4064 in2/ft | #6@ 36.67 in | #6@ 73.33 in |

| Base Support | Vertical Reinforcing | Horizontal Reinforcing | |
|---|---|---|---|
| As (based on applied moment) : | 0.0156 in2/ft | | |
| (4/3) * As : | 0.0208 in2/ft | Min Stem T&S Reinf Area 0.314 in2 | |
| 200bd/fy : 200(12)(3)/60000 : | 0.12 in2/ft | Min Stem T&S Reinf Area per ft of stem Height : 0.144 in2/ft | |
| 0.0018bh : 0.0018(12)(6) : | 0.1296 in2/ft | Horizontal Reinforcing Options : | |
| | ============ | One layer of : | Two layers of : |
| Required Area : | 0.1296 in2/ft | #4@ 16.67 in | #4@ 33.33 in |
| Provided Area : | 0.1333 in2/ft | #5@ 25.83 in | #5@ 51.67 in |
| Maximum Area : | 0.4064 in2/ft | #6@ 36.67 in | #6@ 73.33 in |

## Footing Strengths & Dimensions

| | | | |
|---|---|---|---|
| Toe Width | = | 0.42 | ft |
| Heel Width | = | 0.92 | |
| Total Footing Width | = | 1.34 | |
| Footing Thickness | = | 8.00 | in |
| Key Width | = | 0.00 | in |
| Key Depth | = | 0.00 | in |
| Key Distance from Toe | = | 0.00 | ft |
| f'c | = | 2,500 | psi |
| Fy | = | 60,000 | psi |
| Footing Concrete Density | = | 150.00 | pcf |
| Min. As % | = | 0.0018 | |

Cover @ Top = 1.75 in @ Btm.= 1.75 in

## Footing Design Results

| | | Toe | Heel |
|---|---|---|---|
| Factored Pressure | = | 1,741 | 1,419 psf |
| Mu' : Upward | = | 151 | 128 ft-# |
| Mu' : Downward | = | 11 | 55 ft-# |
| Mu: Design | = | 140 | -73 ft-# |
| Actual 1-Way Shear | = | 0.10 | 5.15 psi |
| Allow 1-Way Shear | = | 75.00 | 75.00 psi |

Min footing T&S reinf Area 0.23 in2
Min footing T&S reinf Area per fc 0.17 in2 /ft
If one layer of horizontal bars: If two layers of horizontal bars:
#4@ 13.89 in
#5@ 21.53 in
#6@ 30.56 in

## Summary of Forces on Footing : Slab is NOT providing sliding restraint, stem is FIXED at footing

**Forces acting on footing for sliding & soil pressure....**

**Sliding Forces**

| | | | |
|---|---|---|---|
| Stem Shear @ Top of Footing | = | -181.5 | lbs |
| Heel Active Pressure | = | -85.9 | |
| **Sliding Force** | = | **267.4** | **lbs** |

Net Moment Used For Soil Pressure Calculations

**40.0 ft-#**

## Load & Moment Summary For Footing : For Soil Pressure Calcs

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Moment @ Top of Footing Applied from Stem | | = | | | | -118.5 | ft-# |
| Surcharge Over Heel | | 16.8 | | 1.13 | | 19.0 | |
| Adjacent Footing Load | = | | lbs | | ft | | ft-# |
| Axial Dead Load on Stem | = | 1,160.0 | lbs | 0.67 | ft | 777.2 | ft-# |
| Soil Over Toe | = | | lbs | | ft | | ft-# |
| Surcharge Over Toe | = | | lbs | | ft | | ft-# |
| Stem Weight | = | 299.8 | lbs | 0.67 | ft | 200.8 | ft-# |
| Soil Over Heel | = | 153.8 | lbs | 1.13 | ft | 173.8 | ft-# |
| Footing Weight | = | 134.0 | lbs | 0.67 | ft | 89.8 | ft-# |
| **Total Vertical Force** | = | 1,764.4 | lbs | Base Moment = | | 1,142.1 | ft-# |

Vertical component of active lateral soil pressure IS considered in the calculation of soil bearing pressures.

# Wall Footing



DESCRIPTION: 16"x8" Ext Footing

*Code References*

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

## General Information

**Material Properties**

| | | | |
|---|---|---|---|
| f'c : Concrete 28 day strength | = | 2.50 | ksi |
| fy : Rebar Yield | = | 60.0 | ksi |
| Ec : Concrete Elastic Modulus | = | 3,122.0 | ksi |
| Concrete Density | = | 145.0 | pcf |
| φ Values Flexure | = | 0.90 | |
| Shear | = | 0.750 | |

**Analysis Settings**

| | | | |
|---|---|---|---|
| Min Steel % Bending Reinf. | = | | |
| Min Allow % Temp Reinf. | = | 0.00180 | |
| Min. Overturning Safety Factor | = | 1.0 | : 1 |
| Min. Sliding Safety Factor | = | 1.0 | : 1 |
| AutoCalc Footing Weight as DL | : | Yes | |

**Soil Design Values**

| | | | |
|---|---|---|---|
| Allowable Soil Bearing | = | 1.50 | ksf |
| Increase Bearing By Footing Weight | = | No | |
| Soil Passive Resistance (for Sliding) | = | 250.0 | pcf |
| Soil/Concrete Friction Coeff. | = | 0.30 | |

**Increases based on footing Depth**

| | | | |
|---|---|---|---|
| Reference Depth below Surface | = | 2.0 | ft |
| Allow. Pressure Increase per foot of depth | = | | ksf |
| when base footing is below | = | 0.0 | ft |

**Increases based on footing Width**

| | | | |
|---|---|---|---|
| Allow. Pressure Increase per foot of width | = | | ksf |
| when footing is wider than | = | 0.0 | ft |

**Adjusted Allowable Bearing Pressure** = 1.50 ksf

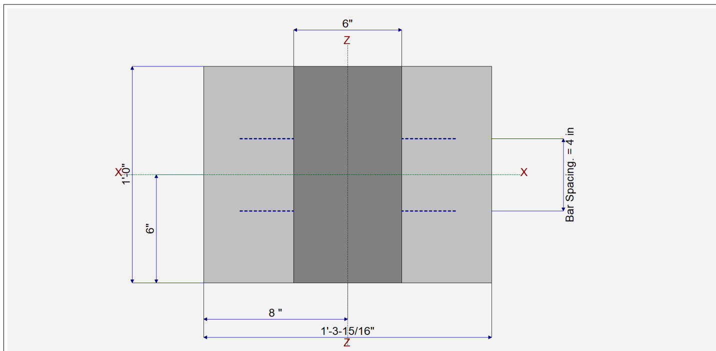
## Dimensions

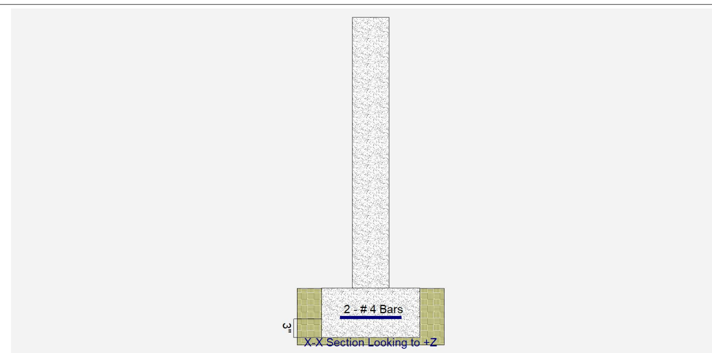
| | | | |
|---|---|---|---|
| Footing Width | = | 1.330 | ft |
| Wall Thickness | = | 6.0 | in |
| Wall center offset from center of footing | = | 0 | in |
| Footing Thickness | = | 8.0 | in |
| Rebar Centerline to Edge of Concrete... at Bottom of footing | = | 3.0 | in |

## Reinforcing

Bars along X-X Axis

| | | |
|---|---|---|
| # of Bars in 12" Width | = | 2 |
| Reinforcing Bar Size | = | # 4 |




## Applied Loads

| | | D | Lr | L | S | W | E | H | |
|---|---|---|---|---|---|---|---|---|---|
| P : Column Load | = | 1.850 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | k |
| OB : Overburden | = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | ksf |
| V-x | = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | k |
| M-zz | = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | k-ft |

Vx applied = 0.0 in above top of footing

# Wall Footing



DESCRIPTION: 16"x8" Ext Footing

## *DESIGN SUMMARY*

**Design OK**

| | Factor of Safety | Item | Applied | Capacity | Governing Load Combination |
|---|---|---|---|---|---|
| **PASS** | n/a | Overturning - Z-Z | 0.0 k-ft | 0.0 k-ft | No Overturning |
| **PASS** | n/a | Sliding - X-X | 0.0 k | 0.0 k | No Sliding |
| **PASS** | n/a | Uplift | 0.0 k | 0.0 k | No Uplift |

| | Utilization Ratio | Item | Applied | Capacity | Governing Load Combination |
|---|---|---|---|---|---|
| **PASS** | 0.9918 | Soil Bearing | 1.488 ksf | 1.50 ksf | D Only |
| **PASS** | 0.02199 | Z Flexure (+X) | 0.1793 k-ft | 8.153 k-ft | +1.40D |
| **PASS** | 0.01414 | Z Flexure (-X) | 0.1153 k-ft | 8.153 k-ft | +0.90D |
| **PASS** | n/a | 1-way Shear (+X) | 0.0 psi | 75.0 psi | n/a |
| **PASS** | 0.0 | 1-way Shear (-X) | 0.0 psi | 0.0 psi | n/a |

## Detailed Results

### Soil Bearing

| Rotation Axis & Load Combination... | Gross Allowable | Xecc | Actual Soil Bearing Stress -X | Actual Soil Bearing Stress +X | Actual / Allowable Ratio |
|---|---|---|---|---|---|
| , D Only | 1.50 ksf | 0.0 in | 1.488 ksf | 1.488 ksf | 0.992 |
| , +0.60D | 1.50 ksf | 0.0 in | 0.8926 ksf | 0.8926 ksf | 0.595 |

### Overturning Stability

Units : k-ft

| Rotation Axis & Load Combination... | Overturning Moment | Resisting Moment | Stability Ratio | Status |
|---|---|---|---|---|

Footing Has NO Overturning

### Sliding Stability

| Force Application Axis Load Combination... | Sliding Force | Resisting Force | Sliding SafetyRatio | Status |
|---|---|---|---|---|

Footing Has NO Sliding

### Footing Flexure

| Flexure Axis & Load Combination | Mu k-ft | Which Side ? | Tension @ Bot. or Top ? | As Req'd in^2 | Gvrn. As in^2 | Actual As in^2 | Phi*Mn k-ft | Status |
|---|---|---|---|---|---|---|---|---|
| , +1.40D | 0.1793 | -X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +1.40D | 0.1793 | +X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +1.20D | 0.1537 | -X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +1.20D | 0.1537 | +X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +0.90D | 0.1153 | -X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +0.90D | 0.1153 | +X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |

### One Way Shear

Units : k

| Load Combination... | Vu @ -X | Vu @ +X | Vu:Max | Phi Vn | Vu / Phi*Vn | Status |
|---|---|---|---|---|---|---|
| +1.40D | 0 psi | 0 psi | 0 psi | 75 psi | 0 | OK |
| +1.20D | 0 psi | 0 psi | 0 psi | 75 psi | 0 | OK |
| +0.90D | 0 psi | 0 psi | 0 psi | 75 psi | 0 | OK |

## Wall Footing



DESCRIPTION: 24"x8" Ext Footing

*Code References*

Calculations per ACI 318-14, IBC 2018, CBC 2019, ASCE 7-16
Load Combinations Used : IBC 2018

### General Information

**Material Properties**

| | | |
|---|---|---|
| f'c : Concrete 28 day strength | = | 2.50 ksi |
| fy : Rebar Yield | = | 60.0 ksi |
| Ec : Concrete Elastic Modulus | = | 3,122.0 ksi |
| Concrete Density | = | 145.0 pcf |
| φ Values Flexure | = | 0.90 |
| Shear | = | 0.750 |

**Analysis Settings**

| | | |
|---|---|---|
| Min Steel % Bending Reinf. | = | |
| Min Allow % Temp Reinf. | = | 0.00180 |
| Min. Overturning Safety Factor | = | 1.0 : 1 |
| Min. Sliding Safety Factor | = | 1.0 : 1 |
| AutoCalc Footing Weight as DL | : | Yes |

**Soil Design Values**

| | | |
|---|---|---|
| Allowable Soil Bearing | = | 1.50 ksf |
| Increase Bearing By Footing Weight | = | No |
| Soil Passive Resistance (for Sliding) | = | 250.0 pcf |
| Soil/Concrete Friction Coeff. | = | 0.30 |

**Increases based on footing Depth**

| | | |
|---|---|---|
| Reference Depth below Surface | = | 2.0 ft |
| Allow. Pressure Increase per foot of depth | = | ksf |
| when base footing is below | = | 0.0 ft |

**Increases based on footing Width**

| | | |
|---|---|---|
| Allow. Pressure Increase per foot of width | = | ksf |
| when footing is wider than | = | 0.0 ft |

**Adjusted Allowable Bearing Pressure** = 1.50 ksf

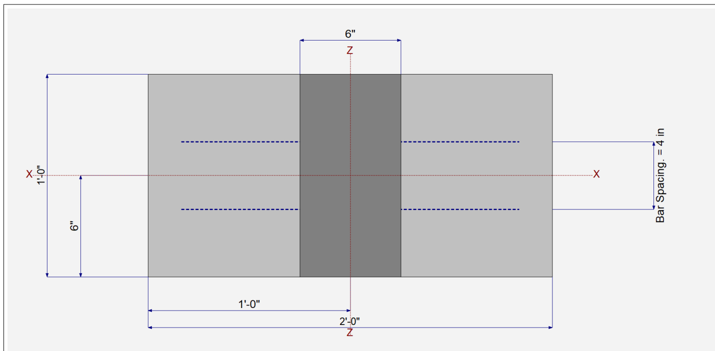
### Dimensions

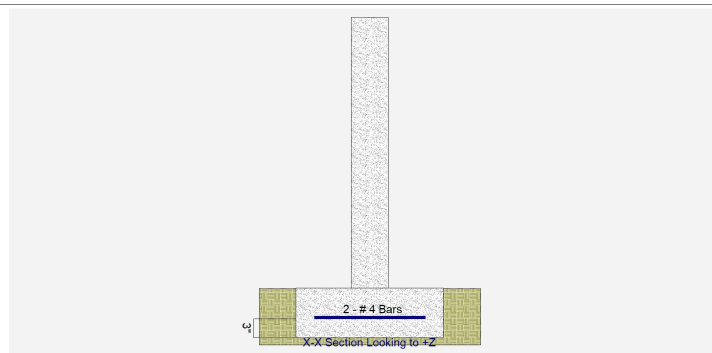
| | | |
|---|---|---|
| Footing Width | = | 2 ft |
| Wall Thickness | = | 6.0 in |
| Wall center offset from center of footing | = | 0 in |
| Footing Thickness | = | 8.0 in |
| Rebar Centerline to Edge of Concrete... at Bottom of footing | = | 3.0 in |

### Reinforcing

Bars along X-X Axis

| | | |
|---|---|---|
| # of Bars in 12" Width | = | 2 |
| Reinforcing Bar Size | = | # 4 |




### Applied Loads

| | | D | Lr | L | S | W | E | H | |
|---|---|---|---|---|---|---|---|---|---|
| P : Column Load | = | 2.80 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | k |
| OB : Overburden | = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | ksf |
| V-x | = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | k |
| M-zz | = | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | k-ft |

Vx applied = 0.0 in above top of footing

## Wall Footing



DESCRIPTION: 24"x8" Ext Footing

### *DESIGN SUMMARY*

**Design OK**

| | Factor of Safety | Item | Applied | Capacity | Governing Load Combination |
|---|---|---|---|---|---|
| **PASS** | n/a | Overturning - Z-Z | 0.0 k-ft | 0.0 k-ft | No Overturning |
| **PASS** | n/a | Sliding - X-X | 0.0 k | 0.0 k | No Sliding |
| **PASS** | n/a | Uplift | 0.0 k | 0.0 k | No Uplift |

| | Utilization Ratio | Item | Applied | Capacity | Governing Load Combination |
|---|---|---|---|---|---|
| **PASS** | 0.9978 | Soil Bearing | 1.497 ksf | 1.50 ksf | D Only |
| **PASS** | 0.07228 | Z Flexure (+X) | 0.5893 k-ft | 8.153 k-ft | +1.40D |
| **PASS** | 0.04647 | Z Flexure (-X) | 0.3788 k-ft | 8.153 k-ft | +0.90D |
| **PASS** | 0.1614 | 1-way Shear (+X) | 12.106 psi | 75.0 psi | +1.40D |
| **PASS** | 0.1614 | 1-way Shear (-X) | 12.106 psi | 75.0 psi | +1.40D |

### Detailed Results

#### Soil Bearing

| Rotation Axis & Load Combination... | Gross Allowable | Xecc | Actual Soil Bearing Stress -X | Actual Soil Bearing Stress +X | Actual / Allowable Ratio |
|---|---|---|---|---|---|
| , D Only | 1.50 ksf | 0.0 in | 1.497 ksf | 1.497 ksf | 0.998 |
| , +0.60D | 1.50 ksf | 0.0 in | 0.8980 ksf | 0.8980 ksf | 0.599 |

#### Overturning Stability

Units : k-ft

| Rotation Axis & Load Combination... | Overturning Moment | Resisting Moment | Stability Ratio | Status |
|---|---|---|---|---|

Footing Has NO Overturning

#### Sliding Stability

| Force Application Axis Load Combination... | Sliding Force | Resisting Force | Sliding SafetyRatio | Status |
|---|---|---|---|---|

Footing Has NO Sliding

#### Footing Flexure

| Flexure Axis & Load Combination | Mu k-ft | Which Side ? | Tension @ Bot. or Top ? | As Req'd in^2 | Gvrn. As in^2 | Actual As in^2 | Phi*Mn k-ft | Status |
|---|---|---|---|---|---|---|---|---|
| , +1.40D | 0.5893 | -X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +1.40D | 0.5893 | +X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +1.20D | 0.5051 | -X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +1.20D | 0.5051 | +X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +0.90D | 0.3788 | -X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |
| , +0.90D | 0.3788 | +X | Bottom | 0.1728 | Min Temp % | 0.4 | 8.153 | OK |

#### One Way Shear

Units : k

| Load Combination... | Vu @ -X | Vu @ +X | Vu:Max | Phi Vn | Vu / Phi*Vn | Status |
|---|---|---|---|---|---|---|
| +1.40D | 12.106 psi | 12.106 psi | 12.106 psi | 75 psi | 0.1614 | OK |
| +1.20D | 10.377 psi | 10.377 psi | 10.377 psi | 75 psi | 0.1384 | OK |
| +0.90D | 7.783 psi | 7.783 psi | 7.783 psi | 75 psi | 0.1038 | OK |