STRUCTURAL CALCULATIONS

LA CENTER COMMUNITY CENTER

Windows

La Center, Washington

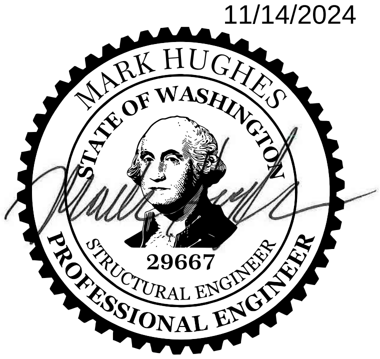
For

City of La Center

November 14, 2024

ALL COMPUTATION AND STRUCTURAL ENGINEERING
FOR THIS PROJECT HAVE BEEN PERFORMED
BY MYSELF OR UNDER MY DIRECT SUPERVISION.

11/14/2024



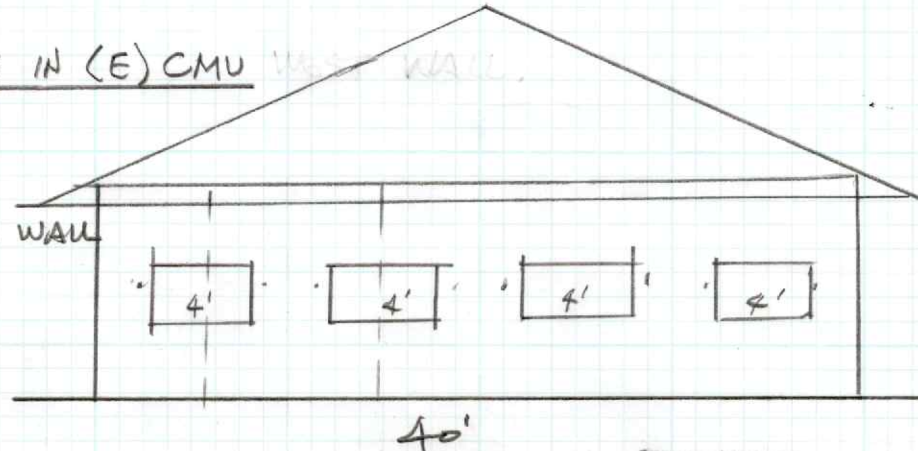
EXP: 03/04/2026

KRAMER GEHLEN & ASSOCIATES, INC.
CONSULTING ENGINEERS
805 Broadway Street, Suite 415
Vancouver, Washington 98660-3310
(360) 693-1621 (503) 289-2661
www.kramer-gehlen.com

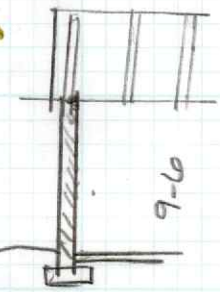
INSTALL (4) NEW WINDOWS IN (E) CMU WEST WALL.

(4) 4'x3' R.O.'s IN 8" CMU WALL

(5) 4'-8" CMU PIERS



LFA: MOTION ⊥ TO WALL



WIND: V_{ULT} 135 PSF $p = -34.6$ PSF

$MULT. TRIB = \frac{8.6}{4.6} = 1.9 \times PIER$

$W_{ULT} = 8.6'(34.6 psf) = 298$ plf FOR 4'-8" PIER

$\div 1.6 = 186$ plf (WS)

$M = 186 plf \frac{(9.5)^2}{8} = 2.0'k$

$f_m = \frac{1}{6} f'_m = \frac{1800}{6} = 300 \quad f_s = 24$ ksi

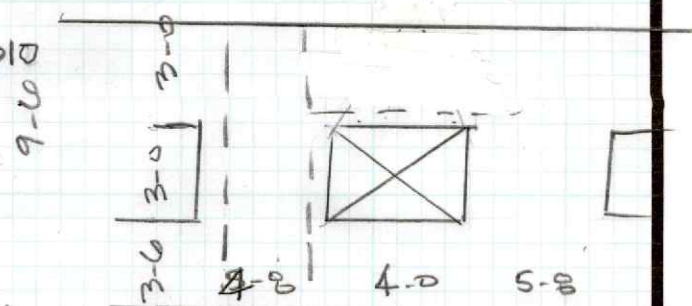
$b = 68" \quad d = 3.8"$

$\left(\frac{2}{JK}\right) = \frac{f_m b d^2}{M12} = \frac{1800(68)(3.8)^2}{2.0(12)} = 76 \quad np \leq 0.001$

$n = \frac{E_s}{750 f'_m} = \frac{29E6}{750(1800)} = 21.5$

$(npj) = \frac{nM12}{bd^2 f_s} = \frac{21.5(2.0)12}{68(3.8)^2 24} = 0.022 \quad np = 0.021$

$\therefore p = \frac{0.021}{21.5} = 0.0010$

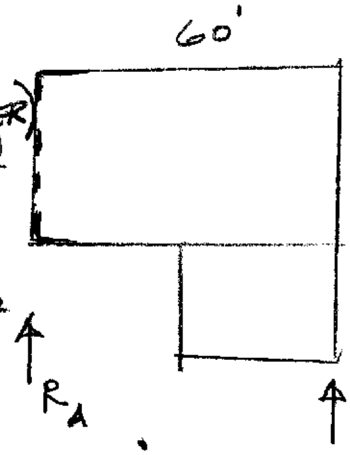


$p = 0.0010$ OK

ASSUME #4 @ 48" o.c. VERT. MIN. OK

KGA Structural Engineers KRAMER GEHLEN ASSOCIATES	PROJECT La CENTER COMM. BLDG WINDOWS		DESIGN
	CLIENT CITY OF La CENTER		
	805 Broadway St. Suite 415 Vancouver, WA 98660-3310	360-693-1621 503-289-2661 Fax: 360-696-1572 www.kramer-gehlen.com	DATE 11.8.24 / DESIGN MH / PROJECT NO. 24203.00 / SHEET LFA-1

LFA : MOTION // TO WALL :



WIND : V_{ULT} = 135 MPH (PER CITY OF La CENTER)

OR $q = 27.8 + (-8.9) = 18.9$ PSF ←

$q = 22.4 + (-4.2) = 18.2$ PSF

$R_{A\,ULT} = 18.9\text{ PSF}\left(\frac{60'}{2}\right)(13') = 7.3^{K} \div 1.6 = 4.6^{K}$

$\div 5 = 1.4^{K}$

SEISMIC : $WT = 2(60\text{ PSF})(4.5') + 15(40') = 1140$ plf

$w = 0.2\,WT = 228$ plf

$_{ULT}\,R_A = w \cdot 30' = 6.8^{K} \div 5 = 1.4^{K}$/PIER

$S_a = 1.01$ FOR SITE D $S_{DS} = 0.73$

$V = C_s W = \frac{S_{DS}}{R I_e} W = \frac{0.73}{(3\frac{1}{2})1} W = 0.2W$

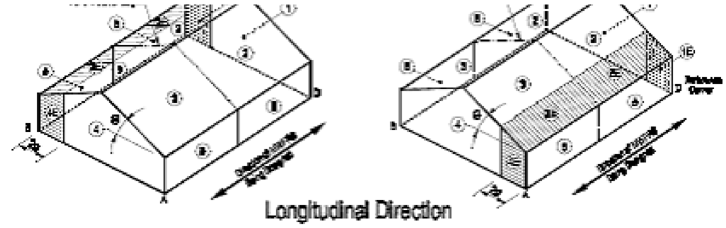
SHEAR : $A = 3\frac{1}{2}\text{ BLKS}(54\text{ IN}^2) = 190\text{ IN}^2$ AT EACH 4'-8" PIER

SEISMIC OR WIND $v_{ULT} = \frac{1400\#}{190\text{ IN}^2} = 7.3\text{ psi} \div 1.6 = 4.6\text{ psi (WS)}$ OK

∴ ADEQUATE SHEAR CAPACITY IN (E) CMU PIERS

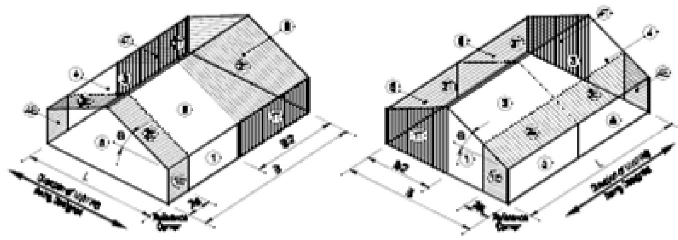
∴ (4) 4'-0" x 3'-0" R.O. MAY BE CUT IN (E) 8" CMU WALL, CREATING (5) 4'-8" PIERS

KGA Structural Engineers KRAMER GEHLEN ASSOCIATES	PROJECT La CENTER COMM. BLDG WINDOWS	DESIGN	
	CLIENT CITY OF La CENTER		
	805 Broadway St. Suite 415 Vancouver, WA 98660-3310 — 360-693-1621 503-289-2661 Fax: 360-696-1572 www.kramer-gehlen.com	DATE 11.8.24	DESIGN MH
		PROJECT NO. 24203.00	SHEET LFA-2



Longitudinal Direction

Basic Load Cases



Transverse Direction Longitudinal Direction

Torsional Load Cases

Disclaimer: This calculator is not intended to be used for the design of actual structures, but only for schematic (preliminary) understanding of structural design principals. For the design of an actual structure, a competent professional should be consulted.

'Calculations courtesy of Alex Tomanovich, PE '

- 30x40 Metal Building
- 40x60 Metal Building
- All Standard Sizes

Net Design Wind Pressure, p_{net30}, in lb/ft², for Exposure B at h = 30 ft, V = 140–200 mph

	Zone	Effective Wind Area (ft²)	Basic Wind Speed (mph)									
			140		150		160		170		180	
Walls	4	10	35.3	–38.2	40.5	–38.2	46.1	–50.0	52.0	–56.4	58.3	–63.2
	4	20	33.7	–36.7	38.7	–36.7	44.0	–47.9	49.6	–54.1	55.7	–60.6
	4	50	31.6	–34.6	36.2	–34.6	41.2	–45.1	46.6	–51.0	52.2	–57.1
	4	100	30.0	–33.0	34.4	–33.0	39.2	–43.1	44.2	–48.6	49.6	–54.5
	5	10	35.3	–47.2	40.5	–47.2	46.1	–61.7	52.0	–69.6	58.3	–78.0
	5	20	33.7	–44.0	38.7	–44.0	44.0	–57.5	49.6	–64.9	55.7	–72.8
	5	50	31.6	–39.8	36.2	–39.8	41.2	–52.0	46.6	–58.7	52.2	–65.8
	5	100	30.0	–36.7	34.4	–36.7	39.2	–47.9	44.2	–54.1	49.6	–60.6

FIGURE 30.4-1 (*Continued*). Components and Cladding, Part 2 [$h \leq 60$ ft ($h \leq 18.3$ m)]: Design Wind Pressures for Enclosed Buildings—Walls and Roofs

continues

Wind Load Calculator

In order for a structure to be sound and secure, the foundation, roof, and walls must be strong and wind resistant. When building a structure it is important to calculate wind load to ensure that the structure can withstand high winds, especially if the building is located in an area known for inclement weather. The main wind force resisting system of a building is a vital component. While wind load calculations can be difficult to figure out because the wind is unpredictable, some standard calculations can give you a good idea of what a building can withstand. Wind loading analysis is an essential part of the building process. If wind loading analysis is not done correctly the resulting effects could include collapsed windows and doors, ripped off roofing, and more. Contact BuildingsGuide for quotes on safe and durable prefabricated steel buildings.

Types of Wind Load Forces on Buildings:

- Shear Load – Wind pressure that is horizontal and could make a building tilt.
- Lateral Load – A pulling and pushing horizontal pressure that can cause a building to move off its foundation.
- Uplift Load – Pressures from wind flow that cause lifting effects.

To assist in your wind loading analysis, use the following wind load calc to get the necessary wind load calculations. Accurate wind load calculations will that a safe, durable structure is assembled.

Wind Loading Analysis - Main Wind-Force Resisting System, per ASCE 7-05 Code [wind loads on structures 2005] for Enclosed or Partially Enclosed Buildings
Using Method 2: Analytical Procedure (Section 6.5) for Low-Rise Buildings

Input Data

Wind Speed, V =	135		mph (Wind Map, Figure 6-1)
Bldg. Classification =	III	[?]	(Table 1-1 Occupancy Cat.)
Exposure Category =	C		(Sect. 6.5.6)
Ridge Height, hr =	18		ft. (hr >= he)
Eave Height, he =	9.5		ft. (he <= hr)
Building Width =	40		ft. (Normal to Building Ridge)
Building Length =	60		ft. (Parallel to Building Ridge)
Roof Type =	Gable		(Gable or Monoslope)
Topo. Factor, Kzt =	1.00		(Sect. 6.5.7 & Figure 6-4)
Direct. Factor, Kd =	0.85		(Table 6-4)
Enclosed? (Y/N)	Y		(Sect. 6.2 & Figure 6-5)
Hurricane Region?	N		

Resulting Parameters and Coefficients:

Member Properties for :

Roof Angle, q =	**23.03**	deg.
Mean Roof Ht., h =	**13.75**	ft. (h = (hr+he)/2, for angle >10 deg.)

Check Criteria for a Low-Rise Building:

1. Is h <= 60' ? **Yes, O.K.** 2. Is h <= Lesser of L or B?Table 10-1 **Yes, O.K.**

External Pressure Coeff's., GCpf (Fig. 6-10):
(For values, see following wind load tabulations.)
Positive & Negative Internal Pressure Coefficients, GCpi (Figure 6-5):

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

If h < 15 then: Kh = 2.01*(15/zg)^(2/a) (Table 6-3, Case 1b)
If h >= 15 then: Kh = 2.01*(z/zg)^(2/a) (Table 6-3, Case 1b)

a =	**9.50**	(Table 6-2)
zg =	**900.00**	(Table 6-2)
Kh =	**0.85**	(Kh = Kz evaluated at z = h)
I =	**1.15**	(Table 6-1)

Velocity Pressure: qz = 0.00256*Kz*Kzt*Kd*V^2*I (Sect. 6.5.10, Eq. 6-15)

qh =	**38.71**	psf qh = 0.00256*Kh*Kzt*Kd*V^2*I (qz evaluated at z = h)

Design Net External Wind Pressures (Sect. 6.5.12.2.2):
p = qh*[(GCpf) - (+/-GCpi)] (psf, Eq. 6-18)

p = qh*[(GCpf) - (+/- GCpi)] (psf, Eq. 6-18)

Wall and Roof End Zone Widths 'a' and '2*a' (Fig. 6-10):

a =	**4.00**	ft.
2*a =	**8.00**	ft.

MWFRS Wind Load for Transverse Direction

Surface	GCpf	p = Net Pressures (psf)	
		(w/ +GCpi)	(w/ -GCpi)
Zone 1	0.54	13.90	27.84
Zone 2	-0.42	-23.14	-9.20
Zone 3	-0.46	-24.96	-11.03
Zone 4	-0.41	-22.91	-8.97
Zone 5	-0.45	-24.39	-10.45
Zone 6	-0.45	-24.39	-10.45
Zone 1E	0.77	22.71	36.65
Zone 2E	-0.66	-32.69	-18.76
Zone 3E	-0.64	-31.80	-17.87
Zone 4E	-0.59	-29.87	-15.93

MWFRS Wind Load for Longitudinal Direction

Surface	*GCpf	p = Net Pressures (psf)	
		(w/ +GCpi)	(w/ -GCpi)
Zone 1	0.40	8.52	22.45
Zone 2	-0.69	-33.68	-19.74
Zone 3	-0.37	-21.29	-7.35
Zone 4	-0.29	-18.19	-4.26
Zone 5	-0.45	-24.39	-10.45
Zone 6	-0.45	-24.39	-10.45
Zone 1E	0.61	16.65	30.58
Zone 2E	-1.07	-48.39	-34.45
Zone 3E	-0.53	-27.48	-13.55
Zone 4E	-0.43	-23.61	-9.68

*Note: Use roof angle q = 0 degrees for Longitudinal Direction.
For Trans. when GCpf is neg. in Zones 2/2E:

For Trans. when GCpf is neg. in Zones 2/2E:

Zones 2/2E dist. = **20.00** ft.

For Long. when GCpf is neg. in Zones 2/2E:

Zones 2/2E dist. = **23.75** ft.

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

MWFRS Wind Load for Transverse, Torsional Case

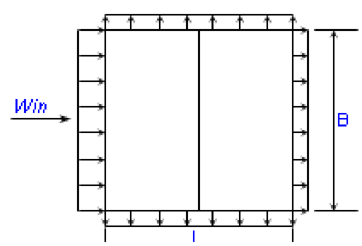
Surface	GCpf	p = Net Pressure (psf)	
		(w/ +GCpi)	(w/ -GCpi)
Zone 1T	---	3.48	6.96
Zone 2T	---	-5.79	-2.30
Zone 3T	---	-6.24	-2.76
Zone 4T	---	-5.73	-2.24

MWFRS Wind Load for Long., Torsional Case

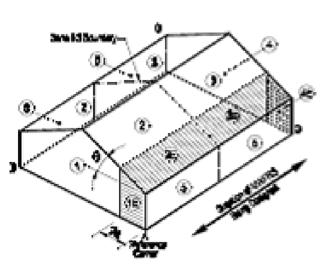
Surface	GCpf	p = Net Pressure (psf)	
		(w/ +GCpi)	(w/ -GCpi)
Zone 1T	---	2.13	5.61
Zone 2T	---	-8.42	-4.93
Zone 3T	---	-5.32	-1.84
Zone 4T	---	-4.55	-1.06

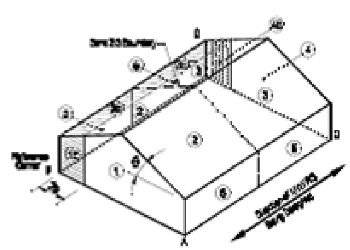
Notes:

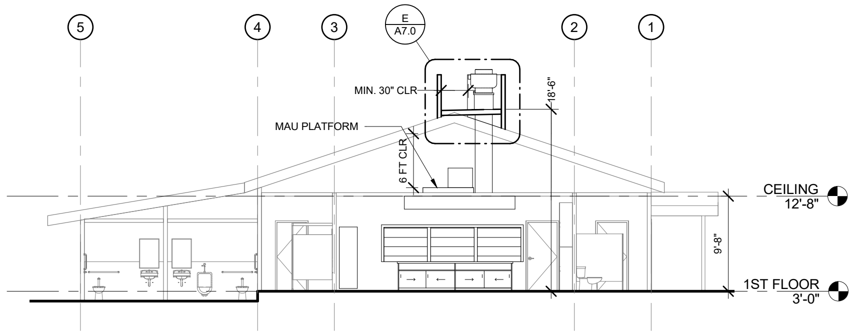
1. For Transverse, Longitudinal, and Torsional Cases:
   - Zone 1 is windward wall for interior zone.
   - Zone 2 is windward roof for interior zone.
   - Zone 3 is leeward roof for interior zone.
   - Zone 4 is leeward wall for interior zone.
   - Zones 5 and 6 are sidewalls.
   - Zone 1T is windward wall for torsional case
   - Zone 3T is leeward roof for torsional case
   - 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 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 6.1.4.1, the minimum wind load for MWFRS shall not be less than 10 psf.
6. References :
   - ASCE 7-02, "Minimum Design Loads for Buildings and Other Structures".
   - "Guide to the Use of the Wind Load Provisions of ASCE 7-02" by: Kishor C. Mehta and James M. Delahay (2004).



Transverse Direction







B
A7.0
CROSS SECTION
1/8" = 1'-0"

Commercial and Non-Prescriptive Residential Structural Design Information

The information in this handout only applies to structures not conforming to the prescriptive criteria set forth in the 2018 International Building Code.

All commercial occupancies will be required to be designed by a Washington State Professional Engineer.

Loading Requirements:

Wind Speed per **2018** IBC Criteria:

I. Vasd = 105 mph (3 second gust); applicable only to methods in exceptions I through 5,, section 1609.1.1.

2. Vult = 135 mph (3 second gust) for Risk Cat. II; use 125 mph for Risk Cat. I; use 140 mph for Risk Cat. III &IV.

3. Exposure B, or as required per 1609.4.

Soil: Type ML - 1500 psfBearing or geo-tech required

Frost Depth: 12"

Minimum roof snow load: 25 psf

Minimum roof load: non reducible

Ground snow: 30 psf (drift calculations as required)

All other loading per the 2018 International Building Code and as adopted by Washington State and City of La Center Codes.

Seismic Design:

Spectral response data can be found on this web site: earthquake.usgs.gov/hazards/designmaps

Use values of two percent probability of exceedance. Otherwise, use the following design information based on specific zip codes within the county:

MCE Ground Motion - Conterminous 48 States

Zip Code - 98642

Central Latitude= 45.802723

Central Longitude= -122.709722

Period, MCE Sa

(sec) (¾g)

0.2, 0.882 MCE Value of Ss, Site Class B

1.0, 0.320 MCE Value of S1, Site Class B

Spectral Parameters for Site Class D:

0.2, 1.01, Sa= Fa Ss, Fa= 1.147

1.0, 0.564, Sa= FvSl, Fv = 1.761