

**Structural Calculations for Vertical and Lateral Design of BBQ Structure**

**PRCNC20260044**

**Project & Location:**

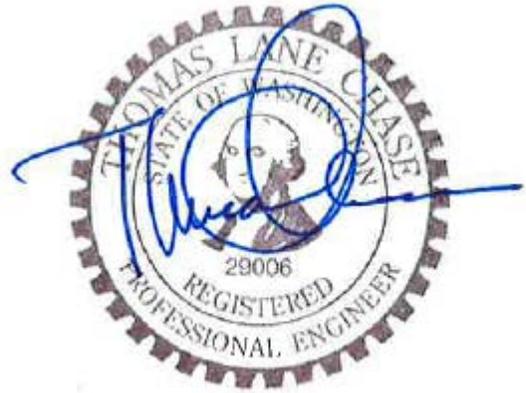
**Structural Calculations**  
**Bradley Heights Apartments**  
 (Lat 47.1652, Long -122.2921)  
 202 27<sup>th</sup> Avenue SE, Puyallup, WA

**Client:**

Timberlane Partners  
 Attn: Dave Enslow  
[dave@timberlanepartners.com](mailto:dave@timberlanepartners.com)

**Professional Engineer:**

Solutions 4 Structures, Inc  
 11605 135<sup>th</sup> St Ct E  
 Puyallup, WA 98374  
 Attn: Tom Chase, PE  
[tom@solutions4structures.com](mailto:tom@solutions4structures.com)  
 (253) 314 - 9822



**Project Number:**

23.007

**Code / Location:**

2021 IBC

**Loads:**

1. Vertical Loads	Dead	Live
Roof	22 PSF	25 PSF (Snow)

01-21-26

2. Lateral Loads  
 Wind Criteria

Basic Wind Speed = 97 MPH  
 Exposure B  
 $I_w = 1.0$ ,  $K_{zt} = 1.0$

Seismic Criteria

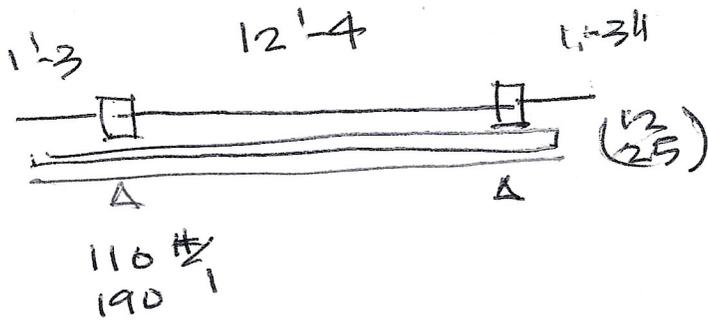
Seismic Design Category "D"  
 Site Class C  
 $I_E = 1.0$ ,  $S_s = 1.263$ ,  $S_1 = 0.435$   
 $SDS = 1.010$ ,  $SD1 = 0.435$

3. Soils Data (per GeoResources Inc. dated 02/10/2022)  
 Bearing Capacity = 2,000 PSF

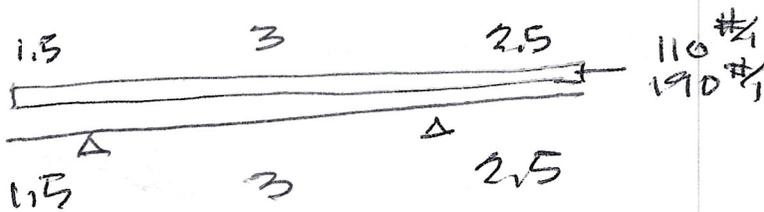
**City of Puyallup**  
**Building**  
**REVIEWED**  
**FOR**  
**COMPLIANCE**

SKinnear  
 02/11/2026  
 8:30:29 AM

Calculations required to be provided by the Permittee on site for all Inspections



~ H.F #2  
 ∴ 4x6 PLAT DECKAS



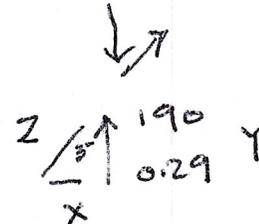
0.09 | 45  
 0.15 | 75

0.19 | 95  
 0.29 | 145

(2) 2x8

↑ EA  
 ONE

EA  
 ONE



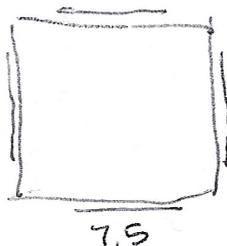
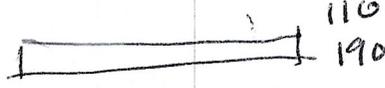
Y = 0.19  
 0.29  
 X = TAN 35

X = .133  
 .203

TAN 35° =  $\frac{x}{y}$

Y = 95  
 145

X = 67  
 102



$$M_A = \frac{110(190)(5.5)^2}{2} - \frac{110(190)(1.5)^2}{2}$$

151.25      1.125  
 1540 # -1  
~~1691.4~~ # -1      4200 # -1  
 2852.3 # -1      2800  
 + 1260 # -1  
 2660      TOTAL  
 D + L

Project Title: Bradley Heights Apartments  
 Engineer: M. Oman  
 Project ID:  
 Project Descr: 3-4 Story Apartment Bldgs

## Wood Column

Project File: Beam Designs.ec6

LIC#: KW-06013765, Build:20.24.12.02

Solutions 4 Structures, Inc

(c) ENERCALC, LLC 1982-2025

DESCRIPTION: --None--

### Code References

Calculations per NDS 2018, IBC 2021, SDPWS 2015  
 Load Combinations Used : ASCE 7-16

### General Information

Analysis Method	Allowable Stress Design			Wood Section Name	<b>8x8</b>
End Fixities	Top Free, Bottom Fixed			Wood Grading/Manuf.	Graded Lumber
Overall Column Height	9 ft			Wood Member Type	Sawn
<i>( Used for non-slender calculations )</i>					
Wood Species	Hem-Fir			Exact Width	<b>7.50</b> in
Wood Grade	No.1			Exact Depth	<b>7.50</b> in
Fb +	975.0 psi	Fv	140.0 psi	Area	56.250 in <sup>2</sup>
Fb -	975.0 psi	Ft	650.0 psi	Ix	263.672 in <sup>4</sup>
Fc - Prll	850.0 psi	Density	26.840 pcf	Iy	<b>263.672</b> in <sup>4</sup>
Fc - Perp	405.0 psi			Allow Stress Modification Factors	
E : Modulus of Elasticity . . .	x-x Bending	y-y Bending	Axial	Cf or Cv for Bending 1.0	
	Basic	1,300.0	1,300.0	1,300.0 ksi	Cf or Cv for Compression 1.0
	Minimum	470.0	470.0		Cf or Cv for Tension 1.0
					Cm : Wet Use Factor 1.0
					Ct : Temperature Fact 1.0
					Cfu : Flat Use Factor 1.0
					Kf : Built-up columns 1.0
					Use Cr : Repetitive ? No
				Column Buckling Condition:	
				ABOUT X-X Axis: Lux = 9 ft, Kx = 2.1	
				Fully braced against buckling ABOUT Y-Y Axis	

### Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 94.359 lbs \* Dead Load Factor

AXIAL LOADS . . .

Axial Load at 9.0 ft, Xecc = 0.50 in, Yecc = 0.50 in, D = 0.090, S = 0.150 k

Axial Load at 4.50 ft, Xecc = 4.0 in, Yecc = 4.0 in, D = 0.190, S = 0.290 k

BENDING LOADS . . .

Lat. Point Load at 4.50 ft creating Mx-x, D = 0.3420, S = 0.5910 k

### DESIGN SUMMARY

Bending &amp; Shear Check Results

<b>PASS</b> Max. Axial+Bending Stress Ratio =	<b>0.7159 : 1</b>	<b>Maximum SERVICE Lateral Load Reactions . .</b>	
Load Combination	+D+S	Top along Y-Y	0.0 k
Governing NDS Formula Comp + Mxx + Myy, NDS Eq. 3.9-		Bottom along Y-Y	0.9330 k
Location of max.above base	0.0 ft	Top along X-X	0.0 k
At maximum location values are .		Bottom along X-X	0.0 k
Applied Axial	0.8144 k	<b>Maximum SERVICE Load Lateral Deflections . . .</b>	
Applied Mx	-4.369 k-ft	Along Y-Y	0.3822 in at 9.0 ft above base
Applied My	-0.170 k-ft	for load combination : +D+S	
Fc : Allowable	375.602 psi	Along X-X	0.02642 in at 9.0 ft above base
		for load combination : +D+S	
<b>PASS</b> Maximum Shear Stress Ratio =	<b>0.1545 : 1</b>	<b>Other Factors used to calculate allowable stresses . . .</b>	
Load Combination	+D+S	<u>Bending</u>	<u>Compression</u>
Location of max.above base	4.470 ft	<u>Tension</u>	
Applied Design Shear	37.320 psi		
Allowable Shear	161.0 psi		

### Load Combination Results

Load Combination	C <sub>D</sub>	C <sub>P</sub>	Maximum Axial + Bending Stress Ratios			Maximum Shear Ratios		
			Stress Ratio	Status	Location	Stress Ratio	Status	Location
D Only	0.900	0.469	0.3308	PASS	0.0 ft	0.07238	PASS	4.470 ft
+D+S	1.150	0.384	0.7159	PASS	0.0 ft	0.1545	PASS	4.470 ft
+D+0.750S	1.150	0.384	0.60	PASS	0.0 ft	0.1301	PASS	4.470 ft
+0.60D	1.600	0.287	0.1109	PASS	0.0 ft	0.02443	PASS	4.470 ft

**Wood Column**

Project File: Beam Designs.ec6

LIC# : KW-06013765, Build:20.24.12.02

Solutions 4 Structures, Inc

(c) ENERCALC, LLC 1982-2025

DESCRIPTION: --None--

**Maximum Reactions**

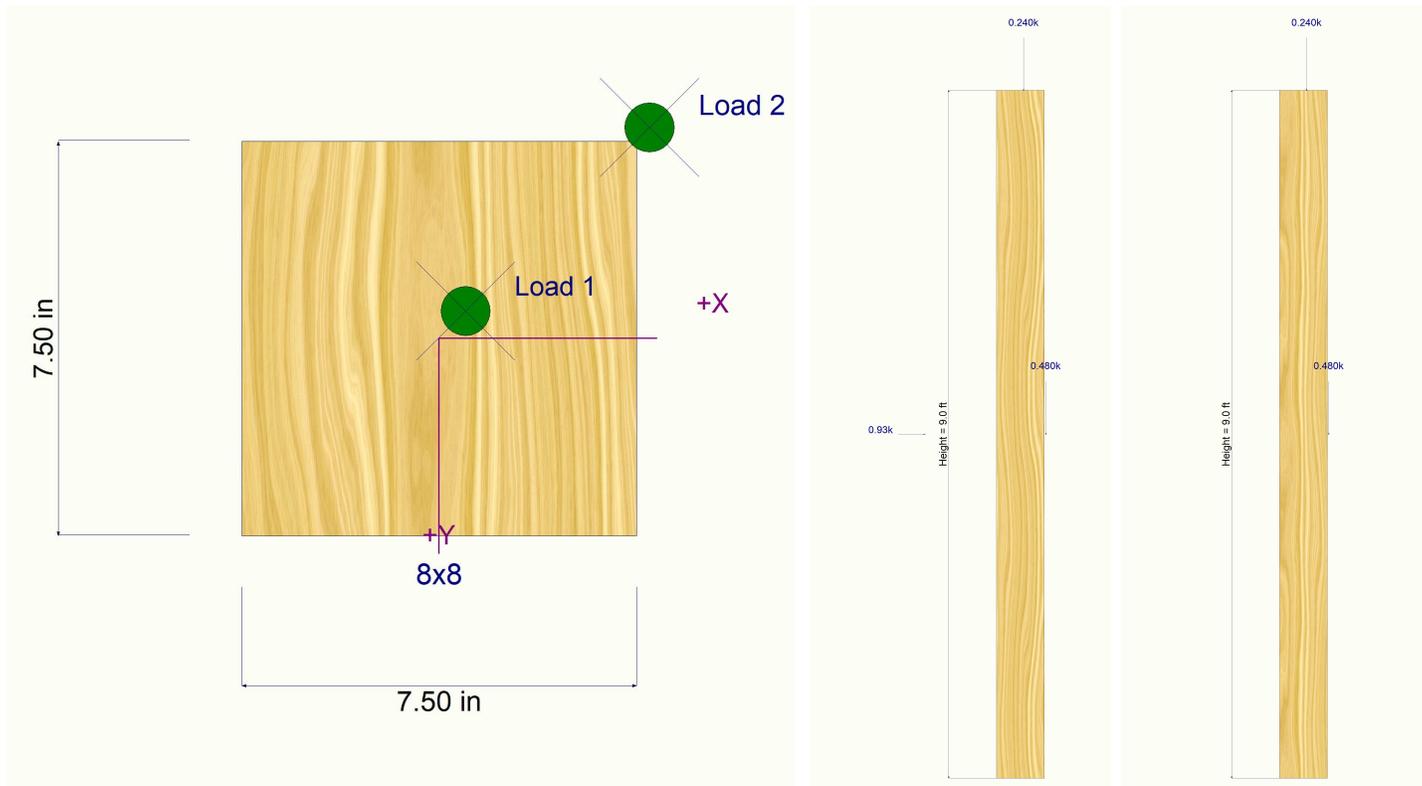
Note: Only non-zero reactions are listed.

Load Combination	X-X Axis Reaction		k	Y-Y Axis Reaction		Axial Reaction	My - End Moments		Mx - End Moments	
	@ Base	@ Top		@ Base	@ Top		@ Base	@ Top	@ Base	@ Top
D Only				0.342		0.374	0.067			1.606
+D+S				0.933		0.814	0.170			4.369
+D+0.750S				0.785		0.704	0.144			3.678
+0.60D				0.205		0.225	0.040			0.964
S Only				0.591		0.440	0.103			2.762

**Maximum Deflections for Load Combinations**

Load Combination	Max. X-X Deflection	Distance	Max. Y-Y Deflection	Distance
D Only	0.0104 in	9.000ft	0.141 in	9.000ft
+D+S	0.0264 in	9.000ft	0.382 in	9.000ft
+D+0.750S	0.0224 in	9.000ft	0.322 in	9.000ft
+0.60D	0.0062 in	9.000ft	0.084 in	9.000ft
S Only	0.0159 in	8.940ft	0.239 in	8.940ft

**Sketches**



# Lateral

BBQ Structure

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**Project:** BBQ Bradley Heights
 

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**Seismic Demands on Non-Structural Components** (ASCE Section 13.3.1)
 I
**Site Class:**Site Class: **C** (IBC 1613.3.2, ASCE Table 20.3-1)**Site Location:**

Latitude: 47.1652 Longitude: -122.2921

**Site Coefficients:** (USGS Open-File Report 01-437)

$$S_S = \mathbf{1.263} \quad F_a = 1.20$$

$$S_1 = \mathbf{0.435} \quad F_V = 1.50$$

$$S_{MS} = F_a * S_S = 1.516 \text{ (IBC Eq.16-37)}$$

$$S_{M1} = F_V * S_1 = 0.653 \text{ (IBC Eq.16-38)}$$

**Spectral Response Parameters:**

$$S_{DS} = 2/3 * S_{MS} = 1.0104 \text{ (IBC Eq.16-39)}$$

$$S_{D1} = 2/3 * S_{M1} = 0.4350 \text{ (IBC Eq.16-40)}$$

**General Eqn:**

$$F_p = .4 * (a_p * S_{ds} * W_p / (R_p / I_p)) * (1 + 2 * z / h) \text{ (ASCE Eqn 13.3-1) where:}$$

$$W_p = \mathbf{1,406} \text{ lbs: (Total Component Operating Weight)}$$

$$S_{ds} = 1.01 \text{ spectral acceleration from above}$$

$$a_p = \mathbf{1.00} \text{ Component Application factor (ASCE Table 13.5-1 or 13.6-1)}$$

$$R_p = \mathbf{2.50} \text{ Component Response Modification factor (ASCE Table 13.5-1 or 13.6-1)}$$

$$I_p = \mathbf{1.00} \text{ Component Importance factor (ASCE Section 13.1.3)}$$

$$z = \mathbf{8.50} \text{ Ft: (Height of component in structure to point of attachment)}$$

$$h = \mathbf{8.50} \text{ Ft: (average roof height of structure with respect to the base)}$$

$$\text{therefore, } F_p = \mathbf{682} \text{ lbs}$$

**However:**
$$F_p \text{ is not required to be taken greater than: } \mathbf{2,557} \text{ lbs: } F_p = 1.6 * S_{ds} * I_p * W_p \text{ (ASCE Eqn 13.3-2)}$$
$$F_p \text{ shall not be taken less than: } \mathbf{426} \text{ lbs: } F_p = 0.3 * S_{ds} * I_p * W_p \text{ (ASCE Eqn 13.3-3)}$$
**Summary:**

$F_p \text{ (ult)} =$	$\mathbf{682} \text{ lbs: (Ultimate Strength Design)}$
$F_p \text{ (asd)} = F_p \text{ (ult)} / 1.4$	$\mathbf{487} \text{ lbs: (Allowable Stress Design)}$

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🔗 The ATC Hazards by Location website will not be updated to support ASCE 7-22. [Find out why.](#)

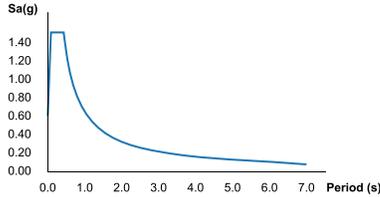
**ATC** Hazards by Location

**Search Information**

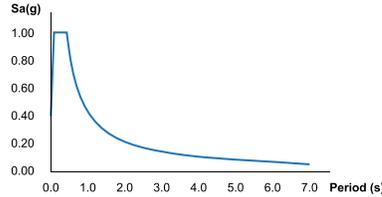
**Coordinates:** 47.16516801120486, -122.2920663220895  
**Elevation:** 386 ft  
**Timestamp:** 2023-05-11T15:08:01.436Z  
**Hazard Type:** Seismic  
**Reference Document:** ASCE7-16  
**Risk Category:** II  
**Site Class:** C



**MCER Horizontal Response Spectrum**



**Design Horizontal Response Spectrum**



**Basic Parameters**

Name	Value	Description
S <sub>S</sub>	1.264	MCE <sub>R</sub> ground motion (period=0.2s)
S <sub>1</sub>	0.436	MCE <sub>R</sub> ground motion (period=1.0s)
S <sub>MS</sub>	1.516	Site-modified spectral acceleration value
S <sub>M1</sub>	0.654	Site-modified spectral acceleration value
S <sub>DS</sub>	1.011	Numeric seismic design value at 0.2s SA
S <sub>D1</sub>	0.436	Numeric seismic design value at 1.0s SA

**Additional Information**

Name	Value	Description
SDC	D	Seismic design category
F <sub>a</sub>	1.2	Site amplification factor at 0.2s
F <sub>v</sub>	1.5	Site amplification factor at 1.0s
CR <sub>S</sub>	0.914	Coefficient of risk (0.2s)
CR <sub>1</sub>	0.898	Coefficient of risk (1.0s)
PGA	0.5	MCE <sub>G</sub> peak ground acceleration
F <sub>PGA</sub>	1.2	Site amplification factor at PGA
PGA <sub>M</sub>	0.6	Site modified peak ground acceleration
T <sub>L</sub>	6	Long-period transition period (s)
S <sub>sRT</sub>	1.264	Probabilistic risk-targeted ground motion (0.2s)
S <sub>sUH</sub>	1.383	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S <sub>sD</sub>	1.5	Factored deterministic acceleration value (0.2s)
S <sub>1RT</sub>	0.436	Probabilistic risk-targeted ground motion (1.0s)
S <sub>1UH</sub>	0.485	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S <sub>1D</sub>	0.6	Factored deterministic acceleration value (1.0s)
PGA <sub>d</sub>	0.5	Factored deterministic acceleration value (PGA)

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

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. [Find out why.](#)

**Disclaimer**

Hazard loads are provided by the U.S. Geological Survey [Seismic Design Web Services](#).

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Job # 23.007

Sheet:

Designed: TLC

Date: 5/12/25

Checked:

Date:

Project: Bradley Heights Apartments 3 story

**WIND ANALYSIS:**

IBC 2021 / ASCE 7-16

**Risk Category**

II I, II, III or IV Figure 26.5-1B

$I_w = 1.00$  (ASCE Table 1.5-2)

100 Typical

Basic Wind Speed,  $V = 97$  mph Section 26.5.1

Exposure Category: B Section 26.7.2

Mean Roof Height,  $h = 10.00$  feet

Alpha = 7

Parapet Height above roof,  $p = -$  feet

$Z_g = 1200$

Building Width,  $B = 7.00$  feet

Building Length,  $L = 15.00$  feet

Partially Open Building

Ground Elevation factor: 386 Elev. (ft) Section 26.9

$GC_{pi} = +/- 0.18$  Table 26.13-1

$G = 0.8500$  gust effect factor defined in section 26.11.1

$K_z = 2.01 (z/Z_g)^{2/\alpha}$  (ASCE 7-16 Table 27.3-1) Section 26.10.1

$K_{zt} = (1 + K_1 K_2 K_3)^2 = 1.00$  (ASCE 7-16 Eq. 26.8-1) Section 26.8.2

$K_e = 0.99$  (ASCE 7-16 Table 26.9-1) Section 26.9

$K_d = 0.85$  (ASCE 7-16 Table 26-1) Section 26.6

$I = 1.00$  (ASCE 7-16 Table 1.5-2)

**Windward:**  $P = qGC_p - qi(GC_{pi})$  (ASCE 7-16) (Eq. 27.3-1)

$C_p = 0.8$  (windward) Figure 27.3-1

Table 27.3-1 Eq. 27.3-1 Eq. 27.4-1a Eq. 27.4-1b Eq. 27.4-1 Eq. 27.4-1

h feet	Sec. 27.3.1 $K_z$	Sec. 27.3.2 $q_z$ (psf)	External $q_z GC_p$	Internal $- qi(GC_{pi})$	Total $q G C_p + qi(GC_{pi})$	Total $q G C_p - qi(GC_{pi})$
10	0.51	10.33	7.03	-	#VALUE!	#VALUE!
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
10	$q=q_h=q_i$	10.33	7.03	1.86	#VALUE!	#VALUE!
0	$q=q_p$	0.00	-	-	-	Parapet

**Totals**

Windward + Leeward		h
Along B	Along L	feet
9.6 (5.8)	11.4 (6.9)	10
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
9.6 (5.8)	11.4 (6.9)	10
0.0 (0.0)	0.0 (0.0)	Parapet

( ) values are ASD = ULT x 0.6

Figure 27.3-1

**Leeward:**  $P = qGC_p - qi(GC_{pi})$  (ASCE 7-16) (Eq. 27.3-1)

External Internal Total Total

$q_h$ (psf)	$q_h GC_p$	$- qi(GC_{pi})$	$q G C_p - qi(GC_{pi})$	$q G C_p + qi(GC_{pi})$
10.33	-4.39	1.86	-2.53	-6.25 Along L
10.33	-2.57	1.86	-0.71	-4.43 Along B

$C_p = -0.5$  (Leeward along L)

$C_p = -0.29$  (Leeward along B)

**Parapet:**  $P_p = q_p GC_{pn}$  (ASCE 7-16) (Eq. 27.3-3)

Windward Leeward

$q_p$ (psf)	$q_p GC_{pn}$	$q_p GC_{pn}$
0.00	0.00	0.00

Section 27.3.4

$GC_{pn} = 1.5$  (Windward Parapet)

$GC_{pn} = -1.0$  (Leeward Parapet)

**Walls:**  $P = q_h [(GC_p) - (GC_{pi})]$  (ASCE 7-16) (Eq. 30.3-1)

$h \leq 60$  ft

Table 26.13-1

Area (ft <sup>2</sup> )	$GC_{pi}(4\&5)$	Windward	$GC_p(4)$	Leeward	$GC_p(5)$	Leeward	$GC_{pi}$
10	1.00	12.2 (7.3)	-1.10	-13.2 (-7.9)	-1.40	-16.3 (-9.8)	0.18 (Windward)
25	0.93	11.5 (6.9)	-1.03	-12.5 (-7.5)	-1.26	-14.9 (-8.9)	0.18 (Leeward)
50	0.88	10.9 (6.6)	-0.98	-12.0 (-7.2)	-1.15	-13.8 (-8.3)	$q_h$ (psf) = 10.33
200	0.77	9.8 (5.9)	-0.87	-10.9 (-6.5)	-0.94	-11.6 (-6.9)	

( ) values are ASD = ULT x 0.6

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### ATC Hazards by Location

#### Search Information

Coordinates: 47.16516801120486, -122.2920663220895  
 Elevation: 386 ft  
 Timestamp: 2023-05-11T15:05:14.182Z  
 Hazard Type: Wind



ASCE 7-16		ASCE 7-10		ASCE 7-05	
MRI 10-Year	67 mph	MRI 10-Year	72 mph	ASCE 7-05 Wind Speed	85 mph
MRI 25-Year	73 mph	MRI 25-Year	79 mph		
MRI 50-Year	78 mph	MRI 50-Year	85 mph		
MRI 100-Year	82 mph	MRI 100-Year	91 mph		
Risk Category I	92 mph	Risk Category I	100 mph		
Risk Category II	97 mph	Risk Category II	110 mph		
Risk Category III	104 mph	Risk Category III-IV	115 mph		
Risk Category IV	108 mph				

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#### Disclaimer

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

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

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202 27th Ave SE, Puyallup, WA 98374



Restaurants

Hotels

Things to do

Transit

Parking

Pharmacies

ATMs



### 202 27th Ave SE

Building



Directions



Save



Nearby



Send to phone



Share

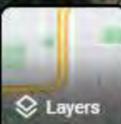
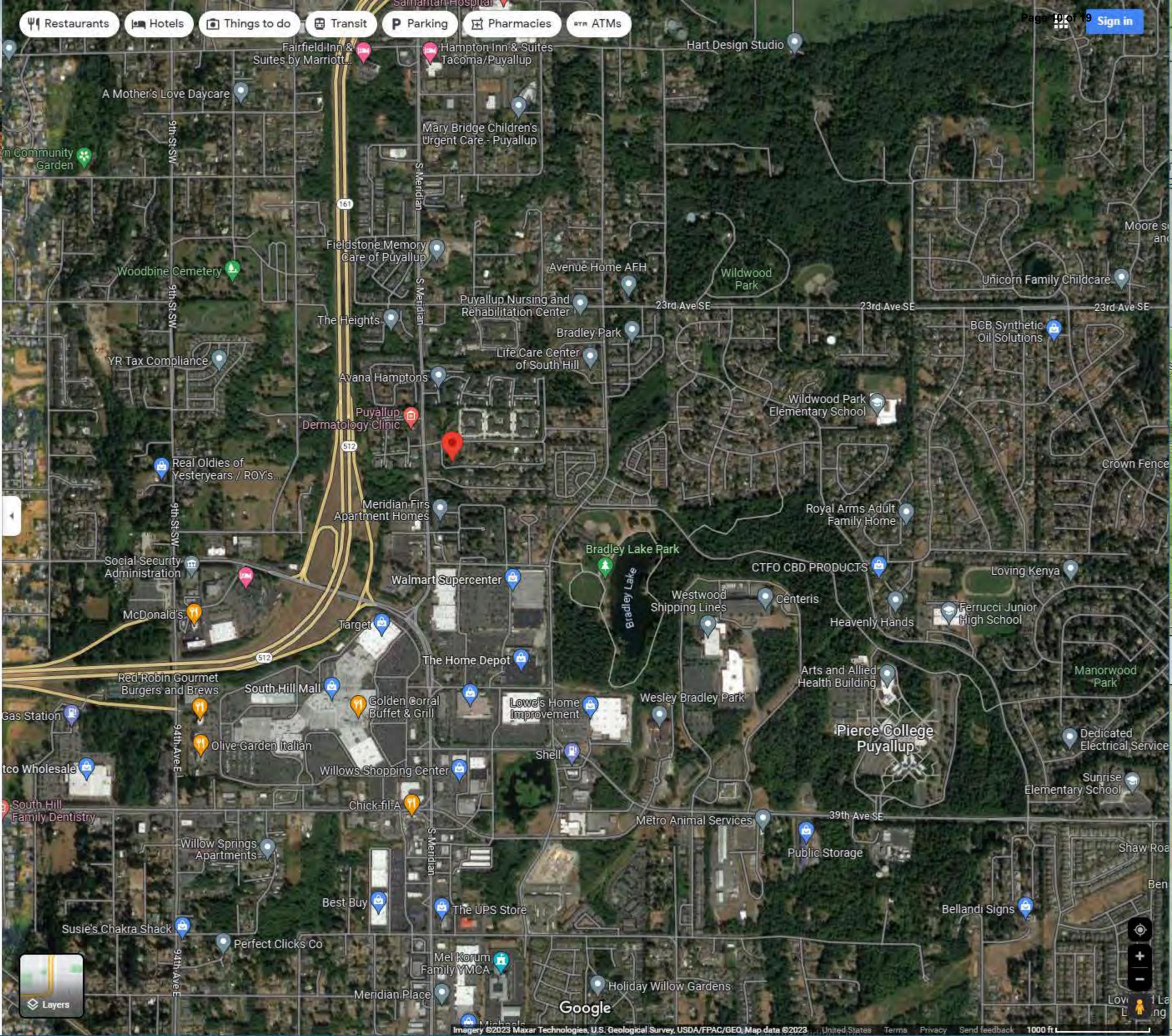
202 27th Ave SE, Puyallup, WA 98374

Suggest an edit on 202 27th Ave SE

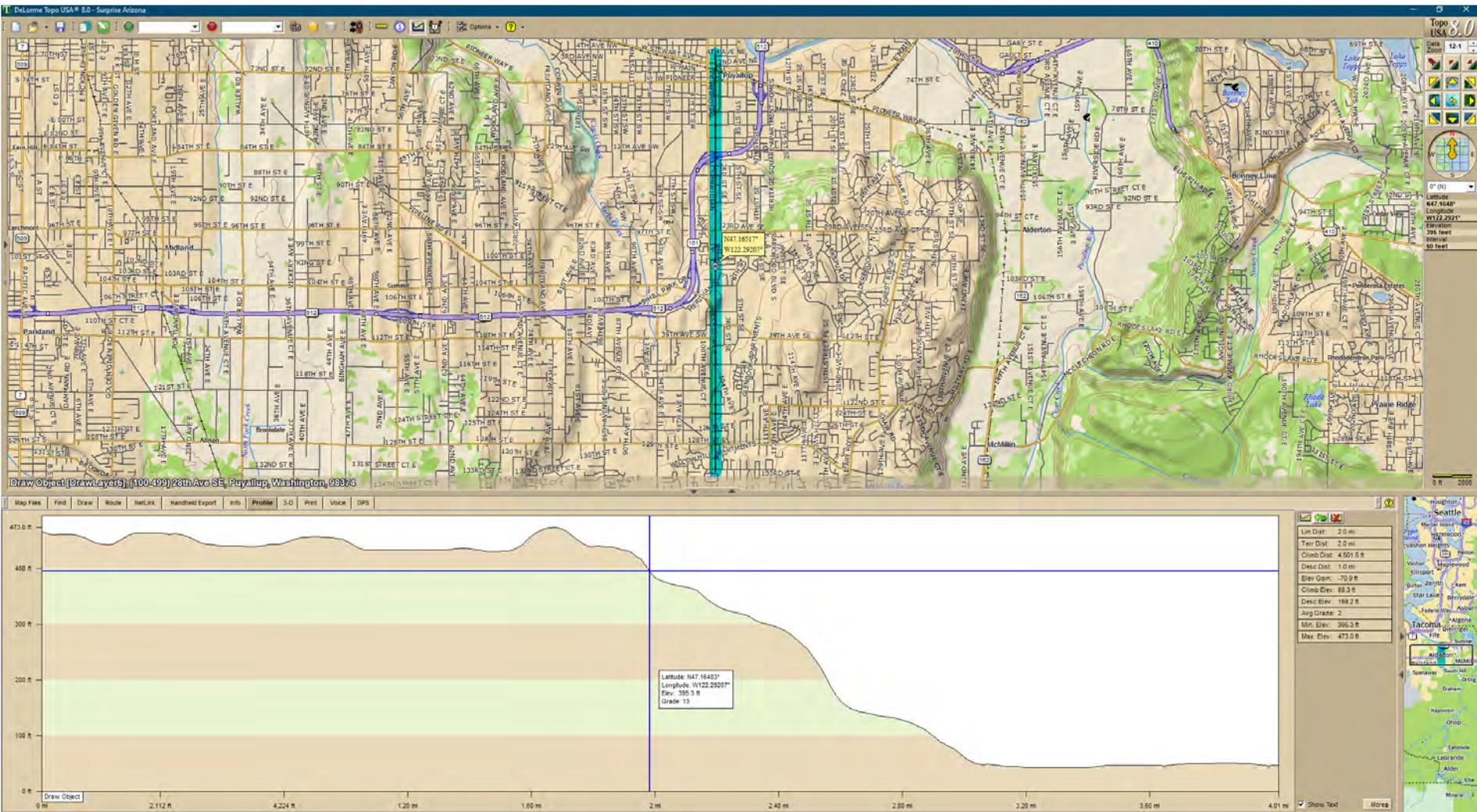
Add a missing place

Add your business

### Photos



Google



Kzt = 1.0

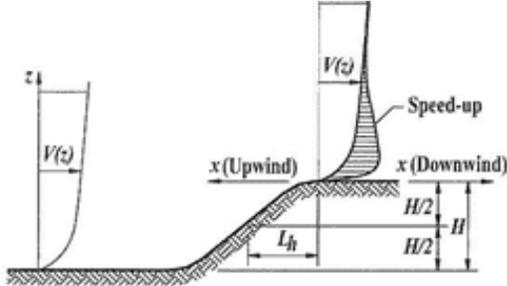
# 26.8 TOPOGRAPHIC EFFECTS

$K_{ZT}$

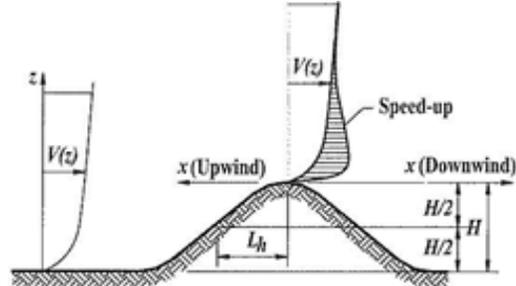
1

Exposure Category:

Hill Shape:



**ESCARPMENT**



**2-D RIDGE OR 3-D AXISYMMETRICAL HILL**

EL<sub>top</sub> = 473 ft  
 EL<sub>Bot</sub> = 142.1 ft  
 H = 330.9 ft  
 H/2 = 165.45 ft  
 L<sub>h</sub> = 3541 ft  
 H/L<sub>h</sub> = 0.0934

Elevation at crest of 2D Escarpment  
 Elevation at base of 2D Escarpment  
 307.55

Kzt Calc Not Required

$K_1 = 0.75H/L_h = 0.070086$   
 $K_1/(H/L_h) = 0.75$

(Figure 26.8-1)

$K_2 = (1 - \frac{|x|}{\mu L_h}) = 0.602372$   
 $x = 2112$  ft

5311.5 distance KZT no long affects wind speed

$\mu = 1.5$   
 $L_h = 3541$  ft

(Figure 26.8-1)

$K_3 = e^{-\gamma z/L_h} = 0.989466$   
 $z = 15$  ft  
 $\gamma = 2.5$   
 $L_h = 3541$  ft

height above ground surface at site  
 (Figure 26.8-1)

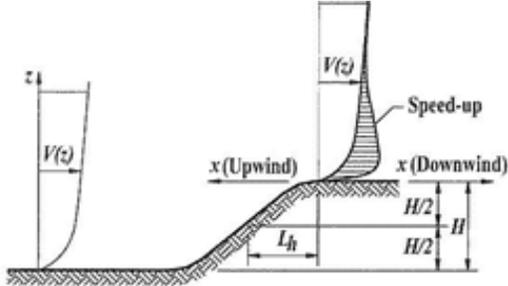
$K_{ZT} = (1 + K_1 K_2 K_3)^2 = 1.00$  (Eq. 26.8-1)

# 26.8 TOPOGRAPHIC EFFECTS

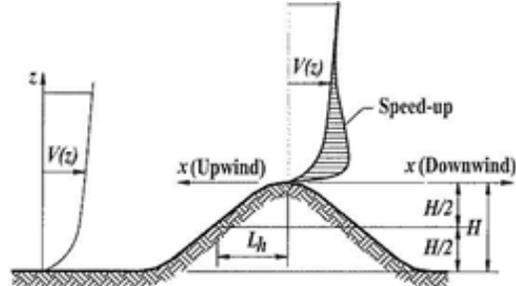
$K_{ZT}$

2

Exposure Category: B  
 Hill Shape: 2D Escarpment



**ESCARPMENT**



**2-D RIDGE OR 3-D AXISYMMETRICAL HILL**

EL<sub>top</sub> = 301 ft  
 EL<sub>Bot</sub> = 142.1 ft  
 H = 158.9 ft  
 H/2 = 79.45 ft  
 L<sub>h</sub> = 940 ft  
 H/L<sub>h</sub> = 0.1690

Elevation at crest of 2D Escarpment  
 Elevation at base of 2D Escarpment  
 221.55  
 Kzt Calc Not Required

$K_1 = 0.75H/L_h = 0.126782$   
 $K_1/(H/L_h) = 0.75$

(Figure 26.8-1)

$K_2 = (1 - \frac{|x|}{\mu L_h}) = 0.562234$   
 x = 1646 ft  
 downwind

3760 distance KZT no long affects wind speed

$\mu = 4$   
 L<sub>h</sub> = 940 ft

(Figure 26.8-1)

$K_3 = e^{-\gamma z/L_h} = 0.960892$   
 z = 15 ft  
 $\gamma = 2.5$   
 L<sub>h</sub> = 940 ft

height above ground surface at site  
 (Figure 26.8-1)

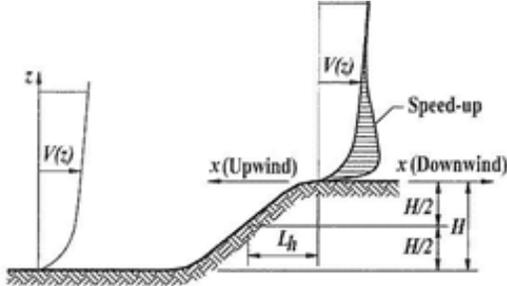
$K_{ZT} = (1 + K_1 K_2 K_3)^2 = 1.00$  (Eq. 26.8-1)

# 26.8 TOPOGRAPHIC EFFECTS

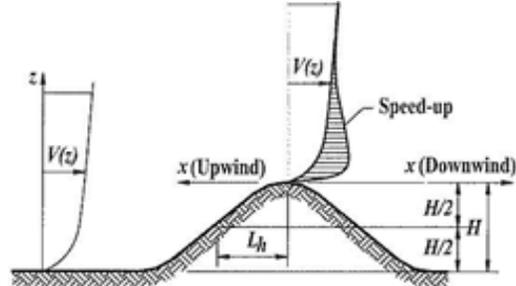
$K_{ZT}$

3

Exposure Category: B  
 Hill Shape: 2D Escarpment



**ESCARPMENT**



**2-D RIDGE OR 3-D AXISYMMETRICAL HILL**

EL<sub>top</sub> = 177.4 ft  
 EL<sub>Bot</sub> = 0 ft  
 H = 177.4 ft  
 H/2 = 88.7 ft  
 L<sub>h</sub> = 1144 ft  
 H/L<sub>h</sub> = 0.1551

Elevation at crest of 2D Escarpment  
 Elevation at base of 2D Escarpment

Kzt Calc Not Required

$K_1 = 0.75H/L_h = 0.116302$   
 $K_1/(H/L_h) = 0.75$

(Figure 26.8-1)

$K_2 = (1 - \frac{|x|}{\mu L_h}) = 0$   
 x = 6598 ft  
 downwind  
 $\mu = 4$   
 $L_h = 1144$  ft

4576 distance KZT no long affects wind speed

(Figure 26.8-1)

$K_3 = e^{-\gamma z/L_h} = 0.967752$   
 $z = 15$  ft  
 $\gamma = 2.5$   
 $L_h = 1144$  ft

height above ground surface at site  
 (Figure 26.8-1)

$K_{ZT} = (1 + K_1 K_2 K_3)^2 = 1.00$  (Eq. 26.8-1)

## K<sub>ZT</sub> Check

### 26.8 TOPOGRAPHIC EFFECTS

#### 26.8.1 Wind Speed-Up over Hills, Ridges, and Escarpments

Wind speed-up effects at isolated hills, ridges, and escarpments constituting abrupt changes in the general topography, located in any exposure category, shall be included in the determination of the wind loads when buildings and other site conditions and locations of structures meet all of the following conditions:

Y    N  
  

1. The hill, ridge, or escarpment is isolated and unobstructed upwind by other similar topographic features of comparable height for 100 times the height of the topographic feature ( $100H$ ) or 2 mi (3.22 km), whichever is less. This distance shall be measured horizontally from the point at which the height  $H$  of the hill, ridge, or escarpment is determined.

2. The hill, ridge, or escarpment protrudes above the height of upwind terrain features within a 2-mi (3.22-km) radius in any quadrant by a factor of two or more.

3. The structure is located as shown in Fig. 26.8-1 in the upper one-half of a hill or ridge or near the crest of an escarpment.

4.  $H/L_h \geq 0.2$ .

5.  $H$  is greater than or equal to 15 ft (4.5 m) for Exposure C and D and 60 ft (18 m) for Exposure B.

#### 26.8.2 Topographic Factor

The wind speed-up effect shall be included in the calculation of design wind loads by using the factor  $K_{zt}$ :

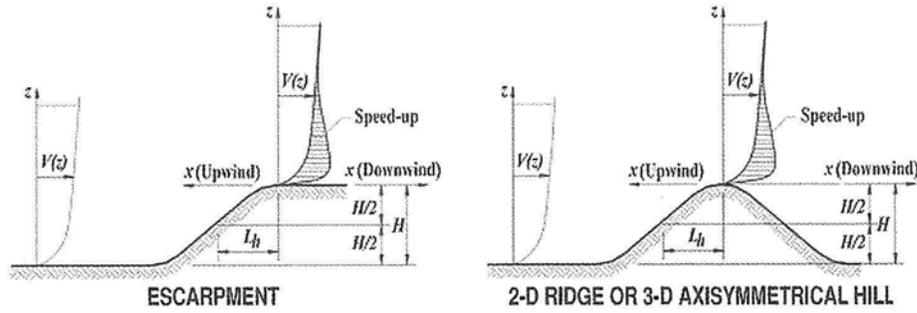
$$K_{zt} = (1 + K_1 K_2 K_3)^2 \quad (26.8-1)$$

where  $K_1$ ,  $K_2$ , and  $K_3$  are given in Fig. 26.8-1.

If site conditions and locations of buildings and other structures do not meet all the conditions specified in Section 26.8.1 then  $K_{zt} = 1.0$ .

$$K_{zt} = 1.0$$

**Diagrams**



**Topographic Multipliers for Exposure  $C^{a,b,c}$**

$H/L_h$	$K_1$ Multiplier			$x/L_h$	$K_2$ Multiplier			$z/L_h$	$K_3$ Multiplier		
	2D Ridge	2D Escarpment	3D Axisymmetrical Hill		2D Escarpment	All Other Cases	2D Ridge		2D Escarpment	3D Axisymmetrical Hill	
0.20	0.29	0.17	0.21	0.00	1.00	1.00	0.00	1.00	1.00	1.00	
0.25	0.36	0.21	0.26	0.50	0.88	0.67	0.10	0.74	0.78	0.67	
0.30	0.43	0.26	0.32	1.00	0.75	0.33	0.20	0.55	0.61	0.45	
0.35	0.51	0.30	0.37	1.50	0.63	0.00	0.30	0.41	0.47	0.30	
0.40	0.58	0.34	0.42	2.00	0.50	0.00	0.40	0.30	0.37	0.20	
0.45	0.65	0.38	0.47	2.50	0.38	0.00	0.50	0.22	0.29	0.14	
0.50	0.72	0.43	0.53	3.00	0.25	0.00	0.60	0.17	0.22	0.09	
				3.50	0.13	0.00	0.70	0.12	0.17	0.06	
				4.00	0.00	0.00	0.80	0.09	0.14	0.04	
							0.90	0.07	0.11	0.03	
							1.00	0.05	0.08	0.02	
							0.50	0.01	0.02	0.00	
							2.00	0.00	0.00	0.00	

<sup>a</sup>For values of  $H/L_h$ ,  $x/L_h$ , and  $z/L_h$  other than those shown, linear interpolation is permitted.  
<sup>b</sup>For  $H/L_h > 0.5$ , assume that  $H/L_h = 0.5$  for evaluating  $K_1$  and substitute  $2H$  for  $L_h$  for evaluating  $K_2$  and  $K_3$ .  
<sup>c</sup>Multipliers are based on the assumption that wind approaches the hill or escarpment along the direction of maximum slope.

**Notation**

- $H$  = Height of hill or escarpment relative to the upwind terrain, in ft (m).
- $K_1$  = Factor to account for shape of topographic feature and maximum speed-up effect.
- $K_2$  = Factor to account for reduction in speed-up with distance upwind or downwind of crest.
- $K_3$  = Factor to account for reduction in speed-up with height above local terrain.
- $L_h$  = Distance upwind of crest to where the difference in ground elevation is half the height of hill or escarpment, in ft (m).
- $x$  = Distance (upwind or downwind) from the crest to the site of the building or other structure, in ft (m).
- $z$  = Height above ground surface at the site of the building or other structure, in ft (m).
- $\mu$  = Horizontal attenuation factor.
- $\gamma$  = Height attenuation factor.

**Equations**

$$K_{st} = (1 + K_1 K_2 K_3)^2$$

$$K_1 = \text{determined from table below}$$

$$K_2 = (1 - |x|/\mu L_h)$$

$$K_3 = e^{-\gamma z/L_h}$$

**Parameters for Speed-Up over Hills and Escarpments**

Hill Shape	$K_1/(H/L_h)$			$\gamma$	$\mu$	
	Exposure				Upwind of Crest	Downwind of Crest
	B	C	D			
2D ridges (or valleys with negative $H$ in $K_1/(H/L_h)$ )	1.30	1.45	1.55	3	1.5	1.5
2D escarpments	0.75	0.85	0.95	2.5	1.5	4
3D axisymmetrical hill	0.95	1.05	1.15	4	1.5	1.5

FIGURE 26.8-1 Topographic Factor,  $K_{st}$

wind combined		wind 3 story		wind 3 story + basement		
156	152	10	10.6875	159	10.5	10.6875
		10	9.083333		10.3	9.083333
102	101	10	1.05	103	10	1.05
		10	9.083333		10	9.083333
101	101	10	1.05	101	10	1.05
		10	9.083333		10	9.083333
				101	10	1.05
					10	9.083333

SEKMK:

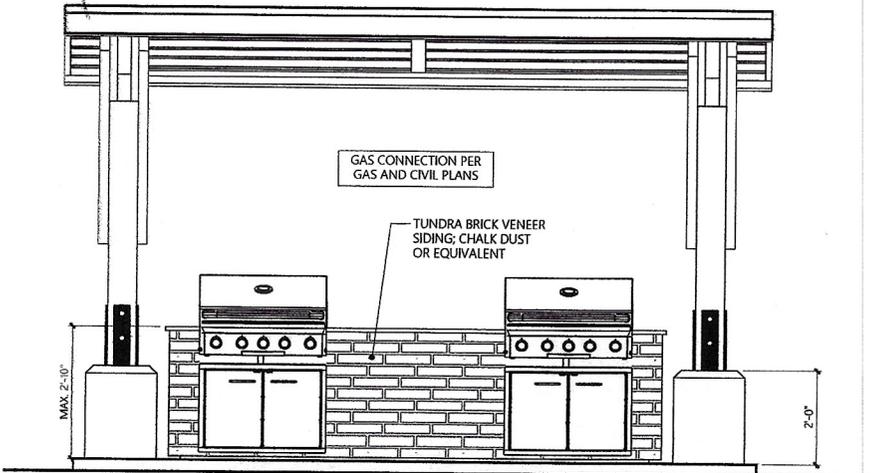
$15(6.25)(15 \text{ psf}) = 1406$

$F_p = 682 \#$

EACH FRAME = 341#

$15(2)(20 \text{ psf}) = 600 \#$  EACH FRAME 300# ok

341# ↑

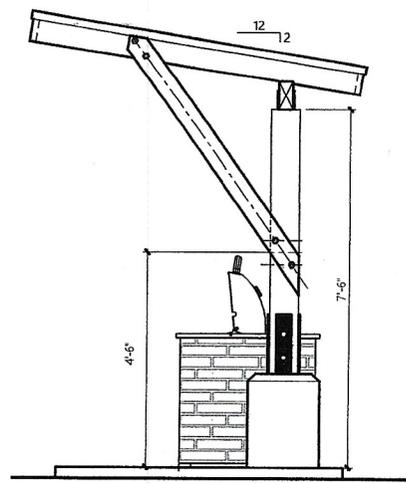


**FRONT ELEVATION**

1/2" = 1'-0"

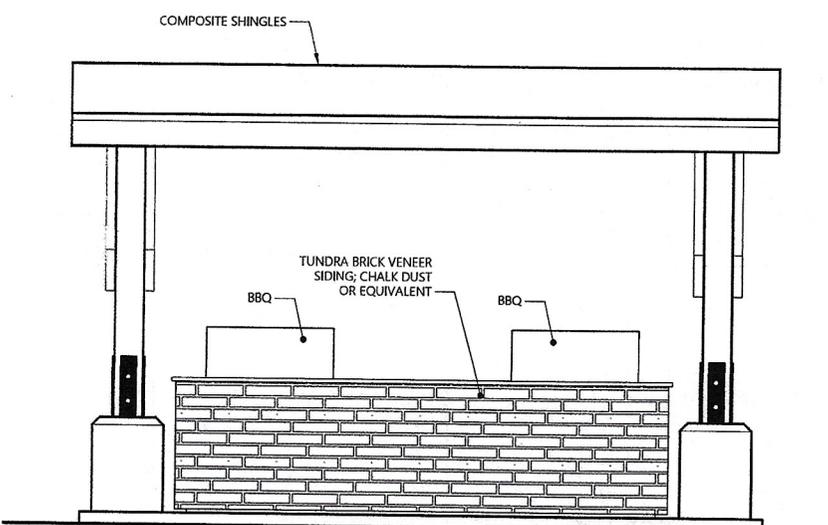
NOTES:

- 1. INSTALL PER MANUFACTURERS RECOMMENDATIONS.



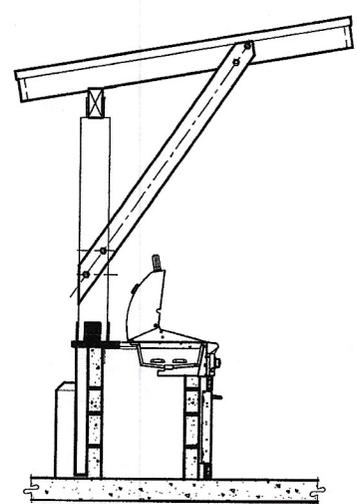
**SIDE ELEVATION**

1/2" = 1'-0"



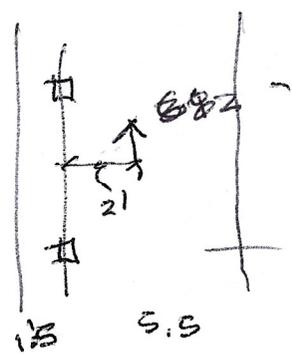
**REAR ELEVATION**

1/2" = 1'-0"



**SECTION C**

1/2" = 1'-0"



ROT

$W = 682(2) = 1364 \# \rightarrow$

$T = C = \frac{1364}{12.33} = 111 \#$

↑ 341# → 359#

□ → 111

$$P(4.5) = \frac{4.369}{4} \cdot 1.0923^{k-1}$$

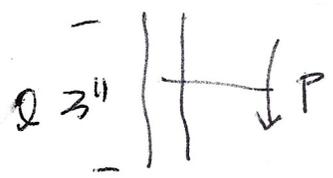
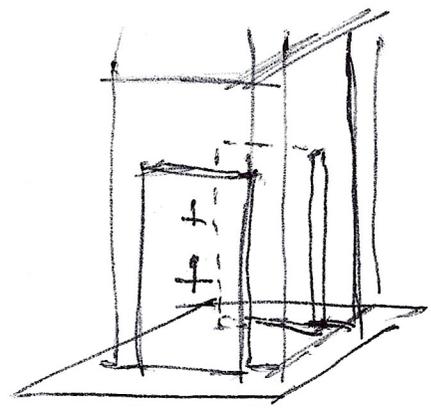
$$P = 1.0923^k$$

D =

C = 9.213

$\frac{b}{3} = 2$

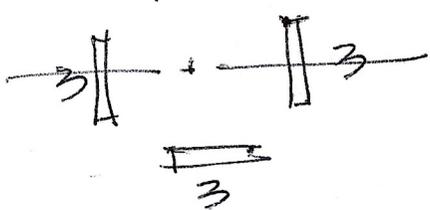
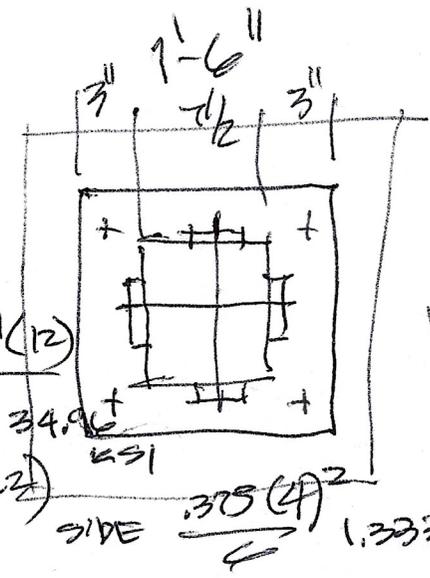
a(3) = 6"



$$\frac{4.369}{2} = 2.1845^k$$

$$f_b = \frac{M}{S} = \frac{2.185^k(12)}{.75}$$

$$S = \frac{.75(3)^2}{6} = 0.375(2)$$



$$\frac{1/4(3)^3}{12} (2) + .75(2)(3.5)^2 + .75(2)(3.5)^2$$

$$= 6.375$$

$$I = 37.87 \text{ in}^4$$

$$S = \frac{37.87}{3.5} = 10.82$$

$$M = \frac{4.369^{k-1}}{10.82} = .403 \text{ ksi}$$

$$Paq = 1.0923^k$$

$$P = \frac{0.933}{2} = 465 \text{ \#}$$

$$0.465^k (a_2) 0.0923^k$$

(2) 3/4" φ →  
MIB ←  
in steel ok.

$$\frac{4.369(12)}{6} = 8.738$$

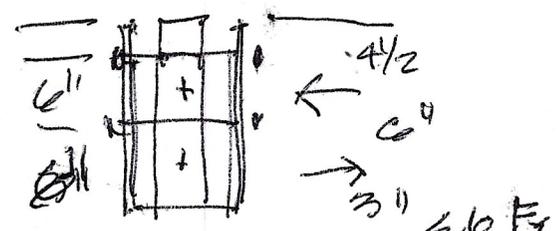
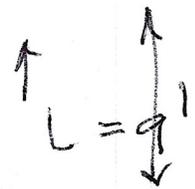
3/4 D.B. STAINLESS 33.13(2)  
8547 6.686(1.15) 7.689  
ASSUME EA TAB STAINLESS

$$\frac{4.369}{2(7.5/12)} = 3.44^k$$

SHEAR

(1.15) 1.738(2) = 3.997

13/2



$$\frac{2.185(12)}{1.3333} = 19.7 \text{ ok. } 3/8 \times 4 \text{ STAINLESS}$$

$$2T \times (7.5) + 2T(3.5) = 4.369(12)$$

$$x = 2T \quad y = 2.383^k$$

$$x = 4.76^k$$

$$\frac{4.369^{k-1}}{7.5^{1/2}} = 6.99^k$$

(2) 3/4" φ MIB 4.4 in STEEL  
EA SIDE