$$\text{mean roof height} = 10 + \frac{(16)(\tan 15°)}{2} = 12.1\ \text{ft}$$

Since K_z is constant in 0-15 ft region, from Table 6-5,
$K_z = K_h = 0.70$ for Case 1 (C&C)
$K_z = K_h = 0.57$ for Case 2 (MWFRS)

Velocity Pressures

$$q_z = 0.00256\ K_z K_{zt} K_d\ V^2\ I\ \text{psf} \qquad \text{(Equation 6-13)}$$

For MWFRS, $q_z = q_h = 0.00256\ (0.57)\ (1.0)\ (0.85)\ (90)^2\ (1.0)$
$= 10.1$ psf

For C&C, $q_z = q_h = 0.00256\ (0.7)\ (1.0)\ (0.85)\ (90)^2\ (1.0)$
$= 12.3$ psf

Gust Effect Factor

$G = 0.85$ (Section 6.5.8.1)

$(GC_{pi}) = +0.18$ and -0.18 (Table 6-7)

Wind Pressure for MWFRS

Because of asymmetry, all four wind directions are considered (normal to walls)

The wall surfaces are numbered 1 through 6; roof surfaces are 7 through 11; porch roof surface is 12.

WIND DIRECTION A

Wall pressures:

Surface 1: p = 10.1 (0.85) (0.8) – 10.1 ($\pm$0.18) = +6.9 $\pm$ 1.8 psf (windward)

Surface 2: p = 10.1 (0.85) (-0.7) – 10.1 ($\pm$0.18) = -6.0 $\pm$ 1.8 psf (side)

Surface 3: p = 10.1 (0.85) (-0.3) – 10.1 ($\pm$0.18) = -2.6 $\pm$ 1.8 psf (leeward)

(for L/B = 80/40 = 2; C_p = -0.3)

Surface 4: p = -6.0 $\pm$ 1.8 psf (side)

Surface 5: p = +6.9 $\pm$ 1.8 psf (windward)

Surface 6: p = -6.0 $\pm$ 1.8 psf (side)

Roof pressures: h/L = 12.1/80 = 0.15; Θ = 15 degrees

Surface 7: p = 10.1 (0.85) (-0.5) – 10.1 ($\pm$0.18) = -4.3 $\pm$ 1.8 psf (windward)

Surface 8: for Θ = 0 degrees; pressure varies along the roof

p = 10.1 (0.85) (-0.9) – 10. 1 ($\pm$0.18) = -7.7 $\pm$ 1.8 psf; 1 to 12.1 ft

p = 10.1 (0.85) (-0.5) – 10. 1 ($\pm$0.18) = -4.3 $\pm$ 1.8 psf; 12.1 to 24.2 ft

p = 10.1 (0.85) (-0.3) – 10. 1 ($\pm$0.18) = -2.6 $\pm$ 1.8 psf; 24.2 ft to end

Surface 9: same pressures as surface 8

Surface 10: p = 10.1 (0.85) (-0.5) – 10.1 ($\pm$0.18) = -4.3 $\pm$ 1.8 psf (leeward)

Surface 11: p = 10.1 (0.85) (-0.5) – 10.1 ($\pm$0.18) = -4.3 $\pm$ 1.8 psf (windward)

Surface 12: same as surface 8 without internal pressure

Overhang pressures: At wall surfaces 1 and 5

p = 10.1 (0.85) (0.8) = +6.9 psf

Internal pressure is of the same sign on all applicable surfaces

WIND DIRECTION B

Wall pressures:

Surface 1: $p = -6.0 \pm 1.8$ psf (side)

Surface 2: $p = +6.9 \pm 1.8$ psf (windward)

Surface 3: $p = -6.0 \pm 1.8$ psf (side)

Surface 4: $p = 10.1\ (0.85)\ (-0.5) - 10.1\ (\pm 0.18) = -4.3 \pm 1.8$ psf (leeward)

(for $L/B = 40/80 = 0.5$; $C_p = -0.5$)

Surface 5: even though technically this surface is side wall, it is likely to see the same pressure as surface 6

Surface 6: same pressure as surface 4

Roof pressures: $h/L = 12.1/40 = 0.3$; $\Theta = 15$ degrees

For windward, $C_p = -0.54$ (interpolated)

For leeward, $C_p = -0.5$

For parallel to ridge, $C_p = -0.9$, -0.5, and -0.3

Surface 7: same pressures as surface 8 for Wind Direction A

Surface 8: $p = 10.1\ (0.85)\ (-0.54) - 10.1\ (\pm 0.18) = -4.6 \pm 1.8$ psf (windward)

Surface 9: $p = 10.1\ (0.85)\ (-0.5) - 10.1\ (\pm 0.18) = -4.3 \pm 1.8$ psf (leeward)

Surface 10: same pressures as surface 8 for Wind Direction A

Surface 11: same as surface 9 because it is sloping with respect to ridge

Surface 12: This surface is at a distance greater than 2h

$p = 10.1\ (0.85)\ (-0.3) = -2.6$ psf; no internal pressure

Overhang pressures: At wall surface 2

$p = 10.1\ (0.85)\ (0.8) = +6.9$ psf

Internal pressure is of the same sign on all applicable surfaces

WIND DIRECTION C

Wall pressures:

Surface 1 and 5: p = -2.6 ± 1.8 psf (leeward)

Surface 2, 4, and 6: p = -6.0 ± 1.8 psf (side)

Surface 3: p = +6.9 ± 1.8 psf (windward)

Roof pressures:

Surface 7 and 11: p = -4.3 ± 1.8 psf (leeward)

Surface 8 and 9: pressures vary along the roof; same pressures as surface 8 for Wind Direction A

Surface 10: p = -4.3 ± 1.8 psf (windward)

Surface 12: same pressures as surface 9 without internal pressures

Overhang pressures: At wall surface 3

p = 10.1 (0.85) (0.8) = +6.9 psf

Internal pressure is of the same sign on all applicable surfaces.

WIND DIRECTION D

Wall pressures:

Surface 1 and 3: $p = -6.0 \pm 1.8$ psf (side)

Surface 2: $p = -4.3 \pm 1.8$ psf (leeward)

Surface 4, 5, and 6: $p = +6.9 \pm 1.8$ psf (windward)

Roof pressures:

Surface 7, 10, and 11: pressures vary along the roof; same pressures as surface 8 for Wind Direction A

Surface 8: $p = -4.3 \pm 1.8$ psf (leeward)

Surface 9: $p = -4.3 \pm 1.8$ psf (windward)

Surface 12: This surface will see pressures on top and bottom surfaces; they will add algebraically.

For $\Theta = 0°$, $h/L < 0.5$, $C_p = -0.9$

$$p = 10.1\ (0.85)\ (-0.9) - 10.1\ (0.85)\ (+0.8) = -14.6 \text{ psf uplift}$$

Overhang pressures: At wall surfaces 4, 5, and 6

$$p = 10.1\ (0.85)\ (0.8) = +6.9 \text{ psf}$$

Internal pressure is of the same sign on all applicable surfaces.

Components and Cladding

Wall Component:

Wall studs are 10 ft long and spaced 16 in. apart.

Effective area = larger of 10 x 1.33 = 13.3 sq ft

or 10 x 10/3 = 33.3 sq ft (controls)

From Figure 6-5a, Equations in Chapter 2 are used

$(GC_p) = +0.91$ for Zones 4 and 5

$(GC_p) = -1.01$ for Zone 4

$(GC_p) = -1.22$ for Zone 5

Distance 'a' = smaller of 0.1 (40) = 4 ft (controls)

or 0.4 (12.1) = 4.8 ft

Design pressure p = 12.3 (0.91 + 0.18) = +13.4 psf (all walls)

p = 12.3 (-1.01 – 0.18) = -14.6 psf (middle)

p = 12.3 (-1.22 – 0.18) = -17.2 psf (corner)

Roof component:

Roof trusses are 32 ft long and spaced 4 ft apart.

Effective area = larger of 32 x 4 = 128 sq ft

or 32 x 32/3 = 341 sq ft (controls)

From Figure 6-5b for $\Theta = 15°$

$(GC_p) = +0.3$ for Zones 1, 2, and 3

$(GC_p) = -0.8$ for Zone 1

$(GC_p) = -1.4$ for Zones 2 and 3

Distance 'a' = smaller of 0.1 (40) = 4 ft (controls)

or 0.4 (12.1) = 4.8 ft

Design pressures

$p = 12.3\ (0.3 + 0.18) = +5.9$ psf (all zones)

$p = 12.3\ (-0.8 - 0.18) = -12.1$ psf (middle roof)

$p = 12.3\ (-1.4 - 0.18) = -19.4$ psf (edges of roof)

Overhang pressures to be used for reaction and anchorage

$p = 12.3\ (-2.2 - 0.18) = -29.3$ psf (edge of roof)

$p = 12.3\ (-2.5 - 0.18) = -33.0$ psf (roof corners)

Roof Panels

Effective area = 4 x 8 = 32 sq ft

From Figure 6-5b for $\Theta = 15°$ (note: Zones 2 and 3 are overhang)

$(GC_p) = +0.4$ for Zones 1, 2, and 3

$(GC_p) = -0.85$ for Zone 1

$(GC_p) = -2.2$ for Zones 2 (with overhang)

$(GC_p) = -3.1$ for Zone 3 (with overhang)

Distance 'a' = smaller of 0.1 (40) = 4 ft (controls)

or 0.4 (12.1) = 4.8 ft

Design pressures

$p = 12.3\ (0.4 + 0.18) = +7.1$ psf (all zones)

$p = 12.3\ (-0.85 - 0.18) = -12.7$ psf (middle roof)

$p = 12.3\ (-2.2 - 0.18) = -29.3$ psf (edges of roof)

$p = 12.3\ (-3.1 - 0.18) = -40.3$ psf (roof corners)

3.6 Example 6 – House of Example 5 on an Isolated Hill

In this example, the one-story house of Example 5 is placed on a hill to illustrate the effect of topography. It is only necessary to calculate velocity pressure, q_z, and compare with the value of Example 5.

The data for the house are the same as Example 5. The parameter of significance is the mean roof height, which is h = 12.1 ft.

The topography dimensions of a 3-D axisymmetrical hill are as shown:

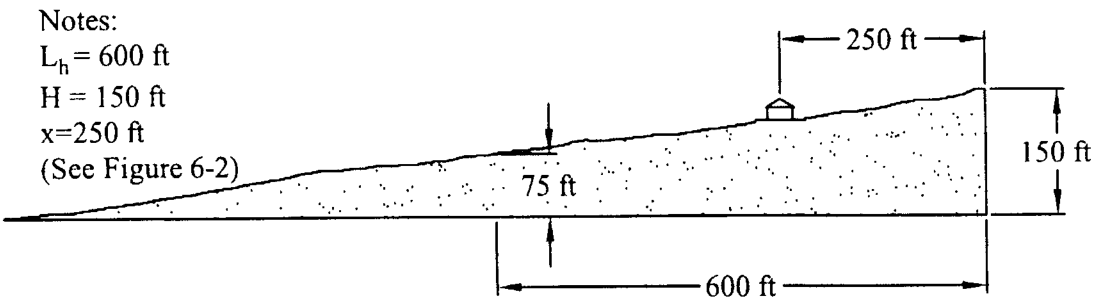

Figure 3.6.1 One-Story House on a Hill

Basic Wind Speed, Exposure, Classification

Same as Example 5: Basic wind speed, V = 90 mph
Category II, I = 1.0
Exposure B, $K_z = K_h = 0.57$ for Case 2 (MWFRS)
$K_h = 0.7$ for Case 1 (C&C)
Directionality factor, $K_d = 0.85$
Classification: Enclosed

Determination of K_{zt}

The topographic effect is applicable only when the following conditions are met, see Section 6.5.7.1:

1. The hill is isolated and unobstructed upwind by similar topographic features for a distance of the larger of 100 x H = 15,000 ft (controls) or two miles.
2. There are no hills higher than 75 ft for a distance of two miles.
3. The building is located in the upper one-half of the hill.
4. $H/L_h = 150/600 = 0.25 \geq 0.2$
5. H = 150 ft > 60 ft for Exposure B

Topographic factor $K_{zt} = (1 + K_1 K_2 K_3)^2$ (Equation 6-1)

For $H/L_h = 0.25$, x = 250 ft and Exposure B (Figure 6-2)

$K_1 = (0.95)(0.25) = 0.24$

$$K_2 = \left(1 - \frac{250}{(1.5)(600)}\right) = 0.72$$

$K_3 = e^{-4(15)/600} = 0.90$ (z is taken as 15 ft to be consistent with K_z)

$K_{zt} = [1 + (0.24)(0.72)(0.90)]^2 = 1.33$

Velocity Pressure

$q_z = 0.00256 K_z K_{zt} K_d V^2 I$ (Equation 6-13)

$= 0.00256 (0.57) (1.33) (0.85) (0.90)^2 (1.0)$

$= 13.4$ psf

Assessment of Topographic Effect

The velocity pressure (hence, design pressure) increases by 33% (13.4 psf versus 10.1 psf) for MWFRS when the house is located on the hill. The velocity pressure increase for C&C will also be 33%. The increase would be 48% if the house were located at the crest of the hill.

3.7 Example 7 – 200 ft x 250 ft Gable Roof Commercial/Warehouse Building Using Rigid Buildings of All Height Provisions

In this example, design wind pressures for a large, one-story commercial-industrial building are determined. The building data are as follows:

Location:	Memphis, Tennessee
Terrain:	Flat farmland
Dimensions:	200 ft × 250 ft in plan
	Eave height of 20 ft
	Roof Slope 4:12 (18.4 degrees)
Framing:	Rigid frames span the 200 ft direction
	Rigid frame bay spacing is 25 ft
	Lateral bracing in the 250 direction is provided by a "wind truss" spanning the 200 ft to side walls and cable/rod bracing in the planes of the walls
	Girts and purlins span between rigid frames (25 ft span)
	Girt spacing is 6 ft 8 in.
	Purlin spacing is 5 ft
Cladding:	Roof panel dimensions are 2 ft wide
	Roof fastener spacing on purlins is 1 ft on center
	Wall panel dimensions are 2 ft × 20 ft
	Wall fastener spacing on girts is 1 ft on center
	Openings are uniformly distributed

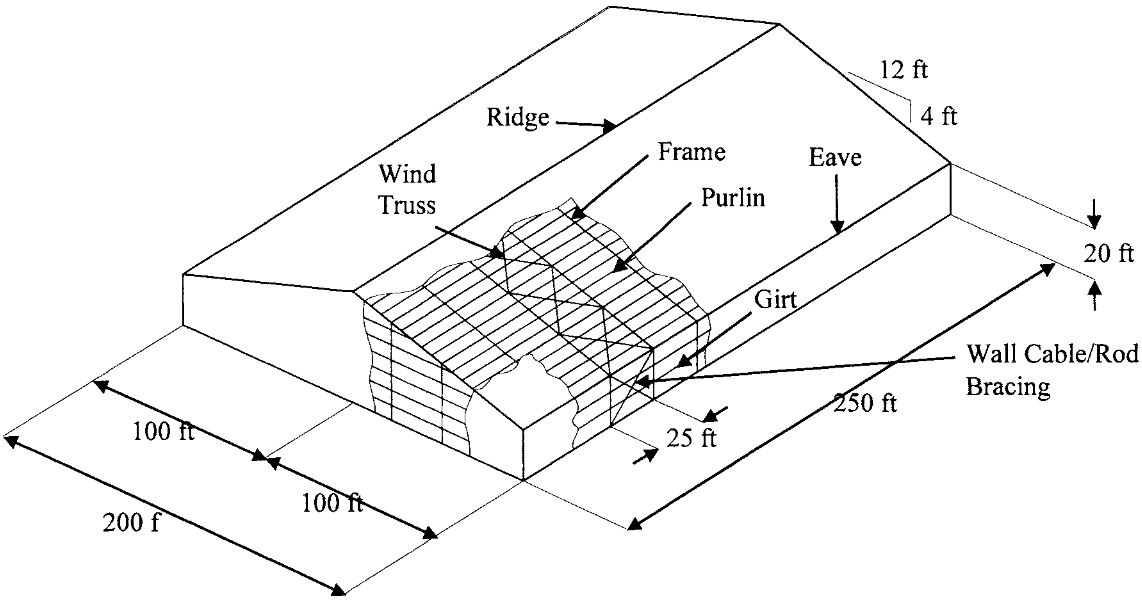

Figure 3.7.1 Dimensions and Framing of the Building of Example 7