

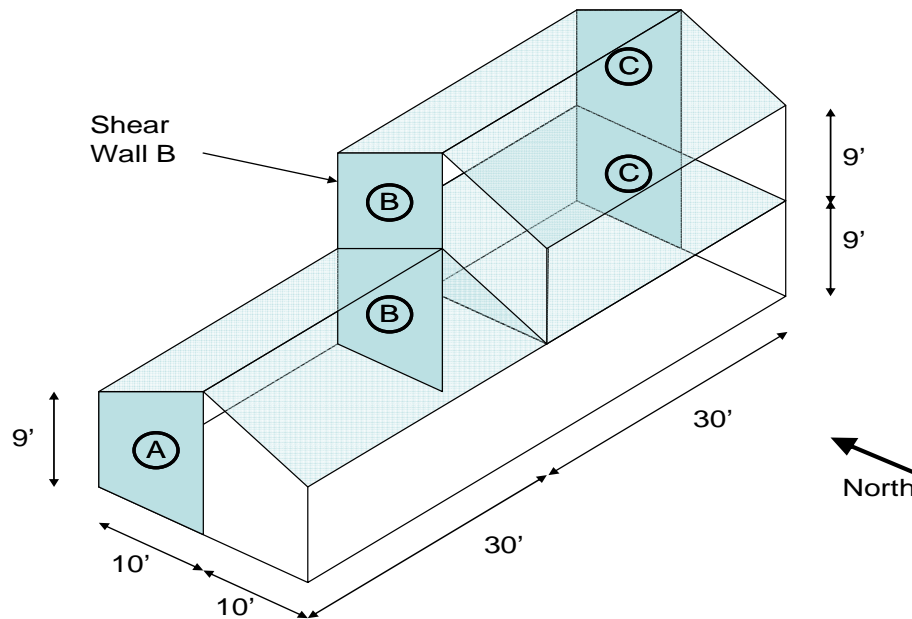
Solution

Given

- The 2 story house configuration shown below
- The roof is sloped at a 4:12 pitch
- The house is located adjacent to open fields near Boise, Idaho
- The house is wood framed with plywood sheathing on walls, roof and floor.
- Wind loading in North-South direction

Determine

- Wall B maximum shear and uplift forces based on the following provisions:
 1. ASCE 7-05 Wind Analytical Procedure Method 2
 2. Proposed Alternate Wind Procedures (see attached)



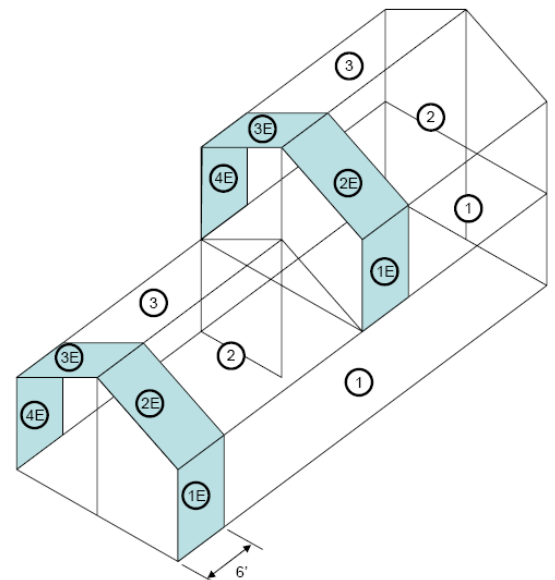
Answer Summary

| | ASCE 7-05 Analytical Wind Method 2 | Proposed Alternate Wind Procedures |
|-----------------------------------|---------------------------------------|---------------------------------------|
| Wall B - Max Wind Shear Force | 4,519 [#] | 4,828 [#] |
| Wall B - Max Wind Uplift Force | 5,448 [#] | 5,717 [#] |

ASCE 7-05 Method 2 Analytical Procedures

- Basic Wind Speed and Wind Directionality Factor
 $V = 90$ mph (Figure 6-1, Boise Idaho)
 $K_d = 0.85$ (Table 6-4, MWFRS)
- Importance Factor
 $I = 1.0$ (Occupancy Category II)
- Exposure Category and Velocity Pressure Exposure Coefficient
 Exposure Category = C (Site adjacent to open fields)
 Building qualifies as Low Rise Building
 $h = (18.0' + 3.33'/2) = 19.67' < 60'$
 $h = 19.67' < 20'$
 $K_h = 0.90$ (Table 6-3)
- Topographic Factor
 $K_{zt} = 1.0$ (Assumed since near open fields)
- Gust Effect Factor
 $G = 0.85$ (rigid structure based on 2 story building height)
- Enclosure Classification
 Enclosed Building (Section 6.5.9)
- Internal Pressure Coefficient
 $GC_{pi} = \pm 0.18$ (Figure 6-5, Enclosed Building)
- External Pressure Coefficient (Figure 6-10)
 Roof Angle = $18^\circ \sim 20^\circ$

| | |
|---------------------|----------------------|
| $GC_{pf-1} = 0.53$ | $GC_{pf-1E} = 0.80$ |
| $GC_{pf-2} = -0.69$ | $GC_{pf-2E} = -1.07$ |
| $GC_{pf-3} = -0.48$ | $GC_{pf-3E} = -0.69$ |
| $GC_{pf-4} = -0.43$ | $GC_{pf-4E} = -0.64$ |
- Velocity Pressure
 $q_h = 0.00256K_hK_{zt}K_dV^2I$
 $= 0.00256 \times 0.90 \times 1.0 \times 0.85 \times 90^2 \times 1.0 = 15.86$ psf
- Design Wind Load
 $p = q_h[(GC_{pf}) - (GC_{pi})]$ Eq. (6-18)
 $p_1 = 15.86$ psf $[(0.53) - (0.18)] = 5.55$ psf
 $p_2 = 15.86$ psf $[(-0.69) - (0.18)] = -13.80$ psf
 $p_3 = 15.86$ psf $[(-0.48) - (0.18)] = -10.47$ psf
 $p_4 = 15.86$ psf $[(-0.43) - (0.18)] = -9.67$ psf
 $p_{1E} = 15.86$ psf $[(0.80) - (0.18)] = 9.83$ psf
 $p_{2E} = 15.86$ psf $[(-1.07) - (0.18)] = -19.83$ psf
 $p_{3E} = 15.86$ psf $[(-0.69) - (0.18)] = -13.80$ psf



$$p_{4E} = 15.86 \text{ psf} [(-0.64)-(0.18)] = -13.01 \text{ psf}$$

11. Wall Forces

Determine width of pressure coefficient zone (a) per Figure 6-10

$$a = 0.10 \times 20' = 2'$$

$$a = 0.4 \times 19.67' = 7.87'$$

$$a = .04 \times 20' = 0.8'$$

$$a = 3' \text{ (Governs)}$$

$$2a = 2 \times 3' = 6'$$

Need not consider torsional load cases since building is 2 stories with flexible diaphragms per Note #5 of Figure 6-10.

Use tributary area to determine wall forces (slight error using tributary area since wind forces on diaphragm are not uniform). Neglect wind pressure at sloping roof since the net roof horizontal wind pressure reduces the horizontal wind forces on the shear wall.

$$F_{2R} = [4.5' \times 6' \times (9.83 \text{ psf} + 13.01 \text{ psf})] + [4.5' \times 9' \times (5.55 \text{ psf} + 9.67 \text{ psf})] = 1,232\#$$

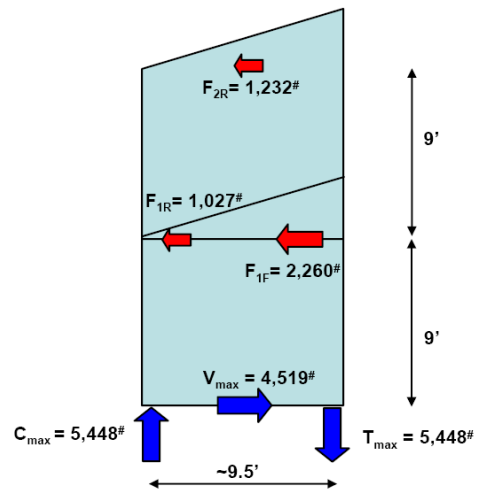
$$F_{1R} = [4.5' \times 15' \times (5.55 \text{ psf} + 9.67 \text{ psf})] = 1,027\#$$

$$F_{1F} = [4.5' \times 15' \times (5.55 \text{ psf} + 9.67 \text{ psf})] + [4.5' \times 6' \times (9.83 \text{ psf} + 13.01 \text{ psf})] + [4.5' \times 9' \times (5.55 \text{ psf} + 9.67 \text{ psf})] = 2,260\#$$

$$V_{\max} = 1,232\# + 1,027\# + 2,260\# = 4,519\#$$

$$M_{OT} = (1,232\# \times 18') + (1,027\# \times 9') + (2,260\# \times 9') = 51,759\#'$$

$$T_{\max} = C_{\max} = 51,759\#'/9.5' = 5,448\#$$



Shear Wall B

Proposed Alternate Procedure

1. Wind Velocity Pressure

Basic Wind Speed $V = 90$ mph (Figure 6-1, Boise Idaho)

$q_s = 20.7$ psf (Table 1609.6.3(1))

2. Velocity Pressure Exposure Coefficient

Exposure Category = C (Site adjacent to open fields)

$K_z = 0.90$ (Table 6-3, use $h=20'$ for entire building, conservative)

3. Net Pressure Coefficient (Table 1609.6.3(2))

$C_{net} = 0.43$ (Windward Wall)

$C_{net} = -0.53$ (Leeward Wall)

$C_{net} = -0.73$ (Windward Roof - 4:12 Slope)

$C_{net} = -0.66$ (Leeward Roof)

4. Importance Factor

$I = 1.0$ (Occupancy Category II)

5. Topographic Factor

$K_{zt} = 1.0$ (Assumed since near open fields)

6. Design Wind Pressure

$$P_{net} = q_s K_z C_{net} I K_{zt}$$

$$P_{net} = 20.7 \times 0.90 \times C_{net} \times 1.0 \times 1.0 = 18.63 C_{net}$$

$$P_{net} = 18.63 \times 0.43 = 8.01 \text{ psf (Windward Wall)}$$

$$P_{net} = 18.63 \times -0.53 = -9.87 \text{ psf (Leeward Wall)}$$

$$P_{net} = 18.63 \times -0.73 = -13.60 \text{ psf (Windward Roof)}$$

$$P_{net} = 18.63 \times -0.66 = -12.30 \text{ psf (Leeward Roof)}$$

7. Shear Wall Forces

Assume flexible diaphragm and use tributary area

$$F_{2R} = 4.5' \times 15' \times (8.01 \text{ psf} + 9.87 \text{ psf}) = 1,207^\#$$

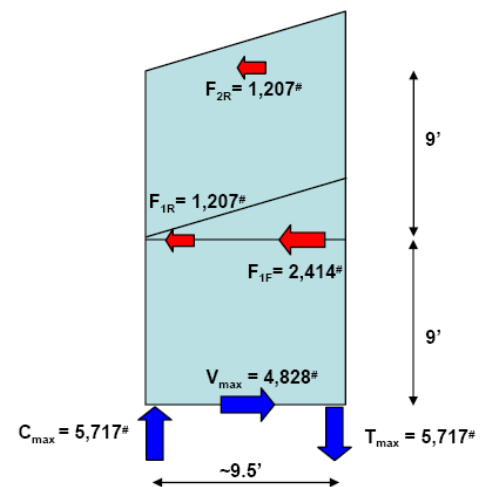
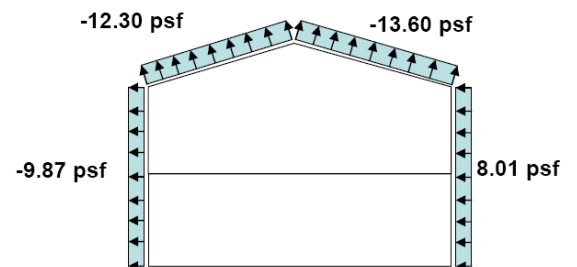
$$F_{1R} = 4.5' \times 15' \times (8.01 \text{ psf} + 9.87 \text{ psf}) = 1,207^\#$$

$$F_{1F} = 9' \times 15' \times (8.01 \text{ psf} + 9.87 \text{ psf}) = 2,414^\#$$

$$V_{max} = 1,207^\# + 1,207^\# + 2,414^\# = 4,828^\#$$

$$M_{OT} = (1,207^\# \times 18') + (1,207^\# \times 9') + (2,414^\# \times 9') = 54,315^\#$$

$$T_{max} = C_{max} = 54,315^\# / 9.5' = 5,717^\#$$



Shear Wall B