

# MWFRS — Enclosed / Partially Enclosed / Partially Open

ASCE 7-22 Ch. 27 — Directional Procedure

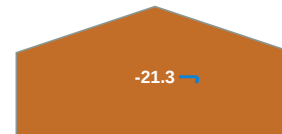
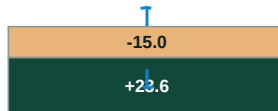
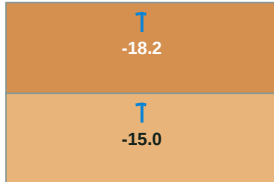
$$p = q \cdot K_d \cdot G \cdot C_p - q_i \cdot K_d \cdot (GC_{pi}) \text{ (psf) [Eq. 27.3-1]}$$

## Pressure Diagrams

Roof plan

Elevation — B face

Elevation — L face



Orthographic roof plan and elevations, wind normal to ridge. Each face is coloured and labelled with its governing design pressure (psf); arrows show inward (+) or outward (–) action.

## Consolidated Design Pressures

| Direction | Surface                | Role                 | Type | C <sub>p</sub> prim | C <sub>p</sub> alt | q <sub>ref</sub> | p (primary,+GC <sub>pi</sub> ) psf | p (primary,-GC <sub>pi</sub> ) psf | Gov  p  (psf) | Min req (psf) | Status      |
|-----------|------------------------|----------------------|------|---------------------|--------------------|------------------|------------------------------------|------------------------------------|---------------|---------------|-------------|
| Normal    | Eave Wall (windward)   | Windward             | Wall | 0.8                 |                    | qz               | 13.72                              | 23.59                              | 23.59         | 16            | OK          |
| Normal    | Eave Wall (leeward)    | Leeward              | Wall | -0.5                |                    | qh               | -16.6                              | -6.72                              | 16.6          | 16            | OK          |
| Normal    | Gable End A (side)     | Side                 | Wall | -0.7                |                    | qh               | -21.26                             | -11.39                             | 21.26         | 16            | OK          |
| Normal    | Gable End B (side)     | Side                 | Wall | -0.7                |                    | qh               | -21.26                             | -11.39                             | 21.26         | 16            | OK          |
| Normal    | Windward Roof          | Windward             | Roof | -0.433              | 0.034              | qh               | -15.03                             | -5.16                              | 15.03         | 8             | OK          |
| Normal    | Leeward Roof           | Leeward              | Roof | -0.569              |                    | qh               | -18.2                              | -8.32                              | 18.2          | 8             | OK          |
| Parallel  | Gable End A (windward) | Windward             | Wall | 0.8                 |                    | qz               | 13.72                              | 23.59                              | 23.59         | 16            | OK          |
| Parallel  | Gable End B (leeward)  | Leeward              | Wall | -0.4                |                    | qh               | -14.27                             | -4.39                              | 14.27         | 16            | MIN GOVERNS |
| Parallel  | Eave Wall A (side)     | Side                 | Wall | -0.7                |                    | qh               | -21.26                             | -11.39                             | 21.26         | 16            | OK          |
| Parallel  | Eave Wall B (side)     | Side                 | Wall | -0.7                |                    | qh               | -21.26                             | -11.39                             | 21.26         | 16            | OK          |
| Parallel  | WW Zone 1 (0 to h/2)   | WW Zone 1 (0 to h/2) | Roof | -0.9                | -0.18              | qh               | -25.93                             | -16.05                             | 25.93         | 8             | OK          |
| Parallel  | WW Zone 2 (h/2 to h)   | WW Zone 2 (h/2 to h) | Roof | -0.9                | -0.18              | qh               | -25.93                             | -16.05                             | 25.93         | 8             | OK          |
| Parallel  | WW Zone 3 (h to 2h)    | WW Zone 3 (h to 2h)  | Roof | -0.5                | -0.18              | qh               | -16.6                              | -6.72                              | 16.6          | 8             | OK          |
| Parallel  | WW Zone 4 (> 2h)       | WW Zone 4 (> 2h)     | Roof | -0.3                | -0.18              | qh               | -11.93                             | -2.06                              | 11.93         | 8             | OK          |

## §27.1.5 — Minimum Design Load (projected area)

| Wind direction    | Wall proj. (sf) | Roof proj. (sf) | Minimum F (lb) | Computed F (lb) | Status |
|-------------------|-----------------|-----------------|----------------|-----------------|--------|
| Normal to ridge   | 2880            | 1599.5          | 58876          | 80938           | OK     |
| Parallel to ridge | 1920            | 1066.4          | 39251          | 49481           | OK     |

§27.1.5 floors the **TOTAL** force on the vertical projection: 16 psf x wall area + 8 psf x roof area, applied simultaneously. A flat roof projects to nothing on a vertical plane, so its 8 psf term is zero.

The computed force uses external  $C_p$  only —  $GC_{pi}$  acts equally on the windward and leeward walls and cancels from the net horizontal force — and integrates  $q_z$  over the wall height.

## Fig. 27.3-1 Note 6 — Total Horizontal Shear

**Requirement** Fig. 27.3-1 Note 6: except for MWFRSs at the roof consisting of moment-resisting frames, the total horizontal shear shall not be less than that determined by neglecting wind forces on roof surfaces. This tool reports surface pressures and does not assemble the base shear, so this floor is the engineer's to apply when combining them.

## §27.3.5 / Fig. 27.3-8 — Design Wind Load Cases

| Case | Axes         | p <sub>Wx</sub> | p <sub>Lx</sub> | p <sub>Wy</sub> | p <sub>Ly</sub> | Mz <sub>x</sub> | Mz <sub>y</sub> | Mz gov. |
|------|--------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|---------|
| 1    | separate     | 23.59           | 16.6            | 23.59           | 14.27           | 0               | 0               | 0       |
| 2    | separate     | 17.69           | 12.45           | 17.69           | 10.7            | 65109.3         | 27258.5         | 65109.3 |
| 3    | simultaneous | 17.69           | 12.45           | 17.69           | 10.7            | 0               | 0               | 0       |
| 4    | simultaneous | 13.28           | 9.34            | 13.28           | 8.03            | 48875.4         | 20462.1         | 69337.5 |

$B_x = 120.0$  ft,  $B_y = 80.0$  ft;  $e = \pm 0.15B$  (rigid).  $M_z$  is per unit height, lb-ft/ft.

Case 2 considers each axis separately, so its governing  $M_z$  is the LARGER of the two; Case 4 applies both at once, so they add.

Fig. 27.3-8 Note 2: roof pressure for Cases 3 and 4 is 100% of the larger of the Case 1 / Case 2 roof pressures — the 0.75 and 0.563 factors apply to the WALLS only.

All four cases of Fig. 27.3-8 computed; the Appendix D exemption is not claimed.

## Provisions Applied — Basis

|                                             |                                                                                                                                                                                             |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mean roof height, h</b>                  | $h = (\text{eave } 24.00 + \text{ridge } 37.33) / 2 = 30.66$ ft (Sec. 26.2)                                                                                                                 |
| <b>§26.13.1 reduction, <math>R_i</math></b> | Sec. 26.13.1 $R_i$ does not apply to this enclosure classification.                                                                                                                         |
| <b>Fig. 27.3-1 footnote b</b>               | The $-1.3$ windward-roof value may be reduced with the area it acts over (1.0 at $\leq 100$ sf, 0.9 at 250, 0.8 at $\geq 1,000$ ). NOT taken; the $-1.3$ is used unreduced.                 |
| <b>§27.3.1.1 Elevated Buildings</b>         | Out of scope. A building raised on piles or columns must have its MWFRS loads assembled from §27.3.1.1.1 and §27.3.1.1.2 instead; this calculation treats the building as bearing on grade. |

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