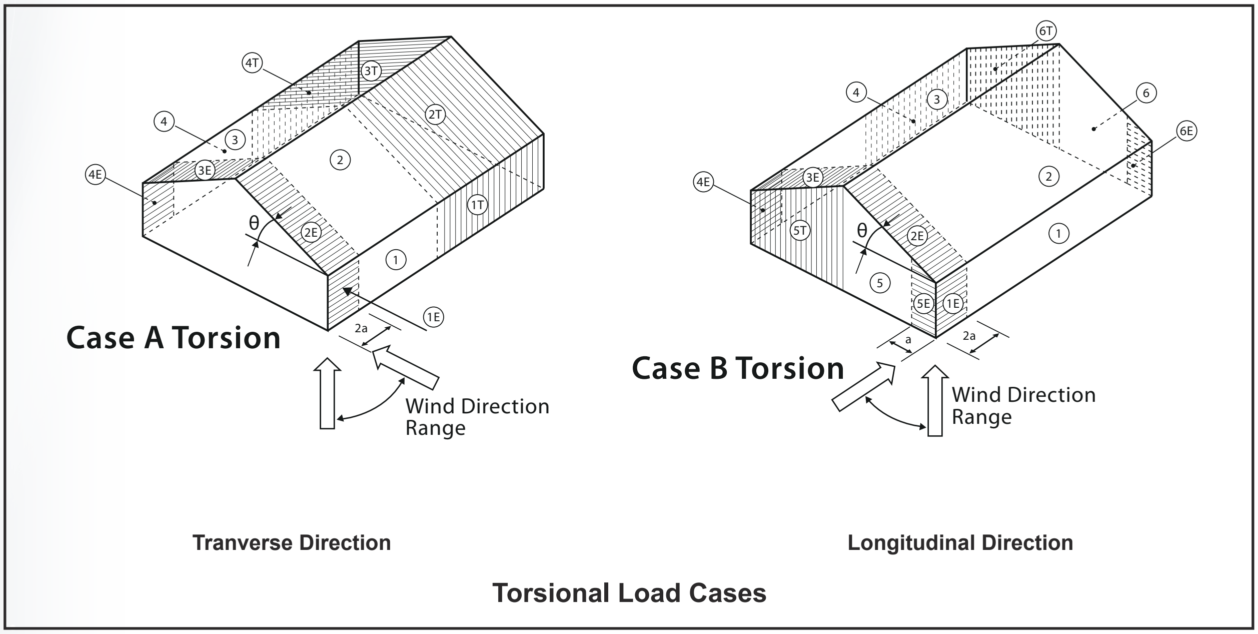
8. The roof pressure coefficient GC_{pf}, when negative in Zone 2 ~~or~~ and 2E, shall be applied in Zone 2/2E for a distance from the edge of roof equal to 0.5 times the horizontal dimension of the building parallel to the direction of the MWFRS being designed or 2.5 times the eave height at the windward wall, whichever is less; the remainder of Zone 2/2E extending to the ridge line shall use the pressure coefficient GC_{pf} for Zone 3/3E.
9. Notation:
   - *a*: 10 percent of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).
   - *h*: Mean roof height, in feet (meters), except that eave height shall be used for $\theta \leq 10°$.
   - θ: Angle of plane of roof from horizontal, in degrees.



Analysis and Commentary

Since the inclusion of this method in the 1995 edition of ASCE 7, there have been several attempts to clarify its application of the external pressure coefficients on a building. This method has been used in the metal building industry since the early 1980's. It is also the primary method by which single-family dwellings are designed for wind loads. The net pressure coefficients, GC_{pf}, applicable to this method represent "pseudo" loading conditions that, when applied to the building, envelope the desired structural actions (bending moment, shear, thrust) independent of the wind direction. Therefore, to capture all the appropriate structural actions, the building must be designed for all wind directions by considering each corner of the building as the windward corner.

In the 2002 edition of ASCE 7, the two figures previously represented by this method, were replaced with 8 figures with the goal to more accurately represent the rotation of the loading conditions required to envelope the MWFRS load effects. Additionally, the phrase "Direction of MWFRS Being Designed" was added to the figures to clarify how the end zones were to be applied relative to the direction of the framing. However, the existing bottom 4 sketches in combination with Note 7, was routinely misinterpreted. This misinterpretation resulted in loads for low slope roofs that were generally consistent with the original requirements, but failed to adequately reproduce the appropriate loads for higher sloped roofs at the ends of the roof and overestimated the loads for the middle portion of the roof.

The end zones are intended to be applied in the direction of the main framing. For a metal building this would be in direction of the moment frames or generally the transverse direction. For a light-framed simple diaphragm building that includes trusses and a wood structural panel roof deck, this would be in the direction of the roof trusses, or again, the transverse direction. While the footnotes were often misinterpreted, the end zones are not intended to be applied perpendicular to the main framing. Only when the main framing is spanning in the longitudinal direction would the end zones be applied in that direction. The revised bottom 4 figures are now identified as Load Case B with its own set of coefficients which removes the need to rely on the footnotes for this load case that has been misinterpreted.

This issue is critical particularly for determining roof-to-wall (rtw) loads for light-framed roofs such as trusses or rafters. For Load Case A where the wind direction is generally the transverse direction, or perpendicular to ridge, the net pressure coefficients decrease on the windward roof slope as the slope increases and ultimately become a positive or inward pressure coefficients as the roof slope exceeds approximately 25 degrees. This greatly reduces the rtw loads in this direction. For example, consider a building with a 30 degree roof slope. The applicable roof pressure coefficients are:

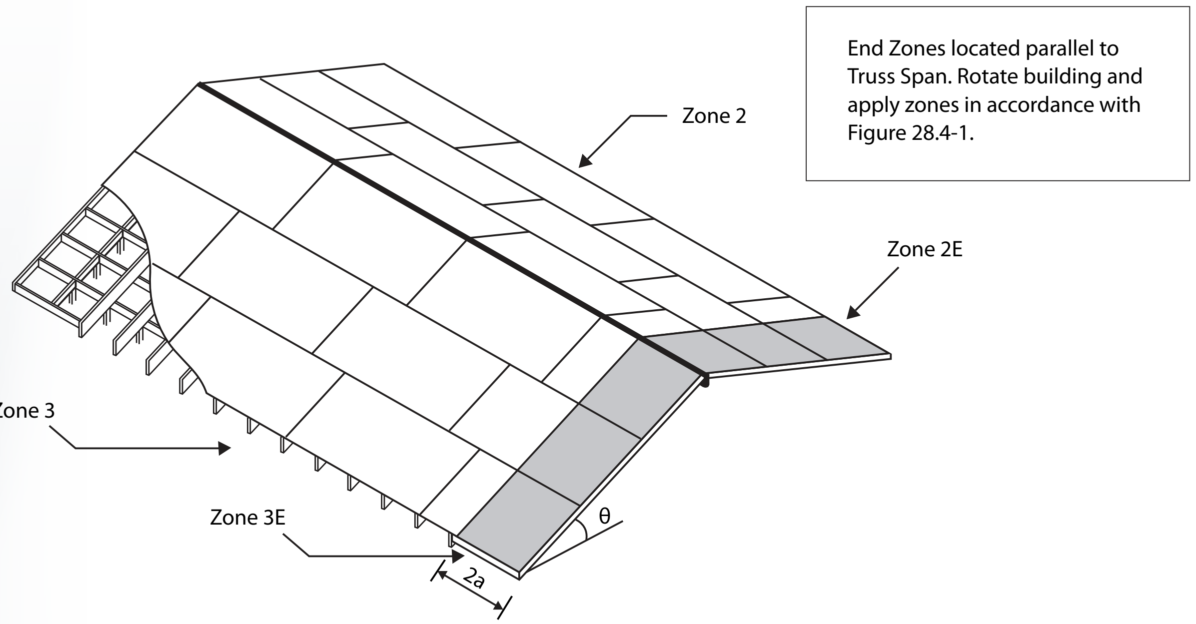
Load Case A:	Zone 2 = 0.21	(windward interior zone)
	Zone 3 = -0.43	(leeward interior zone)
	Zone 2E = 0.27	(windward end zone)
	Zone 3E = -0.53	(leeward end zone)

However, ASCE 7-10 now clarifies that Load Case B has to be considered which includes a single set of coefficients applicable for all roof slopes. The roof pressure coefficients for Load Case B are identical to those in Load Case A for a roof slope of 0-5 degrees.

Load Case B:	Zone 2 = -0.69	(windward interior zone)
	Zone 3 = -0.37	(leeward interior zone)
	Zone 2E = -1.07	(windward end zone)
	Zone 3E = -0.53	(leeward end zone)

Therefore, trusses located in the end zone or the dimension “2a”, would have to be designed using the coefficients for Zones 2E and 3E of Load Case B, and trusses located in the interior zones would have to be designed using the coefficients for Zones 2 and 3 of Load Case B.

A proper interpretation of ASCE 7-02 and ASCE 7-05 would be that the loads on the roof are not permitted to be less than those determined by applying the loads in the transverse direction and using the net pressure coefficients associated with assuming the roof slope to be 0 degrees.



Application of GC_{pf} to Light-Frame Trussed Roof Building

Part IV Simplified Methods for Determining Wind Loads (MWFRS)

26.2 Clarification

Definitions, Simple Diaphragm Building

At a Glance

The definition of a simple diaphragm building for use with the simplified procedures has been revised for clarity.

2010 Standard

26.2 ~~6.2~~ DEFINITIONS

BUILDING, SIMPLE DIAPHRAGM: A building in which both windward and leeward wind loads are transmitted by roof and vertically spanning wall assemblies, through continuous floor and roof diaphragms, to the ~~same vertical~~ MWFRS ~~(e.g., no structural separations)~~.

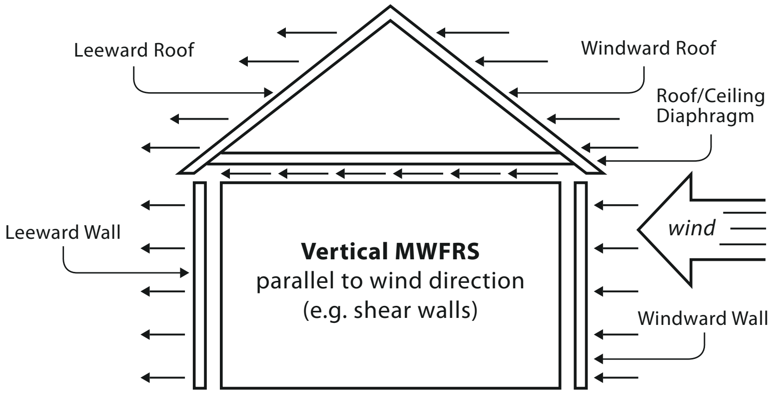
Analysis and Commentary

Since the introduction of a simplified method for simple diaphragm buildings in the 1998 edition of ASCE 7, there has often been confusion about which types of buildings qualify as "simple diaphragm buildings." It's an important determination for using the simplified procedures. The loads given in the simplified tables are the sum of the windward and leeward wall pressures and the sum of the horizontal components of the windward and leeward roof pressures. For simple diaphragm buildings, the roof and floor diaphragms collect the loads from the roof and vertically spanning walls that are normal to the direction of the wind. The roof and floor diaphragms then transfer these loads to the MWFRS that is parallel to the wind direction (such as shear walls). Since the loads essentially become a net horizontal wind force collected in the roof and floor diaphragms, the windward and leeward pressures can be summed to provide a single pressure for which to design the horizontal diaphragms and the MWFRS parallel to the wind direction.

The change to this definition, and the commentary as well, was due to a lack of clarity pertaining to the requirements for vertically spanning walls. The key clarification is that wind loads have to be transmitted from vertically spanning walls, meaning walls normal to the wind direction to the horizontal floor and roof diaphragms. The previous definition used the term "same vertical MWFRS", which could have implied that the horizontal diaphragms subsequently transmitted the loads back to the same vertically spanning walls. The new language makes it clear how the loads are to be transmitted so that the building truly qualifies as a simple diaphragm building.

The word continuous was added to clarify that the floor and roof diaphragms are not permitted to have structural separations such as expansion joints.

The following figure depicts a simplistic illustration of load transfer in a simple diaphragm building.



- Windward Roof and Wall, and Leeward Roof and Wall transmits loads to Roof/Ceiling Diaphragm
- Roof/Ceiling Diaphragm transmits loads to Vertical MWFRS parallel to wind direction

Simple Diaphragm Building

Good Examples

Houses with plywood shear walls
Typical CMU wall buildings
Concrete frames
Steel frames with vertically spanning walls and diaphragm floors and roofs

Bad Examples

Metal building frames with horizontally spanning girts
Unsymmetrical buildings
Any building with an expansion joint in the MWFRS

Figure 28.6-1 Modification

Enclosed Simple Diaphragm Low-Rise Buildings – Wind Loads – Main Wind-Force Resisting System

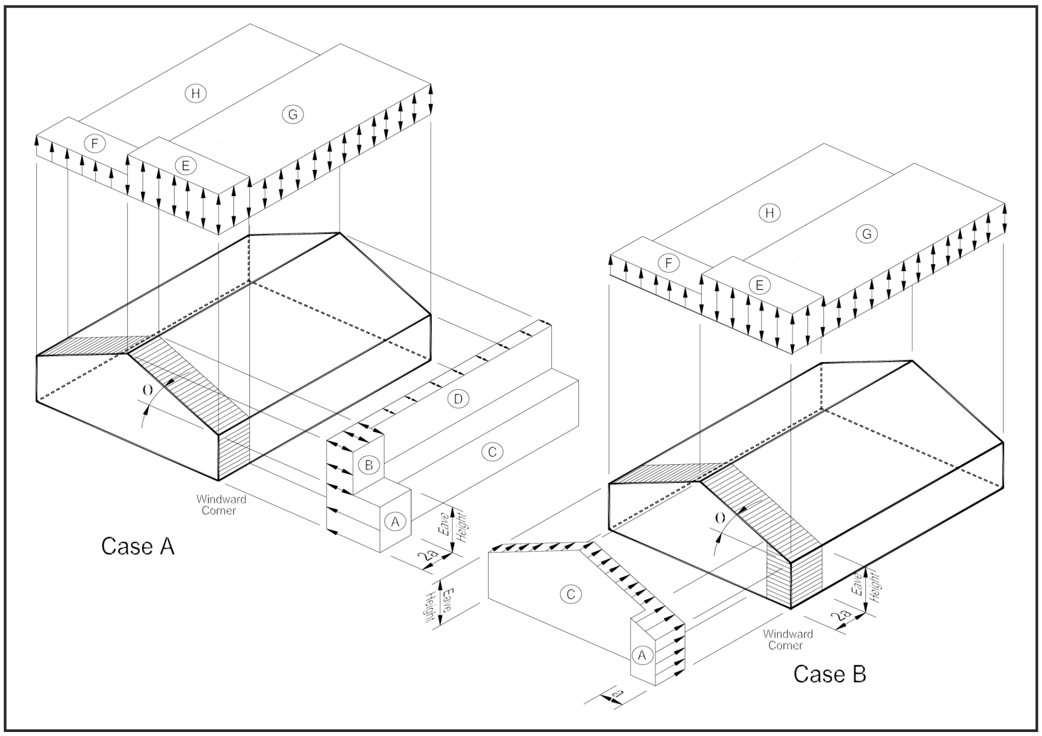
At a Glance

The application of the external pressures for the simplified method for simple diaphragm low-rise buildings has been revised for clarity and to reduce instances of misapplication of the pressure zones due to inappropriate interpretation of the footnotes.

2010 Standard

Replace Figure 6-2 with the following new Figure 28.6-1

Main Wind Force Resisting System ~~– Method 1~~		*$h \leq 60$ ft.*
Figure 28.6-1 ~~6-2~~	Design Wind Pressures	Walls & Roofs
Enclosed Buildings		



Notes:

1. Pressures shown are applied to the horizontal and vertical projections, for exposure B, at h=30 ft (9.1m)~~, I=1.0 and K_{zt}=1.0~~. Adjust to other exposures and heights ~~conditions~~ using Equation 28.6-1 ~~6-1~~.
2. The load patterns shown shall be applied to each corner of the building in turn as the reference corner. (See Figure 28.4-1)
3. For Case B ~~the design of the longitudinal MWFRS~~ use θ = 0° ~~and locate the zone E/F, G/H boundary at the mid-length of the building~~.

4. Load cases 1 and 2 must be checked for $25° < \theta \leq 45°$. Load case 2 at 25° is provided only for interpolation between 25° and 30°.
5. Plus and minus signs signify pressures acting toward and away from the projected surfaces, respectively.
6. For roof slopes other than those shown, linear interpolation is permitted.
7. The total horizontal load shall not be less than that determined by assuming $p_S = 0$ in zones B & D.

~~8. The zone pressures represent the following:~~

~~Horizontal pressure zones – Sum of the windward and leeward net (sum of internal and external pressures on vertical projection of:~~

~~A - End zone of wall~~	~~C - Interior zone of wall~~
~~B - End zone of roof~~	~~D - Interior zone of roof~~

~~Vertical pressure zones – Net (sum of internal and external) pressures on horizontal projection of:~~

~~E - End zone of windward roof~~	~~G - Interior zone of windward roof~~
~~F - End zone of leeward roof~~	~~H - Interior zone of leeward roof~~

8~~9~~. Where zone E or G falls on a roof overhang on the windward side of the building, use E_{OH} and G_{OH} for the pressure on the horizontal projection of the overhang. Overhangs on the leeward and side edges shall have the basic zone pressure applied.

9~~10~~. Notation:

a: 10 percent of least horizontal dimension or 0.4h, whichever is smaller, but not less than either 4% of least horizontal dimension or 3 ft (0.9 m).

h: Mean roof height, in feet (meters), except that eave height shall be used for roof angles <10°.

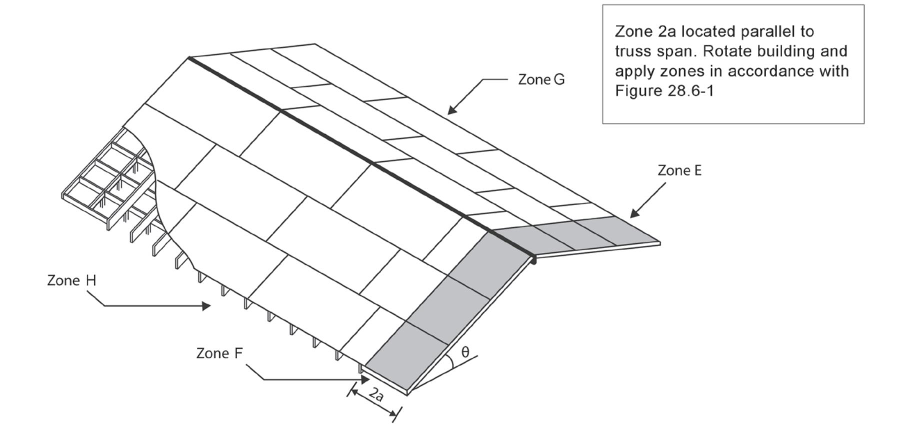
θ: Angle of plane of roof from horizontal, in degrees.

Analysis and Commentary

Since the inclusion of this simplified method in the 2002 edition of ASCE 7, there have been attempts to clarify the proper application of the external pressures on a building when this simplified approach was used. It is based on the Envelope Procedure contained in Section 28.4 that has been used in the metal building industry since the early 1980's. The net pressure coefficients, GC_{pf}, applicable to this method represent "pseudo" loading conditions that, when applied to the building, envelope the desired structural actions (bending moment, shear, thrust) independent of the wind direction. Therefore, to capture all the appropriate structural actions, the building must be designed for all wind directions by considering each corner of the building as the windward corner.

In the 2002 edition of ASCE 7, the two figures previously represented by Figure 28.4-1 (the basis for this simplified method, were replaced with 8 figures with the goal to more accurately represent the rotation of the loading conditions required to envelope the MWFRS load effects. Additionally, the phrase "Direction of MWFRS Being Designed" was added to the figures to clarify how the end zones were to be applied relative to the direction of the framing. However, the existing bottom 4 sketches in combination with Note 7 were routinely misinterpreted. This misinterpretation resulted in loads for low slope roofs that were generally consistent with the original requirements, but failed to adequately reproduce the appropriate loads for higher sloped roofs at the ends of the roof and overestimated the loads for the middle portion of the roof.

The end zones (Zone 2a) are intended to be applied in the direction of the main framing. For a metal building this would be in the direction of the moment frames or generally the transverse direction. For a light-framed simple diaphragm building that includes trusses and a wood structural panel roof deck, this would be in the direction of the roof trusses, or again, the transverse direction. While the footnotes were often misinterpreted, the end zones are not intended to be applied perpendicular to the main framing as was often misinterpreted by Figure 6-2 in ASCE 7-05. Only when the main framing is spanning in the longitudinal direction would the end zones be applied in that direction. The revised longitudinal direction is now identified as Case B and pressures are selected from the table by assuming a roof slope of 0 degrees, as specified by Note 3.



Application of Pressure Zones to Light-Framed Trussed Roof Building

This issue is critical particularly for determining roof-to-wall (RTW) loads for light-framed roofs such as trusses or rafters. For Case A where the wind direction is generally the transverse direction, or perpendicular to ridge, the net pressures decrease on the windward roof slope as the slope increases and ultimately become positive or inward pressure coefficients as the roof slope exceeds approximately 25 degrees. This greatly reduces the RTW loads in this direction. For example, consider a building with a 30 degree roof slope and wind speed of 120 mph. The applicable vertical roof pressures are:

Case A:	Zone E = 2.2 psf	(windward end zone)
	Zone G = 0.7 psf	(windward interior zone)
	Zone F = -15.6 psf	(leeward end zone)
	Zone H = -13.4 psf	(leeward interior zone)

However, ASCE 7-10 now clarifies that Case B has to be considered setting θ = 0°. The applicable vertical roof pressures:

Case B:	Zone E = -27.4 psf	(windward end zone)
	Zone G = -19.1 psf	(windward interior zone)
	Zone F = -15.6 psf	(leeward end zone)
	Zone H = -12.1 psf	(leeward interior zone)

For this situation, Case B provides the most severe loading condition for roof uplift. Therefore, trusses located in the end zone or the dimension "2a", would have to be designed using the pressures for Zones E and F of Case B, and trusses located in the interior zones would have to be designed using the coefficients for Zones G and H of Case B.

Sections 27.5, 27.6 Addition

Enclosed Simple Diaphragm Buildings with $h \leq 160$ ft (48.8 m)

At a Glance

A new simplified method for enclosed simple diaphragm buildings with mean roof heights up to 160 ft has been added.

2010 Standard

(Note: Only portions of the method are shown for brevity.)

PART 2: ENCLOSED SIMPLE DIAPHRAGM BUILDINGS WITH $h \leq 160$ ft (48.8 m)

27.5 GENERAL REQUIREMENTS

27.5.1 Design Procedure.

The procedure specified herein applies to the determination of MWFRS wind loads of enclosed simple diaphragm buildings, as defined in Section 26.2, with a mean roof height $h \leq 160$ ft (48.8 m). The steps required for the determination of MWFRS wind loads on enclosed simple diaphragm buildings are shown in Table 27.5-1

27.5.2 Conditions.

In addition to the requirements in Section 27.1.2, a building whose design wind loads are determined in accordance with this section shall meet all of the following conditions for either a Class 1 or Class 2 building (see Fig. 27.5-1):

Class 1 Buildings:

1. The building shall be an enclosed simple diaphragm building as defined in Section 26.2.
2. The building shall have a mean roof height $h \leq 60$ ft (18.3 m).
3. The ratio of L/B shall not be less than 0.2 nor more than 5.0 ($0.2 \leq L/B \leq 5.0$).
4. The topographic effect factor $K_{zt} = 1.0$ or the wind pressures determined from this section shall be multiplied by K_{zt} at each height z as determined from Section 26.8. It shall be permitted to use one value of K_{zt} for the building calculated at $0.33h$. Alternatively it shall be permitted to enter the pressure table with a wind velocity equal to V $\sqrt{K_{zt}}$ where K_{zt} is determined at a height of $0.33h$.

Class 2 Buildings:

1. The building shall be an enclosed simple diaphragm building as defined in Section 26.2.
2. The building shall have a mean roof height 60 ft $< h \leq 160$ ft (18.3 m $< h \leq 48.8$ m).
3. The ratio of L/B shall not be less than 0.5 nor more than 2.0 ($0.5 \leq L/B \leq 2.0$).
4. The fundamental natural frequency (hertz) of the building shall not be less $75/h$ where h is in feet.
5. The topographic effect factor $K_{zt} = 1.0$ or the wind pressures determined from this section shall be multiplied by K_{zt} at each height z as determined from Section 26.8. It shall be permitted to use one value of K_{zt} for the building calculated at $0.33h$. Alternatively it shall be permitted to enter the pressure table with a wind velocity equal to $V\sqrt{K_{zt}}$ where K_{zt} is determined at a height of $0.33h$.

27.5.3 Wind Load Parameters Specified in Chapter 26.

Refer to Chapter 26 for determination of Basic Wind Speed V (Section 26.5) and exposure category (Section 26.7) and topographic factor K_{zt} (Section 26.8).

27.5.4 Diaphragm Flexibility.

The design procedure specified herein applies to buildings having either rigid or flexible diaphragms. The structural analysis shall consider the relative stiffness of diaphragms and the vertical elements of the MWFRS.

Diaphragms constructed of wood panels can be idealized as flexible. Diaphragms constructed of untopped metal decks, concrete filled metal decks, and concrete slabs, each having a span-to-depth ratio of 2 or less, are permitted to be idealized as rigid for consideration of wind loading.

27.6 WIND LOADS—MAIN WIND FORCE-RESISTING SYSTEM

27.6.1 Wall and Roof Surfaces—Class 1 and 2 Buildings. Net wind pressures for the walls and roof surfaces shall be determined from Tables 27.6-1 and 27.6-2, respectively, for the applicable exposure category as determined by Section 26.7.

For Class 1 buildings with L/B values less than 0.5, use wind pressures tabulated for $L/B = 0.5$. For Class 1 buildings with L/B values greater than 2.0, use wind pressures tabulated for $L/B = 2.0$.

Net wall pressures shall be applied to the projected area of the building walls in the direction of the wind, and exterior side wall pressures shall be applied to the projected area of the building walls normal to the direction of the wind acting outward according to Note 3 of Table 27.6-1, simultaneously with the roof pressures from Table 27.6-2 as shown in Fig. 27.6-1.

Where two load cases are shown in the table of roof pressures, the effects of each load case shall be investigated separately. The MWFRS in each direction shall be designed for the wind load cases as defined in Fig. 27.4-8.

EXCEPTION: The torsional load cases in Fig. 27.4-8 (Case 2 and Case 4) need not be considered for buildings which meet the requirements of Appendix D.

27.6.2 Parapets.

The effect of horizontal wind loads applied to all vertical surfaces of roof parapets for the design of the MWFRS shall be based on the application of an additional net horizontal wind pressure applied to the projected area of the parapet surface equal to 2.25 times the wall pressures tabulated in Table 27.6-1 for $L/B = 1.0$. The net pressure specified accounts for both the windward and leeward parapet loading on both the windward and leeward building surface. The parapet pressure shall be applied simultaneously with the specified wall and roof pressures shown in the table as shown in Fig. 27.6-2. The height h used to enter Table 27.6-1 to determine the parapet pressure shall be the height to the top of the parapet as shown in Fig. 27.6-2 (use $h = h_p$).

27.6.3 Roof Overhangs.

The effect of vertical wind loads on any roof overhangs shall be based on the application of a positive wind pressure on the underside of the windward overhang equal to 75% of the roof edge pressure from Table 27.6-2 for Zone 1 or Zone 3 as applicable. This pressure shall be applied to the windward roof overhang only and shall be applied simultaneously with other tabulated wall and roof pressures as shown in Fig. 27.6-3.