Understanding how design wind uplift pressure is calculated will provide the background necessary to understand the changes made in ASCE 7-22. The equation for design wind uplift pressure in pounds per square foot is p = qhKd[(GCP)– (GCPI)] where velocity pressure qh = 0.00256KzKztKeV2, leaving p = 0.00256KzKztKeV2\*Kd[(GCP)– (GCPI)].

This calculation may appear confusing at first glance, but it all boils down to a dynamic pressure calculation. Dynamic pressure, different from atmospheric pressure, is the additional pressure resulting from the air moving rather than sitting still and is proportional to its kinetic energy per unit volume. Kinetic energy of moving air is easy to figure out using the mass per volume of air (density) and velocity (wind speed). Dynamic pressure = ½ρV2 where ρ is the density of air at normal temperature (59 F) and pressure (1 atmosphere) and V is the wind speed. The density air can be obtained by taking the weight per volume of air (specific weight, γ) and dividing by gravity, g.

For example, ρ = γ / g where γ = 0.00765 lbs / ft3 and g = 32.17 ft / s2 results in ρ = .0023769 lbs \* s2­­ / ft4.

Lastly, so wind speed can be applied in miles per hour, the relationship V2 (ft/s) = 2.15 \* V2 (mph) is included, leaving:

dynamic pressure = ½ρV2 = (½)\*(0.0023769)\*(2.15)V2 = 0.00256V2.

To look at this equation rearranged a little, design wind uplift pressure p = 0.00256V2KzKztKe\*Kd[(GCP)– (GCPI)].

Design wind uplift pressure basically is dynamic pressure multiplied by many factors and coefficients. These factors and coefficients increase or decrease the design wind uplift pressure value to account for a building’s unique characteristics such as shape, size, location, elevation, wind direction, surrounding landscape, enclosure classification and zone within the roof.

The following explains each coefficient:

Kz is the velocity pressure coefficient. Kz values, which range from 0.7 to 1.89 depending on building height and exposure category, can be found in Table 26.10-1-Velocity Pressure Exposure Coefficients, Kh and Kz. Exposure category B, C or D is determined from the information in Section 26.7—Exposure and depends on the relative flatness of the surrounding area.

Kzt is the topographical factor. It is used when a building is in an area where wind speed-up effects occur from isolated hills, ridges and escarpments constituting abrupt changes in the general topography. Section 26.8—Topographical Effects and Figure 26.8-1-Topographical factor, Kzt go into detail regarding when Kzt should be considered and provide tables and equations for its calculation.

Ke­ is the ground elevation factor and reduces the effect of wind as air gets thinner higher above sea level. Values for Ke can be found in Table 26.9-1-Ground Elevation Factor, Ke.

Kd is the wind directionality factor. How wind affects a building depends on the building’s shape and the direction from which the wind comes. Values for Kd can be found in Table 26.6-1-Wind directionality factor, Kd. Kd is equal to 0.85 in most situations.

GCP is the external pressure coefficient. It is calculated from Figures 30.3-2 to 30.3-8 depending on the building configuration, slope, height, roof zone and effective wind area. Effective wind area is the span length multiplied by an effective width as small as one-third the span length. For cladding fasteners, the effective wind area should not be greater than the area that is tributary to an individual fastener. Often, 10 ft2 is chosen and is the most conservative value.

GCPI is the internal pressure coefficient and is determined from Table 26.13-1-Main Wind Force Resisting System and Components and Cladding (All Heights): Internal Pressure Coefficient, (GCpi), for Enclosed, Partially Open, and Open Buildings (Walls and Roof) based on the enclosure classification of the building. Enclosure classification also is defined in Table 26.13-1.

Basic wind speed V is determined from the maps provided in Section 26.5—Wind Hazard Map. There are four maps to be consulted depending on the risk category of the building. Risk category is determined from the information provided in Table 1.5-1-Risk Category of Buildings and Other Structures for Flood, Wind, Tornado, Snow, Earthquake, and Ice Loads with I being the lowest and IV being the highest depending on risk to human life and community.