Comparing wind speeds and uplift pressures

Wind speeds shouldn't be confused with uplift pressures

by Mark S. Graham

A FREQUENT QUESTION posed to NRCA's Technical Services Section is whether the numeric values in low-slope roof systems' uplift-resistance classifications (such as I-90, Class 60) represent buildings' design wind speeds. If you believe they do or are unclear about how the values relate to one another, continue reading.

Uplift pressures

Design wind-uplift pressures on roof systems are determined based on a number of considerations, including a specific building's mean roof height and basic wind speed. The fundamental equation for determining the design wind pressure in the field of a low-slope roof area is $q_h = 0.00256 (K_h)(K_{zt})(K_d)(V^2)(I)$.

The variable q_h represents the calculated design velocity (uplift) pressure at a specific height above grade, which is designated in pounds per square foot (psf). V is the basic wind speed designated in miles per hour. K_h is a velocity pressure coefficient; K_{zt} is a topographic factor; K_d is a wind directionality factor; and I is an importance factor.

The value for the basic wind speed typically is taken from a basic wind speed map, such as Figure 6-1 in ASCE 7, "Minimum Design Loads for Buildings and Other Structures," or the *International Building Code*'s (IBC's) Figure 1609. These basic wind speed maps are based on three-second peak wind gusts measured at 30 feet above ground with 50-year mean recurrence. For the U.S. and its territories, basic wind speed values range from 85 mph on the West Coast to 170 mph for Guam. A 90-mph basic wind speed applies to a majority of the U.S.

As can be seen from the fundamental equation, design uplift pressures increase by the square of the basic wind speed. The variable V is by far the largest numeric variable in the calculation, indicating the basic wind speed is the largest determining factor of a low-slope roof area's design wind pressure. Values for K_h range from 0.70 to 1.89; values for K_{zt} range from 1.37 to 2.96; values for K_d range from 0.85 to 0.90; and values for I range from 0.77 to 1.15. Compared with the basic wind speed value, they have a relatively minimal effect on the resultant design uplift pressure.

Resistance classifications

Low-slope roof systems' uplift- (wind-) resistance classifications generally are based on testing performed according to FM Approvals or Underwriters Laboratories (UL) Inc. guidelines.

Using FM Approvals' approval classification designations, the numeric values represent the tested design uplift resistances for field roof areas taking into account a safety factor of 2.0 or more. For example, an FM I-90 classification designates a tested design uplift resistance of 45 psf.

In UL's classification designations, the numeric values represent the tested uplift resistances for the field of area without a safety factor. For example, UL Class 60 designates a tested uplift resistance of 60 psf.

Still confused?

The numeric values in roof systems' uplift-resistance classifications designate tested uplift-resistance values measured in psf, not design wind speeds.

The design wind speed or basic wind speed is a variable in the calculation of the design uplift pressure. It is important to remember FM Approvals' classifications include a safety factor and UL's classifications do not.

Design uplift pressures for roof systems for many building types and the necessary safety factor can be determined using NRCA's online Roof Wind Designer application, which is available at www.roofwinddesigner.com. Roof Wind Designer is based on ASCE 7-05's Method I—Simplified Procedure, which is recognized in IBC's 2006 and 2009 editions as an appropriate means for determining design uplift pressures on low-slope roof systems.

To view the basic wind speed map of the U.S. and for links to additional articles regarding proper wind design of low-slope roof systems, log on to www.professionalroofing.net.

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