Determining Wind Loads On Buildings – what's the big deal?

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If you've ever picked up a building code or design standard intent on determining the wind design pressure for a building and found yourself in an extreme state of confusion; relax, your not alone. You may however, be wondering why it has to be so complicated.

In it's simplest form; the process involves converting wind speed to wind pressure. Sounds easy enough. Wind is air with mass traveling at a given velocity. Convert it to pressure – right? So what's the big deal? Why do these wind engineers have to make it so complicated? It's been suggested that they make it complicated so that only an engineer can do it.

Look; all they have to do is establish a design wind speed for every possible terrain, in every geographical location, for every possible type and use of building, in every possible setting. Then, establish what pressures the wind will impose at any location on every surface of every possible size, shape and configuration of building for all possible wind directions. Next they need to take the extreme variations in pressures that exist on the building surfaces at any instant in time and give us a nice uniform pressure to work with. Simple, right!

Ok, I'm trying to make a point. Whether you're amused or not, the fact is that the effects of wind on buildings is an extremely complex phenomenon. Research engineers have long strived to reduce these complexities to a practical set of equations and coefficients that can be used in practice to safely design buildings for wind. So, what are these complexities and how do the design provisions deal with them? Before we go on, let's first dispel a few myths.

- The wind design criteria is not something imagined or conjured up from some ivory tower theory, it is derived from a huge database of actual wind pressure measurements.
- Wind speed is not constant and surface pressures are not uniform.
- Negative pressure really does exist.
- Internal pressure really does exist.
- All codes are not created equal.

Codes and Standards

There are four major model codes used in the US. The *BOCA National Building Code*, the *Standard Building Code,* the *Uniform Building Code* and the new *International Building Code.* Each of these codes publish wind load design provisions. In addition, they each recognize Chapter 6 of ASCE 7 *Minimum Design Loads For Buildings And Other Structures* for wind design loads. ASCE 7 in one of its many versions is the foundation of all the wind load provisions used in the US. The most significant change in wind load provisions used today occurred with ASCE 7-95 when the use of 3-second gust speed replaced fastest-mile speeds for the basic wind velocity used in design. Basically what this means is that wind speeds are recorded differently then they have been in the past. The wind load provisions in the current major model codes, except the new International Building Code, are all still based on fastest-mile wind speeds. Since the building codes also recognize ASCE 7 by reference, it essentially gives you two options for determining the design pressures. In addition, some codes and ASCE 7-98 now provide a simplified method that, depending on your building, may provide a third method. This can of course be controlled by a well-written project specification that dictates which criteria to use. Even more ideal would be a project that specifies the design pressures. Sure would level the playing field for the bidding, wouldn't it?

Wind Velocity

Ok, so either by choice or by directive, you've determined which criteria you're going to use. Now you have to select the basic wind velocity. That's easy. Find your project location on the wind speed map and hope that it doesn't fall in one of those *special regions* where "anomalies in wind-speed values exist". Also, be careful, your competitor may interpolate between the wind speed contours and use a lower velocity than you. That's allowed you know.

This article is the first in a series of 2. The second portion will run in the next issue. The second portion will run in the next issue. The next issue will look at the factors of Exposure Classification, Building Importance, Variation in Surface Pressures, Negative Pressure, Internal Pressure and Design Pressure.

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