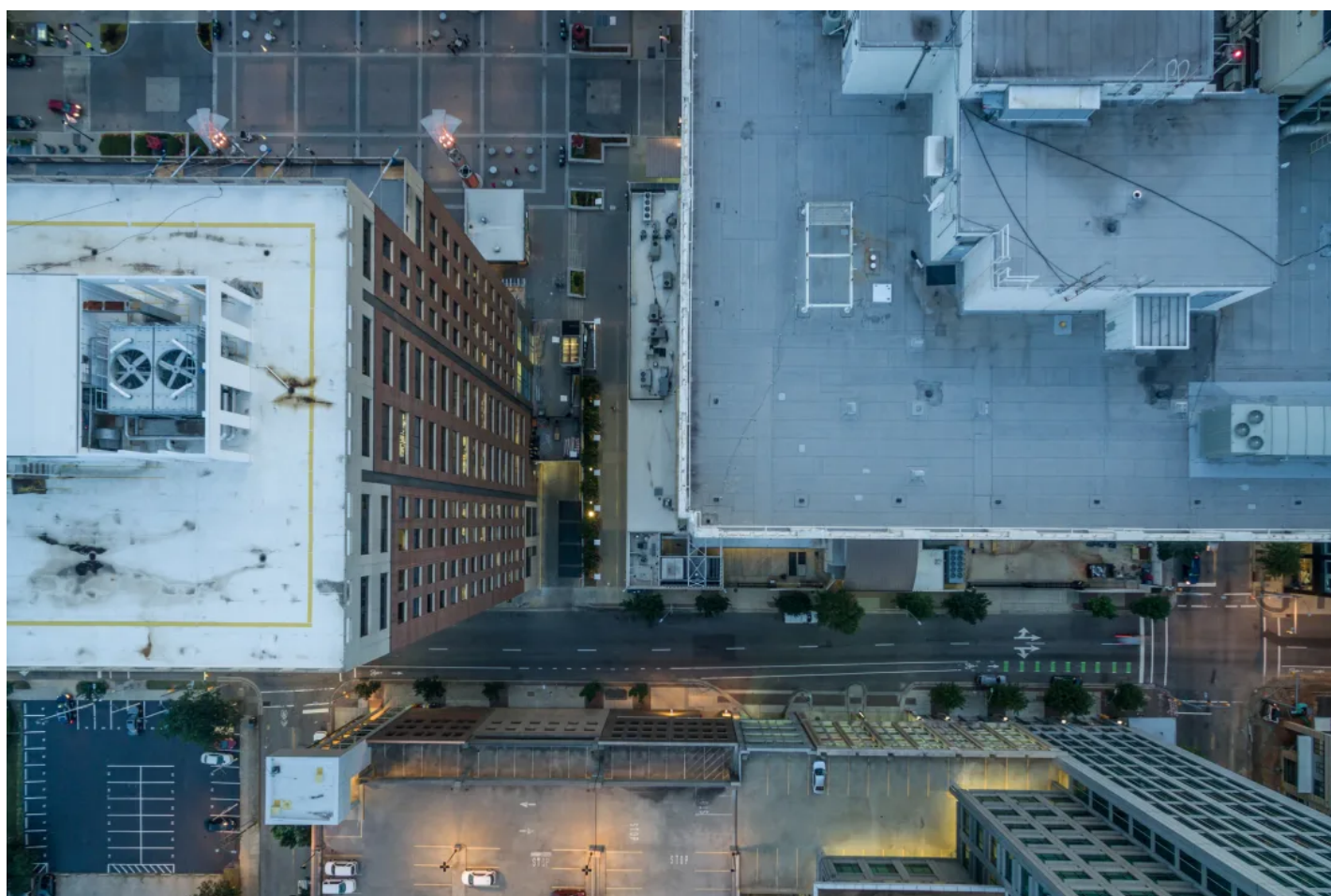


Wind design of roof systems

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WIND DESIGN OF ROOF SYSTEMS CAN BE CHALLENGING, BUT BREAKING DOWN THE STEPS CAN MAKE IT MORE MANAGEABLE.

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Wind design of roof systems is one of the more challenging things that an architect deals with during the design of a building. Conceptually, the goal is to determine design wind pressures, then select a roof system with a tested resistance greater than the design wind loads. While it certainly can be complicated, there are ways to break down the steps of wind design in order to make it much more manageable.

But first...building code requirements

The 2018 International Building Code (IBC) states, in Section 1603.1.4, "Wind design data," that the following is to be included on construction documents:

"1603.1.4 Wind design data. The following information related to wind loads shall be shown...

1. Basic design wind speed, V mph...
2. Risk category
3. Wind exposure...
4. Applicable internal pressure coefficient
5. Design wind pressures..."

Simply put, the architect's responsibility is to provide design wind pressures, and it is the manufacturer's responsibility to determine wind uplift capacity.

Determining design wind pressures

A roof system must be able to resist the design wind pressures acting on the roof. Before selecting a roof system, you need to determine the loads acting on the roof of the specific building. First, calculate the velocity pressure for that building, then convert it to design wind pressures for each roof zone.

The architect/designer needs to know the following: location; the building code that is in effect for that location; height, length, and width; Exposure Category; use and occupancy; enclosure classification; and topographic effects.

Location: The location directs us to the specific version of the IBC or the applicable building code that is in effect for the project, which, in turn, references the applicable version of "ASCE 7 Minimum Design

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Exposure Category: Exposure Category is based on the roughness of a building's nearby terrain. ASCE 7-16 uses three Exposure Category types, B, C, and D. Using Exposure Category B results in the lowest pressures; Category C is higher; and Category D results in the highest pressures.

Use and occupancy: The use and occupancy of a building is used to determine the Risk Category in ASCE 7-16. Each of the Risk Categories is incorporated into a wind-speed map. There are four wind-speed maps in ASCE 7-16, one for each of the four Risk Categories.

Exposure classification: This relates to the possibility that a building will become internally pressurized during a wind event. ASCE 7-16 includes four building classification types: Open, Partially Open, Partially Enclosed, and Enclosed. Using Partially Enclosed (assuming that internal pressurization will occur) versus Enclosed or Partially Open results in a significant increase in the design wind pressures. Selecting an Enclosed or a Partially Open building could result in a roof system without the capacity to handle higher design wind pressures if doors and windows are blown out during a high-wind event.

Topographic effects: Wind speeds can increase significantly due to topographic effects. This increase is known as a wind speed-up effect. ASCE 7-16 addresses speed-up effects by applying a multiplier in the velocity pressure calculations.

These selections may seem straightforward, but some impart a higher resultant velocity pressure and, subsequently, higher design wind pressures. (For more in-depth information about determining wind loads, [read this article](#).)

Roof zones

The next step is to calculate the design wind pressures specific to the interior, field, perimeter, and corner zones. Multiplying the velocity pressure by the external pressure coefficients that are specific to each roof zone results in specific design wind pressures for each roof zone. Providing design wind pressures for each roof zone on the construction documents helps ensure installation of an appropriate roof system with tested capacity.

Determining wind uplift resistance

The primary method for determining a roof system's wind uplift resistance is through physical testing.

Wind uplift tests are run by approved testing agencies, such as [FM Approvals](#), [Underwriters Laboratory](#), [Intertek](#), [NEMO](#), and [PRI](#). Tested roof systems are found in approval listings, which are

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specified roof system. Understanding how the nuances and the importance of each of the selections influence the wind capacity is important to the long-term performance of roof systems.

For more information and key resources, [see the GAF Roofing and Building Science full publication](#). And for more information about Resilient Roof Systems, [check out this article](#).

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