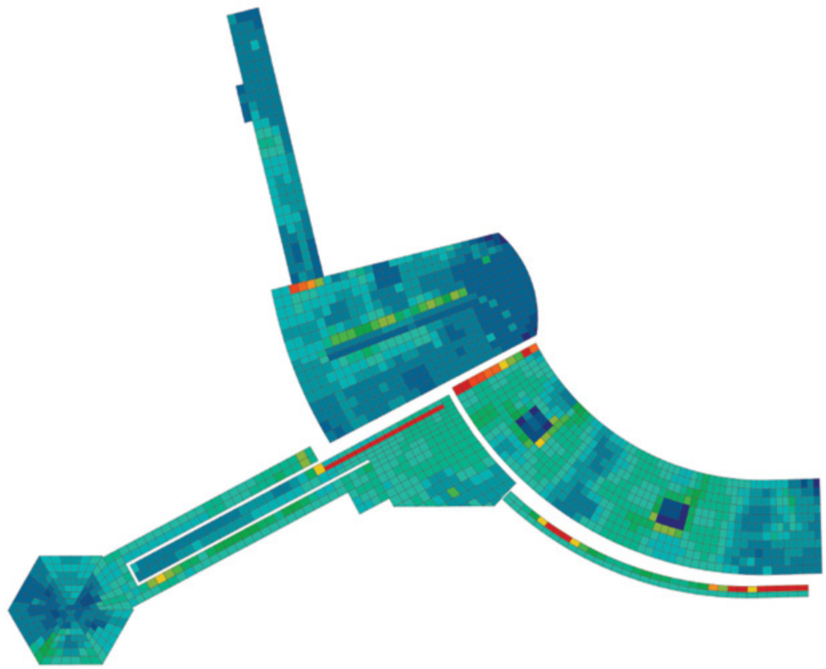
SNOW LOADING

Quantifying wind, climate and thermodynamic factors to address the effects of accumulated snow

In colder regions, the expected weight of accumulated snow can be the governing load for design. Even if this snow loading does not govern, it is often a major component in the strength design of a structure. Getting the loading right at the design stage can save a lot of money in structural materials. More importantly, it ensures the structure is safe.



Local building codes and standards give guidance for snow loads. However, these codes are based on historical observations of snow on the ground surface and existing roofs. A building with amore intricate or larger shape or with improved thermal performance requires new interpretations. In addition, codes can't address the complex, combined effects of wind and other climate factors.

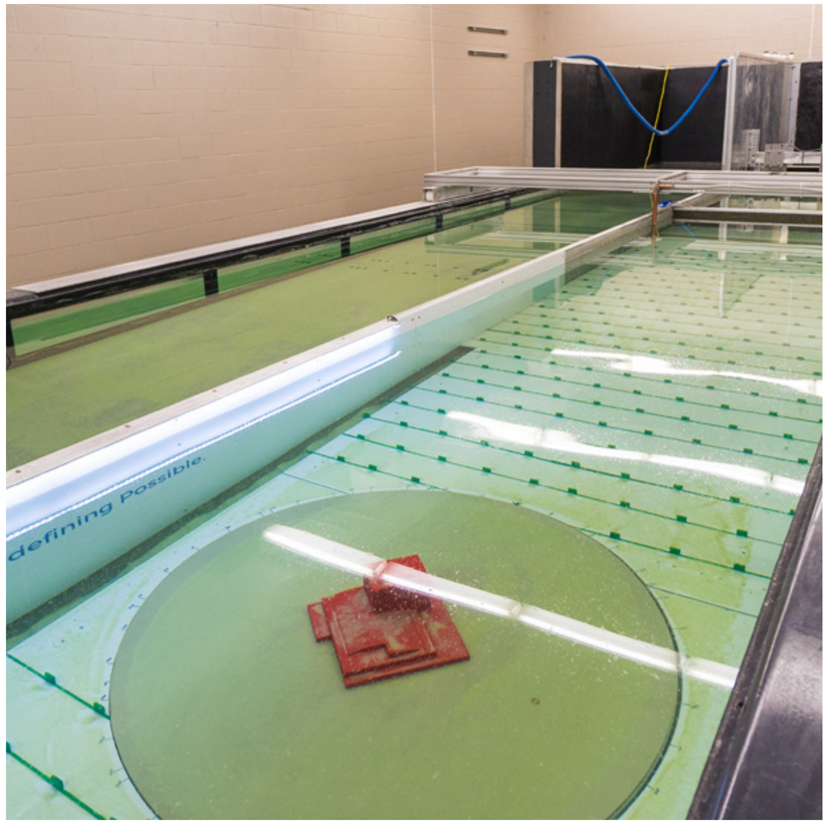
Our Service

We provide fine-tuned snow loading patterns for design of buildings and structures. Our analysis takes into account the specifics of the local climate, surroundings, building shape and construction. This approach provides design snow loads that are "better than code." We have two goals: to reduce costs and to reduce the risk of surprises after construction.

In this analysis, we apply decades of experience and research expertise. We've seen all the common issues—and plenty of uncommon ones—and how they've been solved. We excel at interpreting climate data for very specific places and times. We're also recognized worldwide as experts in the aerodynamics and thermodynamics involved in snow accumulation, especially for complex structures.

We apply this deep technical understanding to interpret results from our sophisticated analysis tools. Our benchmark scale modeling techniques are critical to understanding unique architectural shapes.

Talented in-house model builders construct a scale model of the structure, which is placed in a water flume. We introduce particles into a "wind flow" (simulated by water) and observe how they settle and drift on and around the roofs of the model.



We look in equivalent detail at climate conditions specific to the site. Drawing on extensive meteorological data and computing resources, we use our custom statistical methods to develop an hour-by-hour analysis of weather data.

Finally, we apply our custom analysis methodology to assess the relative loads associated with particular design features. With this method, we quantify snow loads over a specified return period, much as we would state risks of wind loading on structures or cladding. In developing this risk analysis, we may use wind tunnel studies to learn where wind-driven accumulation will occur.

Through these analyses, we go beyond typical codes to produce design-ready loads that are easy to implement.

RWDI is a valuable partner to clients seeking to...

Explore Innovations

- Build unique architectural shapes with confidence in their safety and operation

Create Opportunities

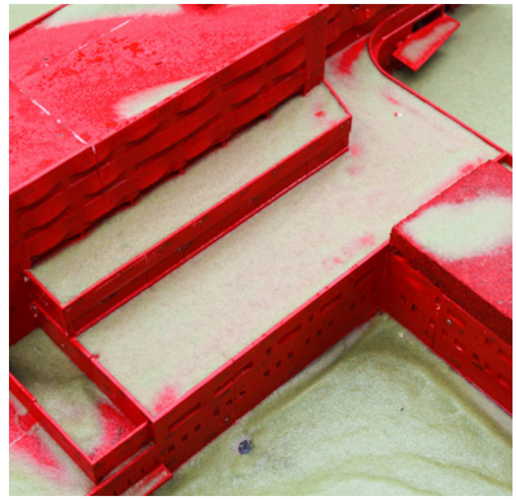
- Improve designs through expert interpretation of building codes, whether for simple or complex matters
- Optimize designs to site-specific conditions for reduced cost and improved operations

Meet Challenges

- Anticipate and accommodate issues from site-specific or design-specific conditions

Fulfill Expectations

- Satisfy code requirements with scientifically defensible interpretations, especially for complex structures



How we work

We investigate and disentangle the many factors that determine design values for snow loading, especially for complex structures and conditions.

Complex Contributing Factors

The worst snow load distribution on a given roof in a particular winter often occurs near the end of the winter, as the spring melt begins and a large accumulation of snow receives rain. This annual worst-case distribution is generally the culmination of many interrelated factors:

- A sequence of snowfall, rainfall, wind (at a wide range of speeds and from many directions), freezing, thawing, and sunshine
- Roof geometry
- Heat loss from inside the building
- Shading from the building itself and adjacent structures
- Drifting sources
- Wind-sheltered regions.

As a result, codes have generally succeeded in ensuring safe building designs for most straightforward situations. However, as structures become larger and more architecturally diverse, the simple provisions of codes become less suitable for addressing the complexities involved.

Beyond Codes

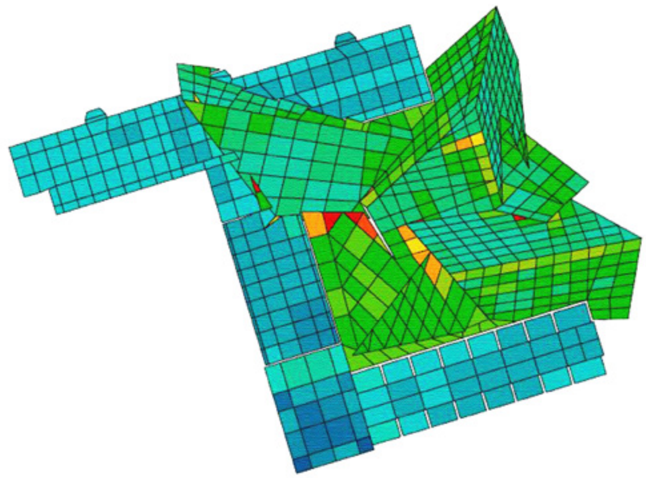
Building codes do not take account of wind directionality; the effects temperature fluctuations, wind speeds, and rainfall on drifting; and heat loss through the roof. We developed a simulation tool that considers the combined effect of all of these factors.

This tool is based on our finite area element (FAE) technique (which should not be confused with finite element analysis). In this technique, we divide the roof surface into area elements and compute the rate at which snow drifts into and out of each element. The rate of accumulation is then the difference between these two rates [1].

We achieve a comprehensive picture of snow loading through a unique hybrid of techniques:

- scale-model wind tunnel testing
- water flume testing
- computer simulation based on our FAE tool

The wind tunnel tests reveal the wind flow patterns over the roof, highlighting areas where complex snow behavior might occur.



In water flume testing, we use water to simulate wind flow. We introduce particles into this simulated flow and observe how they settle and drift on and around the roofs. This testing identifies, for each wind direction, the local aerodynamic regions of the building shape where snow is scoured from and deposited into. (Snow typically drifts from higher, wind-exposed roofs and deposits on roof steps and obstructions.) These patterns help us identify the portions of the roof where we can expect snow loading to increase or decrease.

The computer simulation combnes these patterns with hour-by-hour meteorological data customized to your site. The simulation yields hour-by-hour results for the accumulation, drifting and depletion of snow patterns over the entire roof. After we simulate multiple winters, we can perform a statistical analysis of roof accumulation. From this analysis, we obtain 50-year return period snow loadings for the roof overall and for critical structural areas of the roof, roof steps, unbalanced distributions or any other pattern that is important to the structural designer.

Leading Expertise

Our leadership in simulation of design snow loads is widely recognized. The FAE technique continues to be unique in the field, and we have decades of experience using it to obtain highly accurate results. In addition, our water flume techniques have been replicated and publicly endorsed by researchers active in developing ASCE 7 design standards.