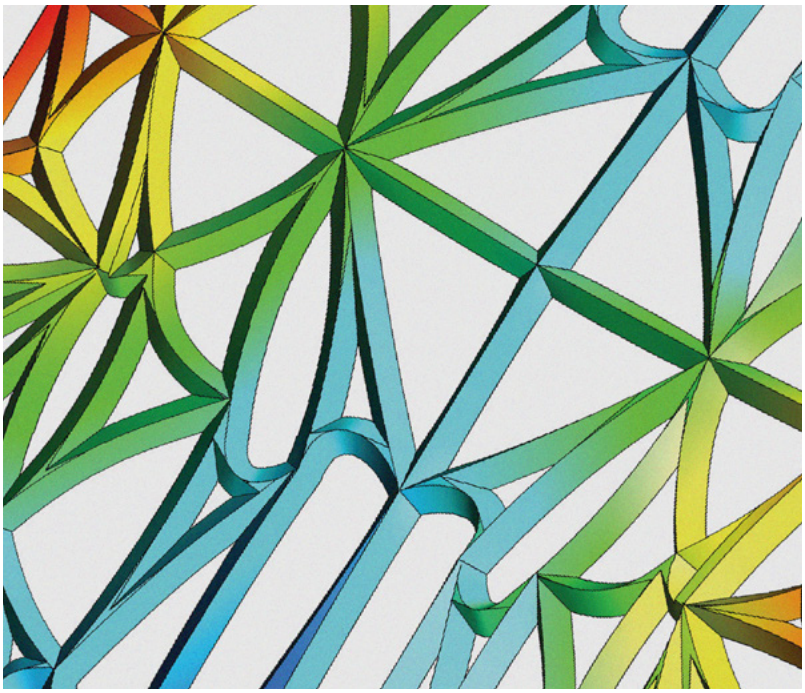
AEROACOUSTICS

Early detection and effective mitigation of wind-induced noise from building elements

The wind often causes parts of buildings or structures to make noise. Usually this “aeroacoustic” (wind-induced) noise is insignificant. But sometimes building elements make significant tonal noise that can be heard miles away. Such problems are often extremely annoying and difficult to solve. They can also become publicly infamous: Because aeroacoustic issues are rare and conspicuous, they are often considered newsworthy.

The good news is that the fixes are usually easy—if you look for this issue during early design. (The potential culprits are often quite small.) But once aeroacoustic noise issues occur, they can be technically difficult and very costly to mitigate—and to litigate.



Our Service

We offer a unique range of services to address aeroacoustic noise: desktop design reviews, wind tunnel testing and remediation of existing aeroacoustic issues.

We can do a screening assessment on your early design to flag potential aeroacoustic noise issues. After this review, we can provide design guidance to help you eliminate the risk. When problems are anticipated—or have been observed—we move to the wind tunnel. We use these measurements to identify the character and severity of noise produced and the specific conditions required to induce it. We’ll work with you to interpret these results and find a solution that works in the context of your project.

We are experts in wind climate, acoustics, fluid/structure interactions, and wind modeling and testing. Few firms have this full complement of expertise; it allows us to perform this work efficiently, saving you time and money. With our results, you can be confident that aeroacoustic noise will not be an annoyance and that proposed mitigation methods will be effective in practice.

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

Explore Innovations

- Design novel external features to enhance building appearance

Create Opportunities

- Add value with functional features, such as sunshades or external screens

Meet Challenges

- Resolve high-profile wind-induced noise issues quickly and completely

Fulfill Expectations

- Assure stakeholders and regulators that noise issues have been considered and addressed

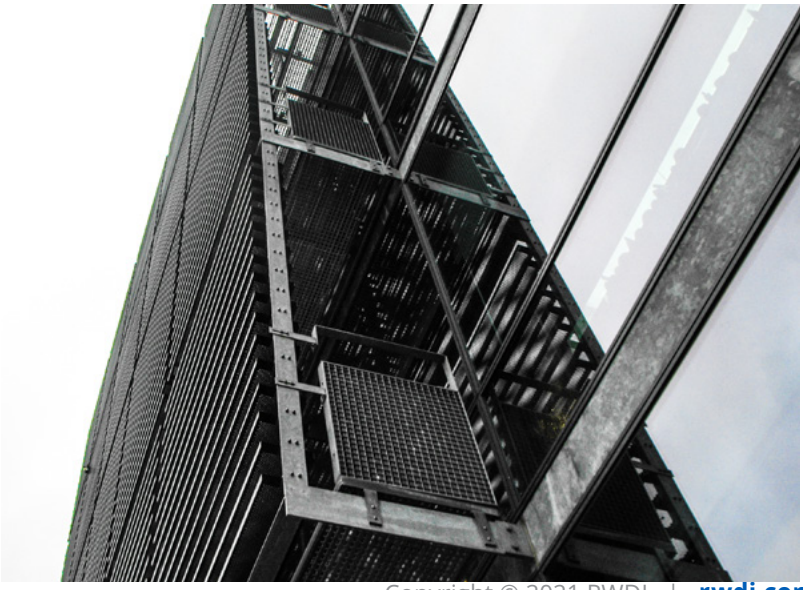
How we work

The phenomenon

We work with features of building geometry that cause the wind flowing around them to oscillate. These oscillations become audible when three conditions occur: (1) the frequency is within the spectrum audible to humans (20 Hz to 20 kHz), and (2) the flow oscillations are reinforced by resonance, and (3) typical local wind conditions are sufficient to elicit that resonant response. Common mechanisms we deal with include cavity resonance (Helmholtz resonance), vortex shedding and formation of jetlets through repeated perforations.

Our analysis

The potential frequencies of resonance can be calculated from the building design. The dimensions of a building feature determine the geometry of the oscillation of air flow. Any interaction between the resonance of a building element and the oscillation of air flow in turn determines the frequency of noise generated.



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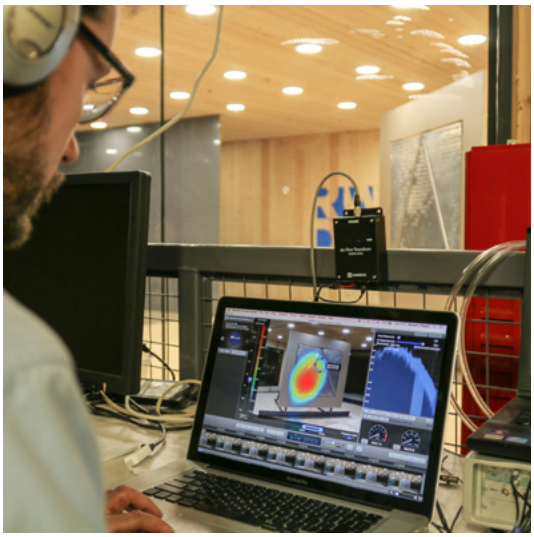

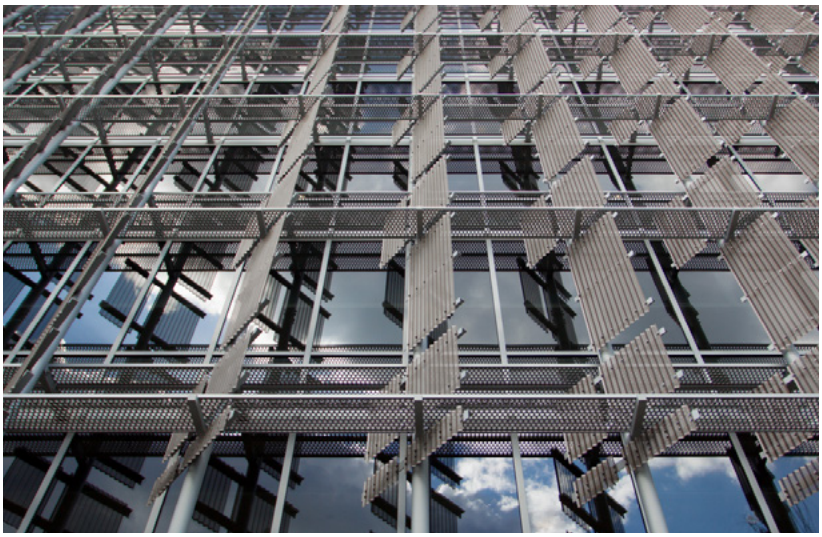

Certain oscillation mechanisms occur only under specific wind speeds and directions. We can use statistical meteorological data to calculate how often these conditions might occur. This approach allows a basic assessment of probability that noise will occur. We can also eliminate certain building features from the analysis, for example, if the wind speed at the site is never high enough to activate them.

Depending on your needs, we will do a desk assessment or physical modeling, or in some cases both. In a desk assessment, we review the architectural drawings and details. We look for proposed building features whose geometry makes them prone to typical wind noise-generating mechanisms.

Then we combine screening-level desktop calculations with local meteorological information (common wind speeds and wind directions). On the basis of this review, we comment on the likelihood of wind-induced noise and may suggest design-based mitigation measures.

We conduct detailed physical modeling in cases where the potential for aeroacoustic noise is particularly high, or where wind-induced noise has already been experienced. We set up a detailed protocol of wind tunnel testing to better quantify the character and severity of the noise problem and develop solutions to mitigate it. Scale models can be tested to determine accelerated flows around a building as a whole. Full-scale replicas of problematic architectural features are tested in a wind tunnel to simulate the audible tones, quantify their amplitudes and frequencies and test the efficacy of proposed solutions.