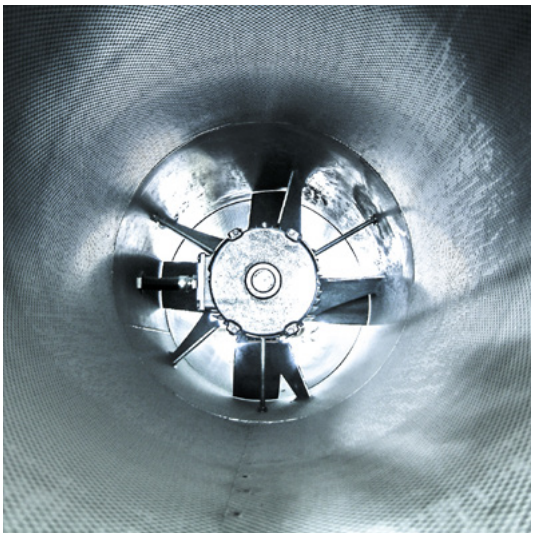
EXHAUST DISPERSION & DESIGN

Managing building air quality to enhance occupants' experience and improve building and equipment performance



The effect of air quality on and near a building can make or break a project. When it's understood and managed properly, nobody notices. When it's unanticipated or unresolved, everybody notices—and complains.

To create a high-performing building, you have to know how air quality can affect your design. For example, will the building exhaust recirculate right back into the building, causing occupants to breathe unhealthy air? Will it contaminate the daycare center or operating room? Will exhaust affect the performance of equipment? Will the plume freeze on the façade?

Assessing and mitigating building air quality issues can be complex. Wind flow around buildings is the key. Exhaust travels with the wind, and wind is invisible. As a result, sometimes exhaust ends up where you least expect it, like at an air intake opposite the direction of the wind. Seemingly small design choices, such as architectural features or equipment placement, may have unexpectedly broad effects on wind flow patterns, either positive or negative. It takes an expert eye to see the unseen and to bring practical solutions to this often complicated issue.

Our Service

We understand that there are many moving parts in a design process, and we partner with you and your team to navigate these complex issues. We can help you solve an existing air quality problem, proactively design a retrofit or renovation, or avoid issues in new construction Whether you have a simple question about placement ("Is the emergency generator too

close to the air supply?") or broader concerns about an unusual building geometry, we help you zero in on the critical issues in your design. Then we deliver advice and creative solutions specific to your concerns and design goals. We are very familiar with air quality issues specific to many sectors, including healthcare, laboratory/research, manufacturing, commercial, institutional, and residential projects, data centers, and transportation facilities. We already speak your language.

Our key service is providing practical design advice. First we model how exhaust disperses in the presence of buildings and structures, and then we predict where it will go. We build a clear picture of how the wind interacts with these structures to affect the dispersal and transport of pollutants and odors. We predict whether the exhaust will re-enter a building (often called re-entrainment), affect a neighbor or outdoor area, affect equipment, or affect other parts of the building or its systems. To do this, we leverage our experience, supported by the use of numerical or physical models—or both if needed.

RWDI has deep, long-standing, and company-wide expertise in wind flows around buildings, microclimate effects, ventilation, and computational fluid dynamics modeling. We draw collaboratively on this expertise throughout the consultation, from choosing the right modeling strategy for your needs to interpreting the results in the larger context of your whole project so that we can help you design healthier, higher performing spaces.

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

Explore Innovations

- Realize ambitious aesthetics, energy efficiency, and good air quality by astute handling of stacks and intakes
- Demonstrate that exhaust fans can be operated at lower horsepower—and lower cost—without compromising safety

Create Opportunities

- Enhance the user experience by delivering better indoor air quality
- Improve the energy efficiency of sensitive equipment (generators, cooling towers, air-cooled chillers) by preventing recirculation of the thermal plume
- Manage costs by correctly matching mitigation to risk
- Improve staff retention by improving the work environment

Meet Challenges

- Protect occupant health by preventing re-entry of unsafe levels of pollutants
- Avoid odor complaints by mitigating movement of odor plumes
- Avoid safety and odor complaints from sensitive outdoor spaces nearby, such as playgrounds and daycares
- Avoid visibility issues from condensing plumes
- Avoid damage to façades from high-temperature or high-humidity plumes

Fulfill Expectations

- Be good neighbors by demonstrating due diligence to community groups, staff, building occupants, and other stakeholders

Sector Challenges

Healthcare

- Create an environment that is more supportive of healing
- Protect sensitive patient spaces (operating theater, maternity, NICU, ICU, etc.)

Laboratories

- Prevent re-entry of chemical exhaust from fume hoods
- Save energy and money by matching exhaust fan flow rates to actual localized risk
- Protect sensitive specialty labs from outdoor contaminants

Commercial

- Maximize value to tenants by creating comfortable, healthy, odor-free interior spaces

Residential

- Avoid effects on the health and comfort of residents
- Avoid complaints about odor (typically arising from diesel sources and kitchens)

Data Centers

- Save money on critical cooling by preventing re-entry of excessive heat
- Reduce the impact of diesel odor from emergency generators

Transportation Centers

- Protect travelers in the event of a fire (e.g., subway, train) by allowing for safe egress
- Improve travelers' experience by preventing exposure to vehicle exhaust in concourse or pedestrian areas

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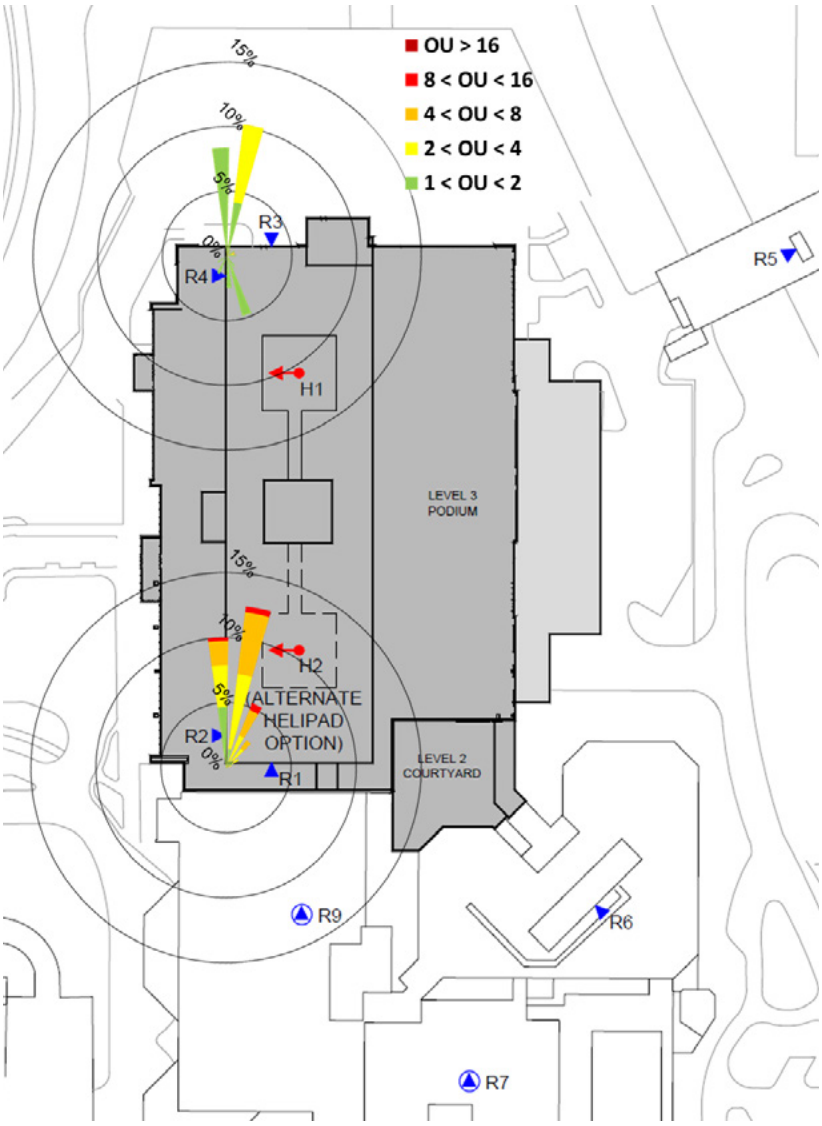
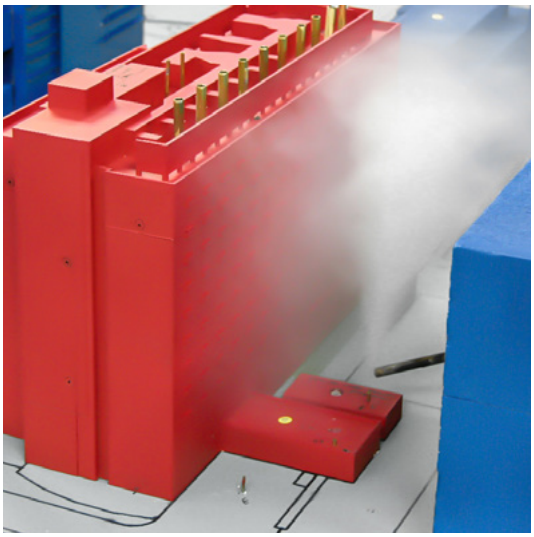
In a consultation on building air quality and exhaust impacts, we'll first discuss your questions and needs in relation to the design process. Our goal is deep understanding. The detail of the analysis will depend on your needs, but in general we will carry out the following steps:

- Evaluate the local aerodynamics. We study how wind flows around the building for different wind conditions and look for places where the flow may take on unexpected, unintuitive patterns. This analysis considers not only your building but also the surrounding buildings and the terrain.
- Conduct a wind climate assessment. We review long-term meteorology from appropriate sources to determine the integrity and applicability of wind data. This data is then analyzed and formatted appropriately for use during the design consultations and subsequent studies.
- Evaluate the location of stacks and air intakes in relation to the airflow. We'll identify critical zones where re-entrainment or other effects could occur.



- Model the dispersion of exhaust plumes in critical area. We'll determine risks, taking into account all relevant factors, such as microclimate effects and your design constraints.
- Recommend design options. We'll give you ideas for how to design stacks, air intakes, mechanical equipment, and other building features, or how to modify operations to minimize risks.
- Give guidance on mitigation equipment. With this guidance, you can make more informed decisions, for example, on the need for carbon filtration on intakes or supplementary exhaust controls.



We might use some or all of the following resources, depending on your needs.

Experience

Early in the design process, it is important to flag big picture issues and broad strokes. A detailed study may not be possible or appropriate, but expert input is critical. We draw on years of deep experience to provide particularly expedient feedback that helps shape early decisions.

Wind Tunnel

This is our most accurate tool. We use wind tunnels to physically simulate dispersion and short-range transport of exhaust plumes and odors in the vicinity of buildings, surroundings, and terrain. Wind tunnel tests are used when the highest degree of refinement and/or the lowest degree of conservatism is required. Such studies benefit almost any structure, from the simplest one-story building, to a complex R&D campus, or a shoehorned retrofit in a dense urban center.

Proprietary desktop dispersion models

These computational models are based on published sources, such as American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) methods and the classic Gaussian dispersion model. They are well suited to less complex geometries or when conservatism can be tolerated. We use them to provide practical design recommendations with a reasonable degree of conservatism.

Regulatory dispersion models

We use these for specific regulatory situations or in situations where the model is well suited to the need. We will not necessarily endorse their use in isolation for design purposes where other models are more appropriate.

