RWDI
CONSULTING ENGINEERS & SCIENTISTS

Reputation Resources Results

TECHNOTES

ISSUE NO. 16

AIR INTAKE PLACEMENT FOR LABORATORIES - A GENERAL OVERVIEW

By Aimée L. Smith, M.Eng., P.Eng., and Glenn D. Schuyler, P.Eng., Principal

Introduction

Optimal placement of outside air intakes is an important laboratory design issue. With contaminant sources occurring at both roof and ground level, the placement of outside air intakes to avoid contamination can be challenging.

An intake system design that provides protection of outside air intakes can have the following benefits: better air quality; reduced need for filtration of odor, dust, and other compounds; and reduced height of exhaust stacks needed to avoid excessive impacts.

The Initial Design Phase

Intake locations should be designed to minimize the probability of exhaust from nearby contaminant sources entering the building's air supply system. Typical exhaust sources include:

- Boilers
- Incinerators
- Idling diesel vehicles
- Mobile vehicle traffic
- Laboratory fume hoods
- Animal holding rooms
- Cooling towers
- Emergency generators

Architectural screens placed around exhausts inhibit dispersion and increase the likelihood of exhaust entering air intake (at right).

The air quality issues associated with these exhaust sources are both health and odor related. In most cases, the amount of exhaust dilution required to eliminate odors is greater than that required to meet health limits. Odors are not a direct health concern but more of a nuisance issue. As a minimum, air intakes should be located to meet applicable health criteria from all exhaust sources of concern.

An assessment of the proposed air intake locations is best performed at the initial stages of the building design when there is flexibility in the mechanical system for modifications.

Modeling Techniques

Numerical methods provide a conservative dilution prediction when the building geometry and surrounding site to be assessed are simple. In these cases, numerical predictions combined with exhaust dispersion experience can effectively evaluate a proposed air intake design.

However, if the building geometry or the site terrain is complex, numerical modeling may not offer sufficient accuracy. The main limitations associated with numerical modeling of rooftop exhausts are described below:

- Most numerical dispersion models were developed for tall isolated stacks and cannot fully account for building generated turbulence and mixing.
- Many of these models do not have the capability to predict the level of exhaust dilution at a receptor located on the same roof as the exhaust source.

- Computational Fluid Dynamics (CFD) modeling is currently not a reliable method for this application because of limited ability to simulate turbulence and external air flow around buildings.

Physical wind tunnel modeling is the most accurate method of predicting impacts from building exhausts because it simulates air flow patterns around complex building configurations. Wind tunnel modeling also accounts for the effect of surrounding structures, local topography and upwind velocity profiles created by surrounding terrain which cannot be simulated numerically.

Scale model of a site with complex topography simulated in a boundary layer wind tunnel.

Air Intake Placement Guidelines

There are different design issues associated with ground level and roof level intakes, which are dependent on the types of exhaust sources present at a particular site.

Upper Level (Sidewall and Rooftop) Intakes

The main concern associated with the placement of upper level intakes is the presence of upper level exhausts. However, ground level exhaust sources and sources on nearby buildings play a part in the optimal placement of upper level air intakes. *Intakes on the sidewall of the building should not be placed on the side of a building that faces ground level sources or surrounding buildings with upper level exhausts.*

A well-placed sidewall intake can provide significantly lower impacts than a rooftop location. Locating a sidewall intake further down the building face provides little exhaust dilution benefit. This is because the contaminant concentration is relatively uniform within the leeward re-circulation region created by the building. *Whenever possible, the building intakes should be placed on the shear building face and not on a setback.*

Intakes generally should not be surrounded by screen walls. Screen walls restrict air flow and increase the stack height and separation distance required to maintain adequate air quality.

Ground Level Intakes

Ground level intakes are advantageous when the majority of exhaust sources are at roof level. However, in cases where there are nearby contaminant sources at ground level, ground level intake placement becomes more difficult. Ground level sources to consider include:

- Loading docks
- Bus stops
- Emergency generators
- Lawnmowers
- Automobile traffic
- Designated smoking areas

An air intake louver located next to a loading area required a no-idling policy (as indicated by the sign) to reduce diesel odors from vehicles using the loading dock.

When possible, the building itself should be used to protect ground level intakes from exhaust sources. If this is not possible, the location of the ground level air intake should maintain a minimum horizontal separation distance from the exhaust source (typically over 100 feet). The minimum required separation distance depends on the source strength and source parameters. Restrictions to air flow caused by adjacent buildings can drastically increase the required separation distance.

Conclusion

In an ideal design situation, building exhausts can be designed to reduce potential of impacts at nearby intake locations. However, in many cases, there are limitations imposed on the design of building exhausts (i.e., visibility of exhaust equipment for aesthetics, maximum height for zoning, etc.), or there are nearby existing exhaust sources of concern that cannot be modified. In these cases, the placement of outside air intakes influences the level of air quality achieved. The issues discussed above should be considered at the early design stage when placing air intakes for laboratories.

RWDI
CONSULTING ENGINEERS & SCIENTISTS

Rowan Williams Davies & Irwin Inc.
(519) 823-1311 www.rwdi.com

RWDI Anemos Ltd.
01582 470250 www.rwdi-anemos.com

Wind and Microclimate Services:

- Acoustics, Noise & Vibration
- Environmental Engineering
- Hazard & Risk
- Wind Engineering
- Microclimate
- Regulatory Permitting
- Industrial Processes