

# **Natural Ventilation**

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## Open a window: The natural ventilation alternative

A few months ago, I was walking through a school with a building engineer. We entered a room smelling like an armpit that was going to be converted into a classroom. After suggesting that there might be an air quality problem, the engineer replied, “Oh, no worries. If the teacher needs some air, she can always open the window.”

Such stories might leave you wondering if the benefits and limitations of natural ventilation are really understood by most people. This commentary reviews the science behind natural ventilation, and offers some suggestions on what you should be on the lookout for when considering natural ventilation systems.

### ***Understanding natural ventilation***

Natural ventilation has a number of benefits, but it is important to understand how it works and its limitations. You also need to understand how air naturally flows before you can assess its impact on air quality.

### ***The forces behind natural ventilation***

There are two forces that move air. First, there's buoyancy or “stack effect”. Hot air rises, so in a building, you'll find warm air at the top. Now, if you put some holes (windows, doors, cracks) in the building envelope at the bottom and top, cold air will infiltrate at the bottom, and warm air will seep out the top openings.

Buoyancy forces become larger as the building height increases. If you just have a single story building, there is not going to be any significant air movement from stack effect, unless there's a tall clearstory or monitor.

Buoyancy forces also rely on temperature differences between the inside of the building and the outdoors. So don't expect much air to be moving from stack effect during warmer weather.

The second driving force is wind (caused by pressure differences). When wind is used to move air inside a building, it is commonly referred to as cross draft. Since wind flow is irregular and dynamic, it is a real challenge to predict how effective it will be when ventilating buildings.

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## ***Benefits to natural ventilation***

Engineers and other conservative folks are often quick to dismiss the prospect of using natural ventilation in buildings. They see the obstacles, and fear the repercussions from uncomfortable occupants. Yet, there's a growing movement towards sustainable living, and natural ventilation can play a big part in that. If you allow air to move around naturally, you save in air transport costs – no big fans or ductwork. Natural ventilation systems are simple, have a low first cost, and have low maintenance needs.

Even though temperature control is not as great as with traditional HVAC systems, the latest ASHRAE research suggests that occupants of centralized HVAC buildings are twice as sensitive to deviations in temperature as are occupants of naturally ventilated buildings. Give someone a window to open, and they'll be more than happy to put up with a broader range of temperatures.

## ***Some limits to being natural***

If you're considering having natural ventilation in your building, you should consider the following:

- Address the security issues of having openable windows at grade level. Sometimes the cost of having security devices can outweigh the benefits of having openable windows.
- Make sure you'll be pulling in quality air. Using low-grade outdoor air will be self-defeating. Check for carbon monoxide and oxides of nitrogen (NO<sub>x</sub>) levels. Also keep in mind that most natural ventilation strategies use unfiltered outdoor air, so if there's a pollen or dust problem at the site, you may end up increasing indoor particulate levels.
- Watch for potential of wind gusts. Ideally, an expert should evaluate local wind patterns through modeling or wind tunnel tests. In practice, most people get a "wind rose" (a history of seasonal wind patterns) from the local weather office and apply some common sense.
- Consider noise transfer. If there's plenty of noise outside your building, look at blocking direct sound travel.
- Remember the bugs. If you're in an area with fly or mosquitoes problems, you may need to add screens to any openings. Keep in mind insect screens severely restrict free airflow.

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It's also important to realize that just having openable windows in a building doesn't give you a free bill of health. For example, if you have a mould problem, you're much better off tackling the mould than trying to dilute the pollutant using ventilation.

### ***Checks & balances***

If you can pass the hurdles mentioned above, natural ventilation might be appropriate for your building. To make sure it is a success, some serious computer modeling will need to be done. Fortunately, with all the interest in natural ventilation (especially in Europe), there are a number of software programs that engineers can use. In these programs, temporal effects of wind, temperature, sun, and people can be modeled, with estimates of air quality, temperature gradients, and air movement through buildings shown in colour, three-dimensional graphics.

As with any building project, proper IAQ commissioning and ongoing monitoring is highly recommended.

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