

Re-Arch: The Initiative for Renewable Energy in Architecture

Fact Sheet



Technology: Passive Ventilation

Common Uses:

Passive ventilation, sometimes referred to as natural ventilation, is most often used in smaller buildings with moderate cooling needs. It is increasingly being used in hybrid double-skin envelope systems in larger buildings, often with mechanical airflow assistance.

Site Considerations:

A narrow footprint perpendicular to prevailing breezes is best to foster cross-ventilation. It is best to orient operable windows to prevailing winds and locating the building where breezes are not obstructed by heavy vegetation. Vegetation and site topography can also be strategically used to direct or re-direct breezes toward the building.

Size Considerations:

Single-sided ventilated spaces with high-openings are effective to a depth of about 2x the room height. Single-sided ventilated spaces with high and low-openings are effective to a depth of 2.5x the room height. Double-sided or cross-ventilated spaces are effective to a depth of 5x the room height. Higher ceilings and vertical shaft elements can foster air movement, due to temperature stratification.

Design Considerations:

Consider protruding elements, such as fins or wing walls, to catch and re-direct breezes. Combine “ventilation” elements with “daylighting” elements. Choose window opening or hinging configurations to maximize airflow from different directions, such as center-hinged “butterfly” joining of multiple-ganged casement windows to avoid self-blocking. Provide lower openings oriented to prevailing breezes and higher openings on the downwind or “lee” side of the building. Take advantage of ceiling or building height to create “stack effect” and consider inducing stack effect with “solar chimney” elements. Allow heat to rise and stratify, by careful placement of air returns. For “earth cooling,” provide adequate cross-section area to minimize airflow resistance with positive drainage and condensate removal to prevent mold growth or other air stream contamination.

System Costs:

In its simplest form, operable windows do not significantly increase costs. Natural ventilation can be induced or augmented by passive solar strategies and/or with mechanical-assisted ventilation to create a “mixed-mode” strategy, at a modest additional cost. Double-skin facades work best with mixed-mode ventilation, utilizing passive solar chimney effect in the daytime to induce cross-ventilation, and nighttime venting to induce passive cooling. ASHRAE Standard 55 incorporates hybrid ventilation models.

More Information:

There are several books and reference guides that outline basic principles of natural ventilation. In addition, there are several web-based sets of guidelines and case studies that discuss the topic.

Books and Resources:

- Sun, Wind & Light: Architectural Design Strategies, G.Z. Brown & Mark DeKay, Wiley, 2000, ISBN 978-0471348771
- Window Systems for High-Performance Buildings, Stephen Selkowitz, Eleonor Lee, Dariush Arasteh, Todd Wilmert & John Carmody, Norton, 2003, ISBN 978-0393731217
- Passive Solar Energy: The Homeowner's Guide to Natural Heating and Cooling, Bruce Anderson & Malcolm Wells, Brick House, 1996, ISBN 978-0931790225

Websites:

- Whole Building Design Guide wbdg.org
- U.S. DOE Energy Efficiency & Renewable Energy eere.energy.gov
- Lawrence Berkeley Laboratory gaia.lbl.gov/hpbf

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