



National Center for
Healthy Housing

IMPROVING VENTILATION IN MULTI-FAMILY BUILDINGS

FALL 2009

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GREEN & HEALTHY HOUSING

IMPROVING VENTILATION IN MULTI-FAMILY BUILDINGS THAT DO NOT HAVE FAN-POWERED VENTILATION

WHY VENTILATE?

Most of us spend the majority of our time in homes or apartments. Making sure the home living environment has enough clean fresh air will help to improve occupant health. Many multi-family buildings do not consistently provide families with clean, fresh air. While all of our buildings have windows, these windows do not make a complete ventilation system in most U.S. climates. Nearly all buildings require mechanical ventilation and fans to:

- Exhaust pollutants generated inside the building, such as moisture from bathrooms and cooking, contaminants generated during cooking, and

chemicals from building materials and cleaners; and

- Provide consistent clean, fresh air by pulling in and filtering outside air before it is heated, cooled, or circulated in the building to help reduce contaminants and allergens in homes.

Buildings that are well ventilated are also less likely to experience odor or moisture/mold issues that are unhealthy and can trigger tenant complaints. Living in damp or moldy environments has been linked to increased risks of breathing problems, such as asthma.¹

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IS THIS FACT SHEET FOR YOU?

This fact sheet is for you if:

- You have a building that is constructed and occupied; and
- There are no ventilation fans in the building:
 - No exhaust fans in the units;
 - No rooftop exhaust fans that have grills in multiple-unit buildings; or
 - No air handlers that blow outdoor air into each unit or corridors.

Note: There may be a passive ventilation system that includes grills in units or the corridors that connects to vertical ducts or chimneys running to outlets on the roof. In these instances, the airflow is driven by warm air rising up through the ducts to the roof and

wind drawing air up to the roof, but there are no ventilation fans. (See Figure 1.)

This factsheet may be particularly useful if you are:

- Receiving complaints of odors, resident illness, and/or condensation or mold growth in cool weather (low ventilation rates are not the only reason these problems may appear);
- Planning a building renovation; or
- Interested in a ventilation upgrade as part of an energy retrofit.

¹National Academies Press, *Damp Indoor Spaces and Health*, Institute of Medicine of the National Academies, ISBN 0-3-9-09246-9, 2004.



Figure 1 | Passive rooftop ventilators contain no fans. They depend on warm air rising and wind uplift to provide exhaust ventilation.



WHAT CAN I DO TO IMPROVE VENTILATION?

Provide fan-powered ventilation for each unit by installing exhaust fans for bathrooms and kitchens and supplying outdoor air for bedrooms and living rooms.

1. Install a bathroom and kitchen exhaust in each unit. The fans can be located in each unit, or an owner may use larger fans to exhaust more than one unit. Pick the strategy that is easiest to implement for the conditions in the building. In low-rise buildings, like duplexes and row houses, separate exhaust for each unit is often the easiest solution. However, it may be more effective to use central exhaust

fans to serve multiple units if there is an easy way to run duct work to all the units (e.g., common attics, crawlspaces, basements, or flat roofs). Systems serving multiple units must be designed and operated so that air does not flow from one unit to another through the ducts. Strategies to stop air from one unit getting to another through the ducts include backdraft dampers, motorized dampers, continuous operation, and designing the ductwork system to operate at static pressures high enough to get good distribution (e.g., 0.3 inches water column).

2. Provide outdoor air for the bedrooms and living space. There are two situations and strategies:

- **For units lacking heating or cooling duct work:** In these units, improved ventilation will rely on the exhaust systems (e.g., bath fans) to draw air through the air leaks in the windows and through leaks in the exterior and interior walls, floors, and ceilings of each unit. Most of this make-up air will be drawn through the biggest leaks. Units with a lot of exterior surface area compared to the surface area of common walls, floors, and ceilings are good candidates for make-up air through air leaks. A rough rule of thumb is that if the exterior walls represent more than 60% of the total perimeter

wall area, then it is likely that make-up air could come through exterior walls. The amount of air drawn from outside can be increased by air sealing the interior partitions, chases, and utility penetrations and by adding passive air inlets (e.g., trickle vents) in the bedrooms and living room. (See Figure 2 for an example of trickle vents and Figure 3 for an example of air sealing.) A blower door test can be conducted on a unit to see how airtight it is to start with and how airtight it is after sealing.

- **For units heated and cooled by individual air handlers (e.g., fan coils, heat pumps, warm-air furnaces):** In these units, a more effective way to add ventilation to the bedrooms and living space is to run outdoor air ducts to the return side of the air handler and add a cycle timer to be certain the air handler runs frequently enough.

3. Improve passive ventilation systems and possibly save energy.

If the building has a ventilation system that consists of exhaust grills connected to vertical shafts with passive ventilation caps on them, an opportunity exists to improve ventilation and reduce energy use. (See Figure 1.) Passive systems of this kind often over-ventilate buildings during the coldest weather and under-ventilate during milder weather. Turning the passive system into a fan-powered system can moderate the ventilation over the year, delivering enough ventilation during mild weather and not too much during the coldest weather. Fan-powering a passive system is more than simply adding fans. It is important to also do the following:

- Measure for the correct size and select exhaust fans accordingly;
- Seal the big holes in the duct and shaft system;
- Add flow-limiting dampers to the exhaust inlets; and
- Be certain the new system meets fire codes.

If you want to estimate how much energy can be saved by transforming the passive

Make-up Air:

If a room or unit has a fan exhausting air from it, the air going out must be replaced. Replacement air may be drawn into the room by the exhaust fan, or it may be blown in by another fan. The replacement air for an exhaust fan is called make-up air. If replacement air is not provided, potentially dangerous backdrafting from combustion appliances like water heaters can occur, resulting in carbon monoxide and other harmful exposures.

system, you will need to measure the airflows through the passive system during the colder parts of the year, compare this to the amount of airflow needed to meet code or standards, and calculate the amount of fuel saved.

WHAT ABOUT TRASH CHUTES?

Trash chute systems are often found in taller apartment buildings. Trash chutes run vertically through the building, with a trash compactor or dumpster at the bottom. The compactor and dumpster should be in a room that is hard for rodents and insects to enter. There is a passive or fan-powered vent at the top. Doors on each floor open into the chutes to allow occupants to drop trash into the compactor. Maintenance to keep these systems running properly includes the following:

- Keep doors to chutes clean, operating freely, and closing tightly (clean and lubricate hinges, closing mechanism, repair alignment) and weather-strip doors.
- Keep the chute running at a lower air pressure than the building (a retrofit exhaust fan may be needed if air travels from the trash chute into the building). This is more likely if an exhaust-only ventilation system is added to the building. Consider providing a shroud between the trash chute and dumpster to help trash chute exhaust capture emissions from dumpster and its contents. Tissue paper, incense or an ostrich feather can be used to see whether air is sucked into the trash chute or not.
- Keep the compactor/dumpster room clean and sealed against rodent and insect entry (weatherseal on the entry doors is a common problem area). Make-up air inlets should be screened, cleaned, and sized to keep the compactor/dumpster room at a lower air pressure than the rest of the building.
- Clean the chutes themselves.

Figure 2 | Trickle vent installed in window frame.



Figure 3 | Air sealing with fire stop around pipe penetrations between floors.



Trash chutes run vertically through the building, with a trash compactor or dumpster at the bottom. The compactor and dumpster should be in a room that is hard for rodents and insects to enter.

WHOM SHOULD I HIRE?

Getting an effective ventilation system designed and installed means finding the right designer and contractor.

Getting an effective ventilation system designed and installed means finding the right designer and contractor. You need them to do the following:

- Assess the conditions at the building (what ventilation systems are practical, what existing problems may be solved by a new ventilation system);
- Calculate the airflows required to meet local building code requirements and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers' (ASHRAE) recommended rates;

- Find equipment that can provide the airflows you need; and
- Make sure the ventilation is effectively exhausted from or delivered to each unit.

If a potential designer or contractor includes these items in their questions, inspections, and proposals, they are more likely to give competent service. For some situations you will need to hire a registered engineer to design the system.

RESOURCES

“Constant Airflow Regulators (CAR) in Multi-Family Multi-Story Central Ventilation Systems: New York, NY & Caldwell, NJ”—National Association of Homebuilders Research Center. www.toolbase.org/Building-Systems/HVAC/constant-airflow-regulators. This website documents a case study that uses central exhaust systems and flow-limiting dampers to provide exhaust-only ventilation for an apartment building. A link to the final report for the project is included.

Energy-Efficient Ventilation for Apartment Buildings—Lawrence Berkeley Laboratories. www.epb.lbl.gov/publications/energy_eff_ventilation.pdf. This is a fairly large overview of ventilation systems in multi-family buildings.

“Multifamily Ventilation”—Joe Lstiburek. www.buildingscienceconsulting.com/resources/mechanical/ventilation/Multifamily_Ventilation.pdf. This article covers important and often overlooked fundamentals and includes a case study that uses air handlers in each unit to provide ventilation.

“Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments”—The Center for Energy and Environment. www.mncee.org/research/environmental_tobacco/multifamily_bldgs/index.php. This report covers efforts made to stop tobacco smoke migration from one unit to another. It highlights the importance of controlling airflow between units, regardless of whether it is a smoking or non-smoking building.

*Prepared with assistance provided by
Steven Winter Associates, Camroden Associates, and Tohn Environmental Strategies.*