Whole House Ventilation

Diagram showing the ventilation system of a house, including kitchen range hood, common area supply, hall supply, bath exhaust, HRV/ERV, and outside air.
AGENDA

- Why ventilate? – what the studies say
- What code requires
- Ventilation Strategies
- Wrap up
Do we have any data that show a connection between residential mechanical ventilation and occupant health?

Do we know how much ventilation is desirable for optimal occupant health?

The answer to the first question is no, not really. And the answer to the second question is an emphatic no.

*Green Building Advisor, Musing of an Energy Nerd, Martin Holladay, January 22, 2010*
Five ventilation options

Do we have any data that show a connection between residential mechanical ventilation and occupant health?

Do we know how much ventilation is desirable for optimal occupant health?

The answer to the first question is no, not really. And the answer to the second question is an emphatic no.

Green Building Advisor, Musing of an Energy Nerd, Martin Holladay, January 22, 2010
Natural Ventilation Defined

Natural Ventilation: Uncontrolled air movement into a building through cracks and small holes (infiltration) and through vents such as windows and doors.

• People make little use of their windows
• A home’s natural infiltration rate is unpredictable and uncontrollable because it depends on the homes airtightness, outdoor temperatures, wind and other factors.
• Over ventilating wastes energy and may pull from a polluted area
  • Garage, crawlspace, attic, etc.
• Under ventilating fails to remove chemicals

Source: everblue
Mechanical Ventilation Defined

Mechanical Ventilation: Intentional ventilation that allows the homeowner some control in the amount and timing of air exchange in the house

- Provides fresh air
- Removes pollutants, orders, and excess moisture
- Formaldehyde
- Radon
- VOC’s
- Stale air
- Moisture

Source: everblue
Code Ventilation Requirements
The 2012 IECC addresses WHOLE-HOUSE ventilation with a fan efficacy requirement and a Mandatory reference to ventilate according to the IRC or IMC or other approved means e.g. ASHRAE

Table R403.5.1, Whole-house Mechanical Ventilation System Fan Efficacy

<table>
<thead>
<tr>
<th>Fan Location</th>
<th>Air Flow Rate Minimum (CFM)</th>
<th>Minimum Efficacy (CFM/watt)</th>
<th>Air Flow Rate Maximum (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range Hoods</td>
<td>Any</td>
<td>2.8</td>
<td>Any</td>
</tr>
<tr>
<td>In-line Fan</td>
<td>Any</td>
<td>2.8</td>
<td>Any</td>
</tr>
<tr>
<td>Bathroom, Utility Room</td>
<td>10</td>
<td>1.4</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Bathroom, Utility Room</td>
<td>90</td>
<td>2.8</td>
<td>Any</td>
</tr>
</tbody>
</table>
Both the 2012 IRC and IMC require mechanical ventilation when the air infiltration rate of the dwelling unit is < 5 ACH when tested with a blower door in accordance with the 2012 IECC provisions.

**IRC Section N1102.4.1.2 and IECC Section R402.4.1.2**

The building air leakage not to exceed 5 ACH in CZ 1 and 2 . . . and 5 ACH in CZ 3-8.
IRC Section 303.4

Where the air infiltration rate of a dwelling unit is less than 5 air changes per hour when tested with a blower door at a pressure of 0.2 inch w.c. (50Pa) in accordance with Section N1102.4.1.2, the dwelling unit shall be provide with whole-house ventilation in accordance with Section M1507.3
Whole-house mechanical ventilation systems shall be designed in accordance with Sections M1507.3.1 through M1507.3.3.
M1507.3.1 System Design
Whole-house ventilation includes supply and exhaust air provided through mechanical means.
Air is exhausted when the home or dwelling unit is occupied to meet the ventilation requirements, and outside air is drawn in by negative pressure through window vents or through-the-wall vents.

Air is exhausted when the home or dwelling unit is occupied to meet the ventilation requirements, and fresh makeup air is provided to replace exhausted air via ventilation ductwork that is independent or connected to the HVAC return duct.

Outside ventilation air is supplied with a dedicated fan, and relief vents allow air to escape from the home or dwelling unit when the supply air pressurizes the home.

A combination of supply and exhaust fans operate, often in conjunction with a heat recovery unit, to both supply the required ventilation air through ductwork and exhaust stale air.
IRC Section M1507.3

M1507.3.2 includes System Controls that enable manual override.

M1507.3.3 provides ventilation rates based on floor area and number of bedrooms.

Further specifies that this rate of ventilation shall be continuous as determined by Table M1507.3.3(1). Or at a minimum 25% rate if proper controls are utilized (Table M1507.3.3(2))
## IRC M1507.3
### Code Ventilation Requirements

### IRC Table M1507.3.3

<table>
<thead>
<tr>
<th>Dwelling unit floor area</th>
<th>0 – 1 bedrooms</th>
<th>2 – 3 bedrooms</th>
<th>4 – 5 bedrooms</th>
<th>6 – 7 bedrooms</th>
<th>&gt; 7 bedrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1,500</td>
<td>30</td>
<td>45</td>
<td>60</td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td>1,501 – 3,000</td>
<td>45</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>105</td>
</tr>
<tr>
<td>3,001 – 4,500</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>105</td>
<td>120</td>
</tr>
<tr>
<td>4,501 – 6000</td>
<td>75</td>
<td>90</td>
<td>105</td>
<td>120</td>
<td>135</td>
</tr>
<tr>
<td>6,001 – 7,500</td>
<td>90</td>
<td>105</td>
<td>120</td>
<td>135</td>
<td>150</td>
</tr>
<tr>
<td>&gt; 7,500</td>
<td>105</td>
<td>120</td>
<td>135</td>
<td>150</td>
<td>165</td>
</tr>
</tbody>
</table>
### IRC Table M1507.3.3 - (ASHRAE 62.2)

<table>
<thead>
<tr>
<th>Dwelling unit floor area</th>
<th>0 – 1 bedrooms</th>
<th>2 – 3 bedrooms</th>
<th>4 – 5 bedrooms</th>
<th>6 – 7 bedrooms</th>
<th>&gt; 7 bedrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1,500</td>
<td>30</td>
<td>45</td>
<td>60</td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td>1,501 – 3,000</td>
<td>45</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>105</td>
</tr>
<tr>
<td>3,001 – 4,500</td>
<td>60</td>
<td>75</td>
<td>90</td>
<td>105</td>
<td>120</td>
</tr>
<tr>
<td>4,501 – 6000</td>
<td>75</td>
<td>90</td>
<td>105</td>
<td>120</td>
<td>135</td>
</tr>
<tr>
<td>6,001 – 7,500</td>
<td>90</td>
<td>105</td>
<td>120</td>
<td>135</td>
<td>150</td>
</tr>
<tr>
<td>&gt; 7,500</td>
<td>105</td>
<td>120</td>
<td>135</td>
<td>150</td>
<td>165</td>
</tr>
</tbody>
</table>
0.35 ACH but not less than 15 cfm/person

Defines minimum rate of outdoor air for private dwellings, single and multiple

*The cfm you need for .35 ACH*

\[0.35 \times \text{house volume}/60 = \text{CFM}\]
How much air depends on the standard

2,248 Square Feet
20,000 Cubic Feet

$0.35 \times 20,000 / 60 \text{ minutes} = \text{cfm} \ldots \text{Or 116 cfm}$
Ventilation Strategies

- Kitchen Range Hood
- Common Area Supply
- Bath Exhaust
- Hall Supply
- HRV/ERV
- Outside Air
- Inside Air
- Supply
- Return
- Bath Exhaust
- Filter
- Manual Damper (controls flow rate)
- Motorized Damper (controls open time)
Qualities of whole-house ventilation

• Quiet
• Good controls
• Good air distribution
• Filtration
• Serviceable
Three broad types of ventilation

- Exhaust
- Supply
- Balanced
Six ventilation options (at least)

- Exhaust-only (spot) ventilation
- Supply only ventilation
- Central-fan-integrated supply ventilation
- Balanced ventilation system using an HRV
- Balanced ventilation system using an ERV
- Balanced natural ventilation

Perhaps best used for cooling in cold dry climates
Exhaust-only (spot) Ventilation

Exhaust ventilation systems work by depressurizing your home. The system exhausts air from the house while make-up air infiltrates through leaks in the building shell or through intentional passive vents.

From:
http://energy.gov/energysaver/articles/whole-house-ventilation
Supply-only ventilation

Supply ventilation systems use a fan to pressurize your home, forcing outside air into the building while air leaks out of the building through openings in the shell, bath and range fan ducts, and intentional vents, if any exist.

From:
http://energy.gov/energysaver/articles/whole-house-ventilation
Supply-only ventilation

A balanced ventilation system usually has two fans and two duct systems. Fresh air supply and exhaust vents can be installed in every room, but a typical balanced system is designed to supply fresh air to bedrooms and living rooms where occupants spend most of their time.

From: http://energy.gov/energysaver/articles/whole-house-ventilation
Exhaust-only (spot) Ventilation

$125 - $369
Spot exhaust/supply ventilation using an ERV or HRV

FV-04VE1WhisperComfort™
Spot ERV Ceiling Insert Ventilator with Balanced Ventilation and Patent-Pending Capillary Core

Spot ERV  WhisperComfort is a ceiling insert sport ERV ideal for a single room. The unit provides a low rate of continuous air exchange. Fresh air is supplied while maintaining balanced air pressure. This is an affordable way to add ERV to a specific room or a new addition. Ideal for home office, game rooms, family rooms

$449
Supply-only ventilation

$200 to $400 more or less

Note: With this system you need relief openings in the building envelope or you will pressurize the home and force moisture into the envelope.

Images from Building America
Central fan integrated supply
Central fan integrated supply

AirCycler® g2-k $369.95 USD

Combine the AirCycler® g2 controller with the FanConnect™ switch and a 6" Motorized Damper for a complete Whole-House Ventilation System.

$143.95 USD
Balanced ventilation using an ERV or HRV

- Stale air to outside
- Fresh air to outside
- Fresh air to your home
- Stale air from your home
- Recovery core where the warm inside air transfers its heat and moisture to the cold incoming fresh air
Balanced ventilation using an ERV or HRV

A whole-house ventilation system with dedicated ducting in a new energy-efficient home. |

Photo courtesy of ©iStockphoto/brebca
Balanced ventilation using an ERV or HRV

Heat Recovery and Energy Recovery Ventilators are the next step in creating a clean, healthy environment for your family.

Port Configurations

Five Port Models feature motorized damper for recirculation mode and defrost. Positive shut off of supply port when unit is in standby.
Balanced ventilation using an ERV or HRV

RenewAire
Energy Recovery Ventilation
Balanced ventilation using an ERV or HRV

Broan HRV90HT Heat Recovery Ventilator

$974.10
Balanced ventilation using an ERV or HRV
One fan provides both supply and exhaust ventilation.

Manufactured in Germany, the Lunos e2 fan reverses direction every 70 seconds.

When two such fans are connected to a controller that synchronizes the fan reversal sequence, a pair of fans can work together to provide supply and exhaust ventilation. Frequent reversal of the fan direction allows the ceramic heat-storage core to recover heat that would otherwise be lost in the exhaust stream.
Natural Ventilation

$\$ Price varies
What are your best practices?
Resources

• 2012 IRC
• 2012 IECC
• 2012 IMC
• ASHRAE Standard 62.2
• Greenbuildingadvisor.com
• Building America Solution Center: 
  http://basc.pnnl.gov
Heyoka Solutions
384 page ventilation guide
$54.37 on amazon

buildingscience.com