

Ventilation and Indoor Air Quality

Gary Nordeen
WSU Energy Program
(360) 956-2040
nordeeng@energy.wsu.edu

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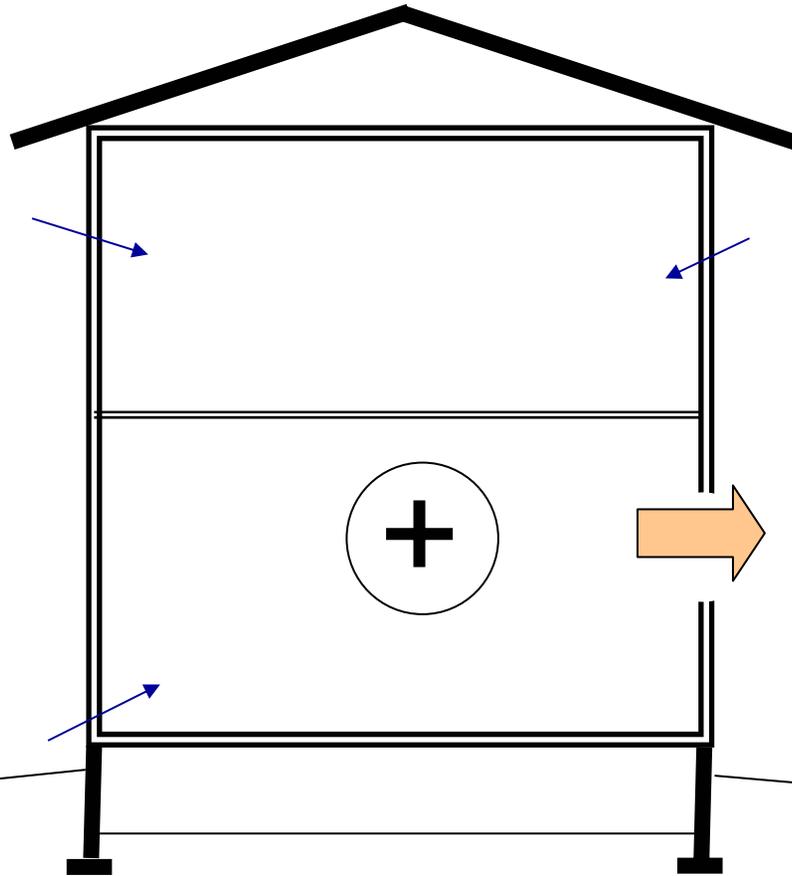


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Ventilation Basics

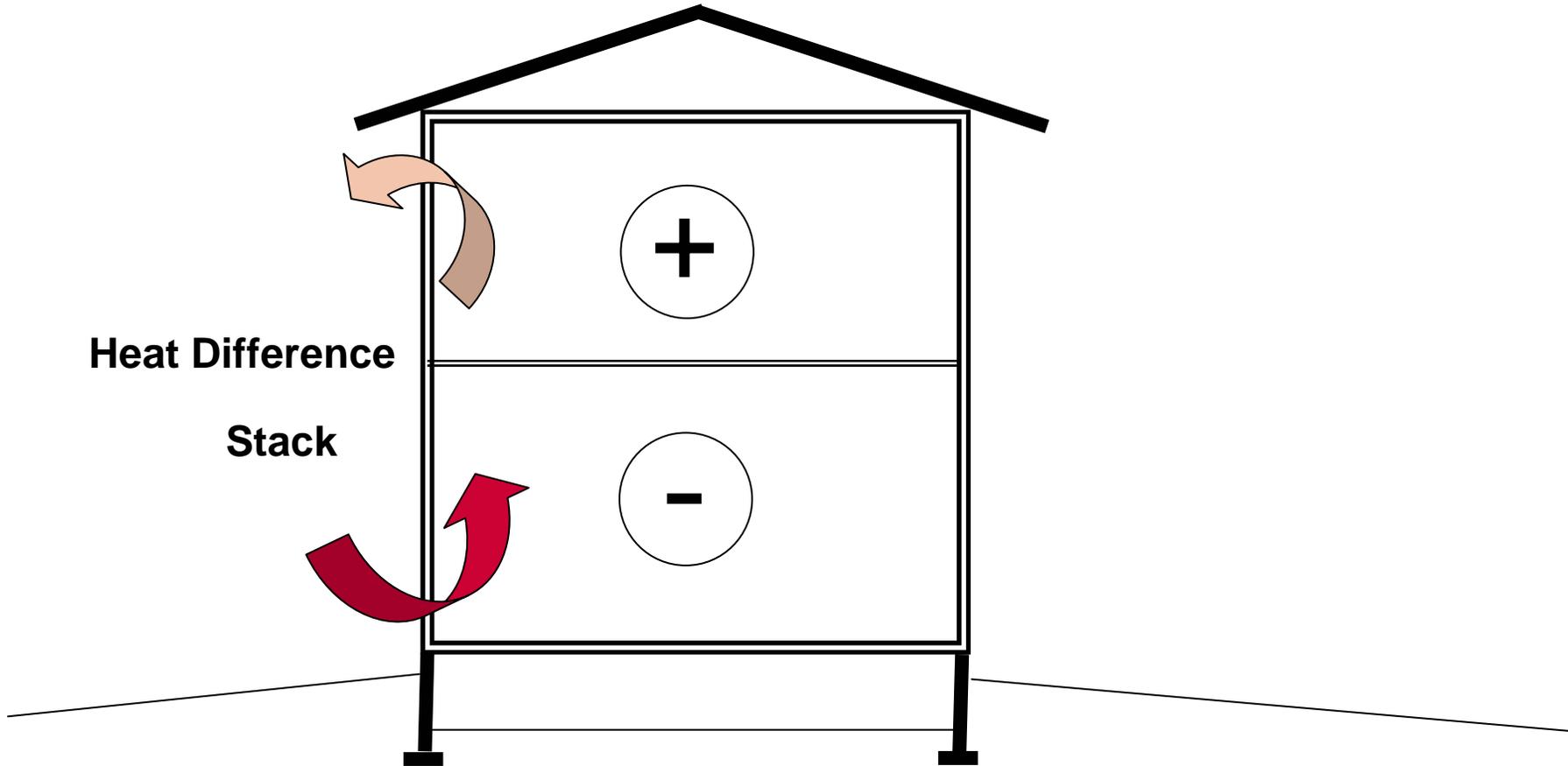




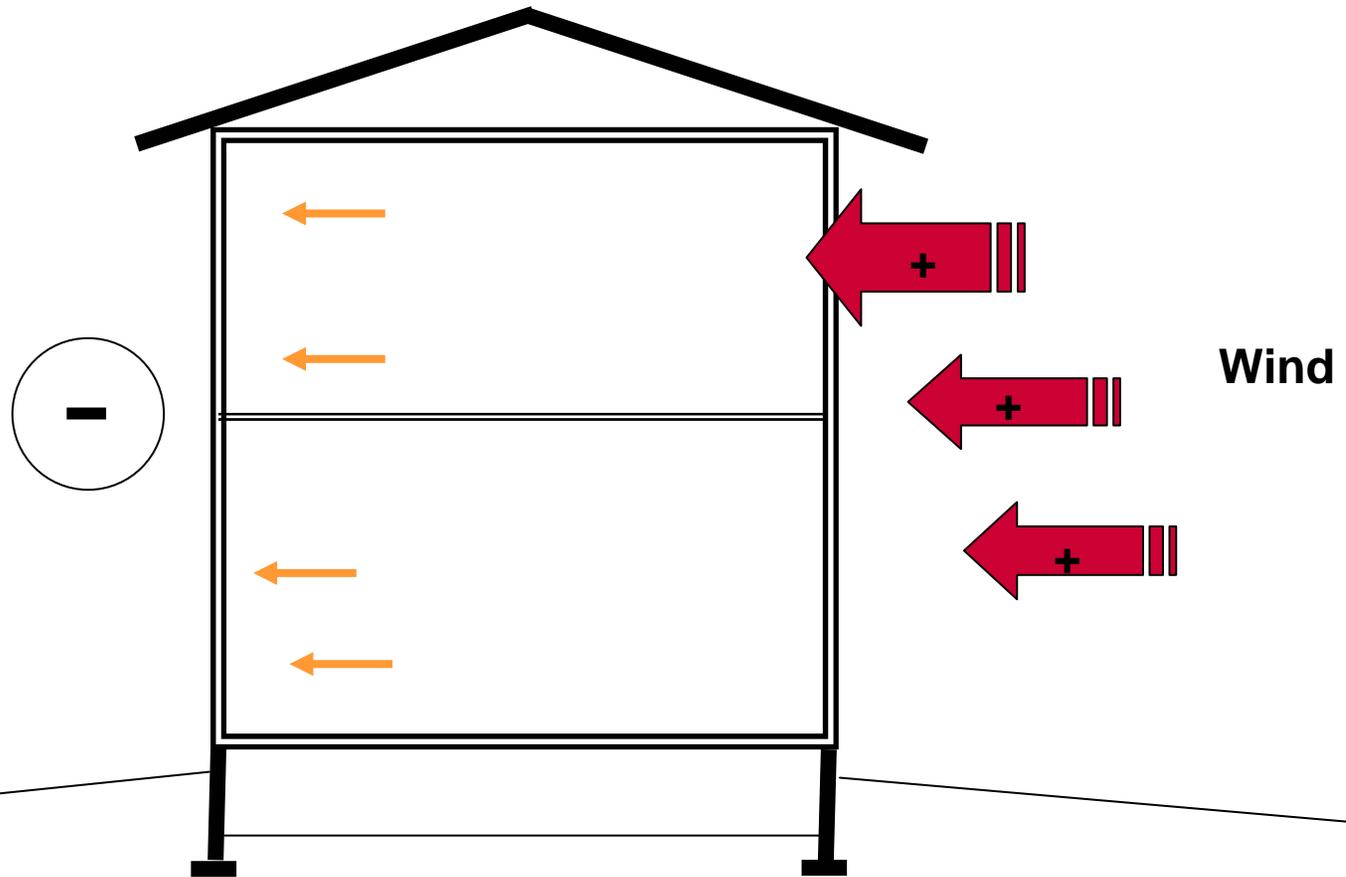
**Ventilation Requires a
Hole and a Driving
Force**

CFM out will = CFM in

Natural Driving Forces



Natural Driving Forces



Can't We Just Use Natural Ventilation?

- **Not reliable**
 - **Hard to control**
 - **May waste energy**
 - *A combination of a tight house, and a mechanical ventilation system is more reliable and less expensive to operate.*
-

Why Mechanical Ventilation?

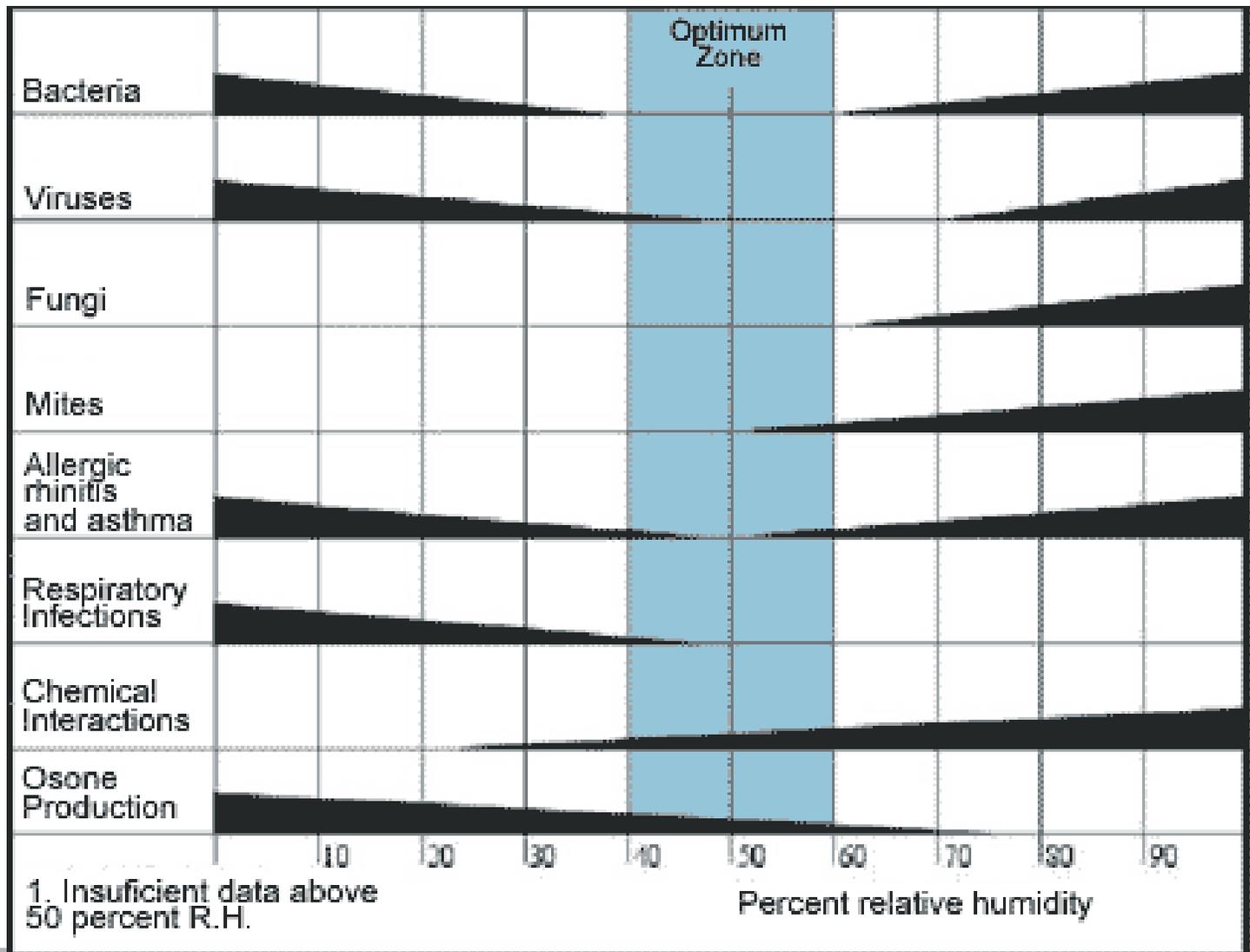
- Indoor air may be more polluted than outdoor air
- Off gassing of building materials, household chemicals, etc



Moisture and Mold

- Average family of four produces **2 to 3** gallons of moisture per day
- Most molds grow at 60%(+) relative humidity (RH)
- Dust mites need 45% to 50% RH





Enforcement of IRC and IECC will result in tighter houses

- A well-sealed home and duct system is required
 - Window and door sealing
 - Building envelope sealing
 - Plumbing penetrations
 - Electrical penetrations
 - Ducts and Air Handlers



ANSI/ASHRAE Standard 62.2-2004
(Includes ANSI/ASHRAE addenda listed in Appendix C)



ASHRAE STANDARD

Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

See Appendix C for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submital form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site, <http://www.ashrae.org>, or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2000. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-836-6400 (worldwide), or toll free 1-800-527-4723 (for orders in U.S. and Canada).

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1791 Tullie Circle NE, Atlanta, GA 30329
www.ashrae.org

STD
ASHRAE
62.2
2004

Types of Mechanical Ventilation

- ***Local Exhaust*** Ventilation
 - Sometimes referred to as “Spot Ventilation”
 - Removes pollutants, steam, odors at their source
 - ***Whole Building*** Ventilation
 - Supplies fresh air to a structure through the use of:
 - Exhaust Fans
 - Forced Air System
 - Supply Fan
 - Heat Recovery System
-

Local Exhaust Ventilation Locations

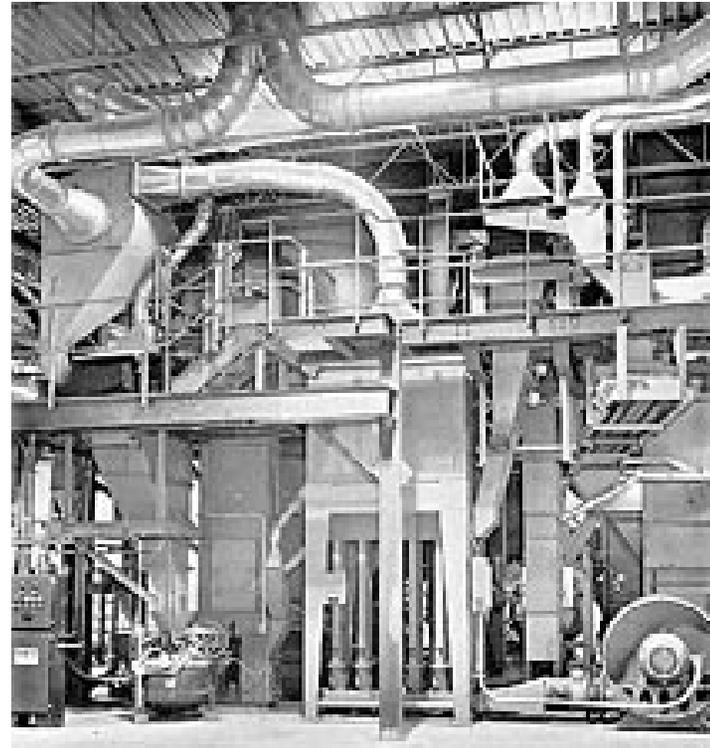
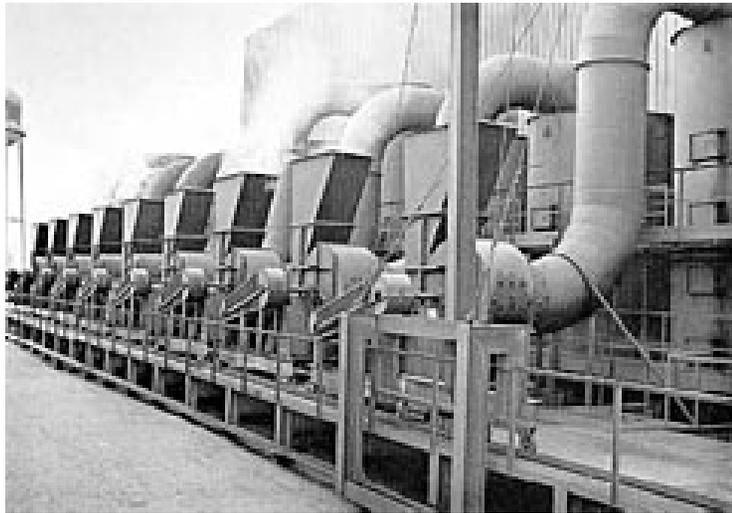


- **Kitchens:**
- **100 cfm intermittent**
- **25 cfm continuous**

- **Baths:**
- **50 cfm intermittent**
- **20 cfm continuous**



Whole Building Ventilation



Mechanical Ventilation Successful Design Criteria

- **Supplies the design Air Change**
 - **Acceptable to the occupant**
 - **Quiet**
 - **Operation costs are low**
 - **Operation is simple to understand**
 - **Does not create an unsafe condition**
 - **Combustion back drafting?**
-

Continuous or Intermittent Operation?

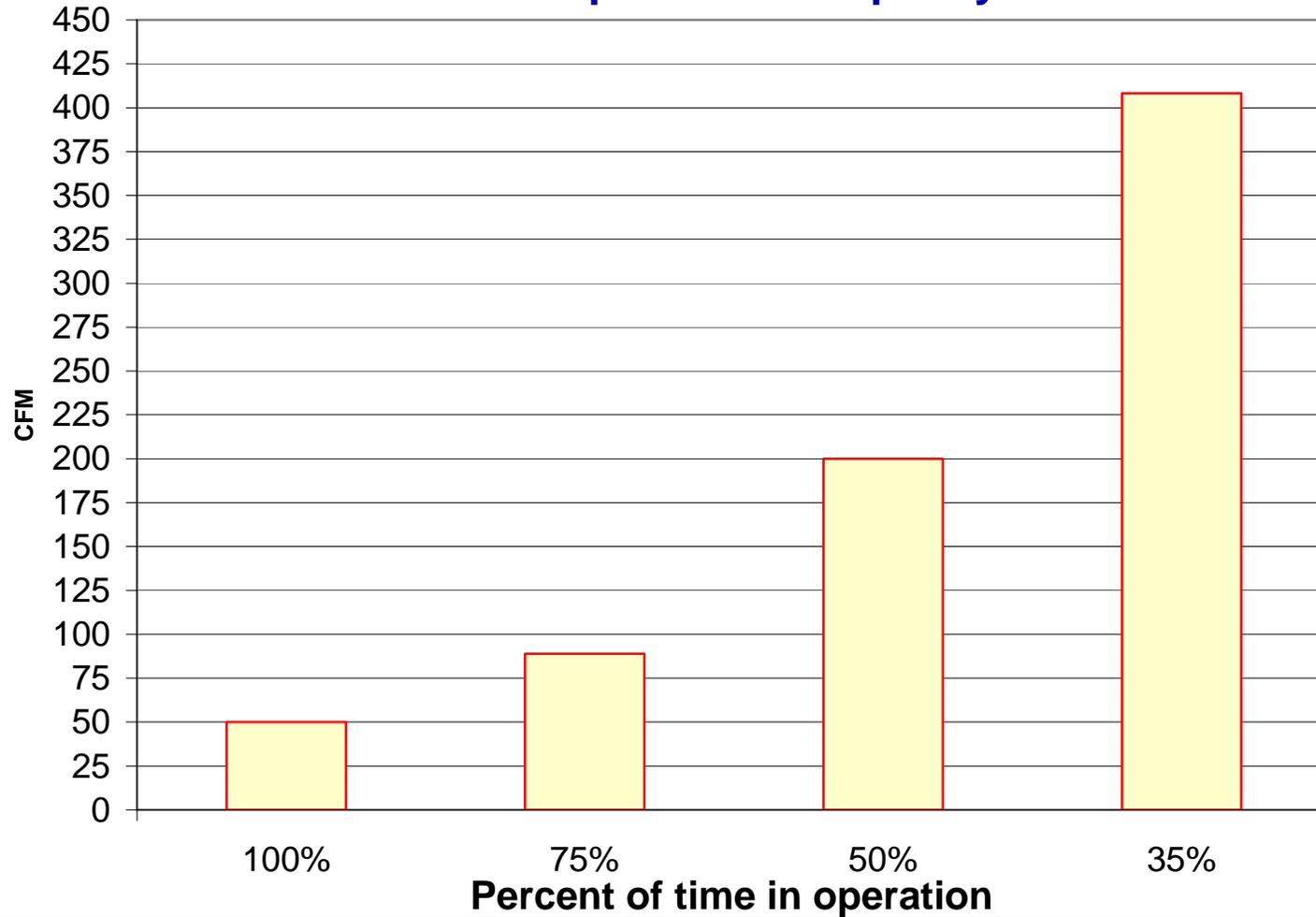
- ASHRAE 62.2 focuses on continuously operating systems
 - Intermittent systems may be used but significantly larger fans are required
 - Intermittent systems are sized based on:
 - Ventilation Air Requirements from Table 4.1a
 - Ventilation Effectiveness
 - Daily Fractional On-Time
-

Sizing the fan

TABLE 4.1a (I-P)
Ventilation Air Requirements, cfm

Floor Area (ft ²)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500	30	45	60	75	90
1501-3000	45	60	75	90	105
3001-4500	60	75	90	105	120
4501-6000	75	90	105	120	135
6001-7500	90	105	120	135	150
>7500	105	120	135	150	165

ASHRAE 62.2-2003 Continuous and Intermittent Ventilation Required Fan Capacity



Ventilation Ducts

- **Sized per 62.2 Table 7.1**
- **Must terminate outside the building***
- **Insulated to R-4 when outside the heated space***
- **Terminal elements screened and sized correctly***

* ***Good practice-not a 62.2 requirement***

ASHRAE 62.2 Table 7.1

TABLE 7.1 Prescriptive Duct Sizing

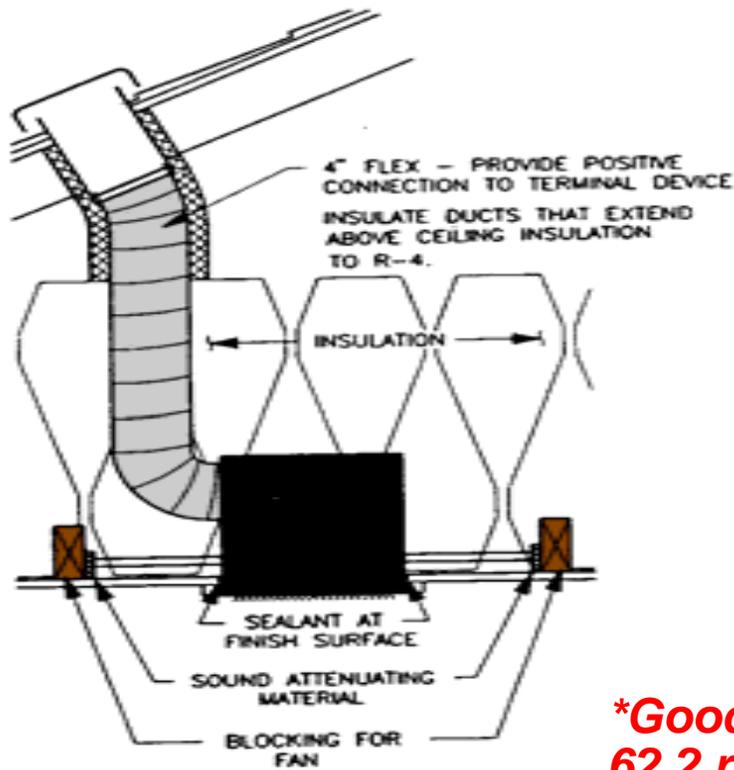
Duct Type	Flex Duct				Smooth Duct			
Fan Rating CFM @ 0.25 in. wg (L/s @ 62.5 Pa)	50 (25)	80 (40)	100 (50)	125 (65)	50 (25)	80 (40)	100 (50)	125 (65)
Diameter in. (mm)	Maximum Length ft. (m)							
3 (75)	X	X	X	X	5(2)	X	X	X
4 (100)	70(27)	3(1)	X	X	105(35)	35(12)	5(2)	X
5 (125)	NL	70(27)	35(12)	20(7)	NL	135(45)	85(28)	55(18)
6 (150)	NL	NL	125(42)	95(32)	NL	NL	NL	145(48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 feet (5 m) of allowable duct length for each elbow.

NL = no limit on duct length of this size.

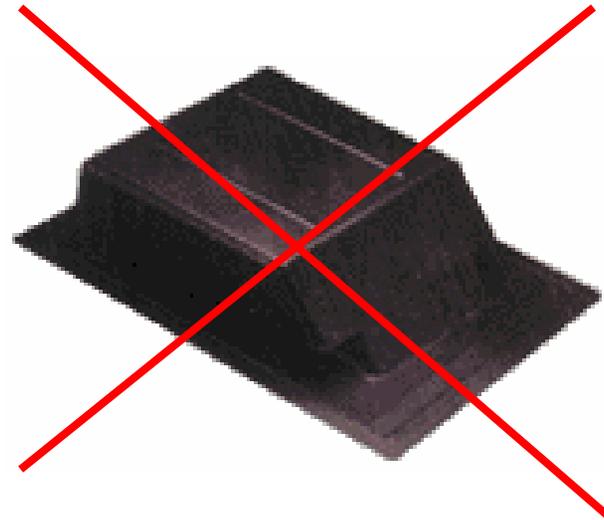
X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.

Exhaust Duct Insulation (R-4)*



**Good practice-not a 62.2 requirement*

Use the correct duct termination



Local Exhaust Fan Controls

(Intermittent)

- *Shut-off timers*
- *Occupancy sensors*
- *Multiple-speed fans*
- *Combined switching*
- *Indoor air quality sensors*



***Continuous operation
requires an occupant
override control***

Whole House Fan Requirements

- **CFM rated at .25 inches water gauge**
 - **Maximum noise rating is 1.0 sones**
 - **Applies when the fan motor is within 4 feet of the interior pick up grille.**
 - **Must be labeled**
 - **Must be designed to operate during occupied hours with a mechanical override**
-

CFM at .1" W.G.

DO NOT REMOVE THIS LABEL.

NOT FOR USE IN KITCHENS.

To protect finish, wash with mild soap or detergent only.

MODEL	VOLTS	HZ	AMPS	CFM	SONES
S110U-A	120	60	0.7	110	1.5

PERMANENTLY LUBRICATED MOTOR.

MAY BE USED OVER TUB OR SHOWER WHEN INSTALLED IN A GFCI BRANCH CIRCUIT.



Broan-NuTone LLC

DISCONNECT POWER AT SERVICE ENTRANCE BEFORE CLEANING OR SERVICING.

VI 53027

10L



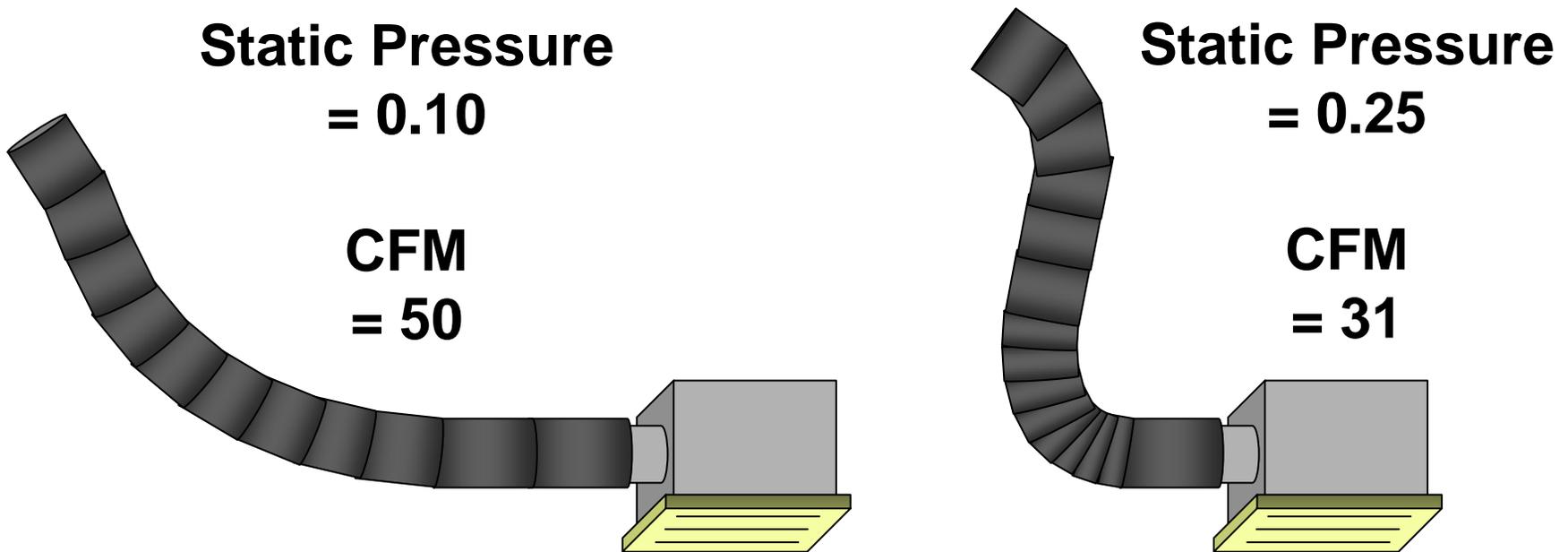
LISTED FANS
969G
E17814



H 990717200B

Fan Static Pressure and CFM

The label on the box says 50 CFM, but....



PERFORMANCE RATINGS

SOLITAIRE ULTRA-SILENT® BATH FANS - MODELS S50UE, S80UE, S110UE

AMCA LICENSED PERFORMANCE

Model	Sones @ 0.0" Ps	CFM @ Static Pressure (in. wg Ps)					Volts	Hz	Watts	RPM	Duct Size
		0.0"	0.1"	.125"	.250"	.375"					
S50UE	< 0.3	66	52	48	32	17	120	60	19	720	4" Diameter
S80UE	0.9	90	79	77	62	49	120	60	24	1070	4" Diameter
S110UE	1.9	116	110	107	98	83	120	60	37	1240	4" Diameter

Performance shown is for installation type B - Free inlet, Ducted outlet. Speed (RPM) shown is nominal. Performance is based on actual speed of test. Performance ratings include the effects of supplied inlet grille and backdraft damper in the airstream. The sound ratings shown are loudness values in fan sones at 5' (1.5m) in a hemispherical free field calculated per AMCA Std. 301. Values shown are for installation Type B: free inlet fan sone levels.

ASHRAE 62.2 Sound Ratings

- **7.2.1 Continuous Ventilation Fans < 1 sone**
 - **7.2.1 Intermittent Fans < 3 sones**
This is loud.
 - **Exception: remote mounted fans or air handlers**
-

ASHRAE 62.2

Whole Building Ventilation Controls

- **4.2 A simple switch is acceptable**
 - **4.3 Fan controls may be “fan on switch” on a thermostat. (furnace based systems)**
 - **4.4 Intermittent operation must have a timed control.**
-

Controls

Don't forget the label



\$25



\$35



\$35

Installers need to provide operating instructions. A sample can be found at: www.energy.wsu.edu

Prices as of 3/25/04

Outdoor Air Inlets

May be necessary in unusually tight construction

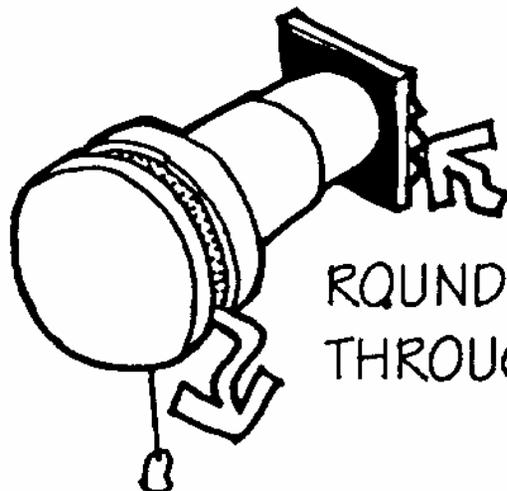
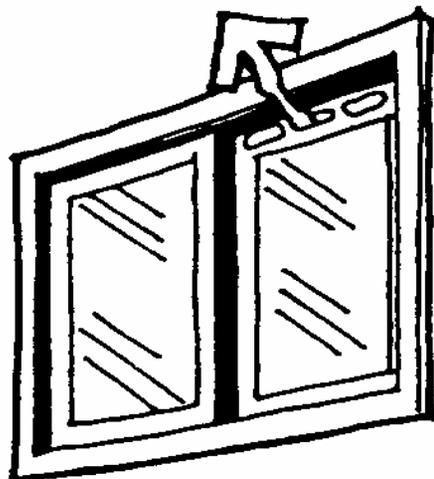
Hardware

- Controllable and secure openings
- Sleeved when installed in a window or wall
- Minimum of 4 in² or minimum 10 cfm (tested)

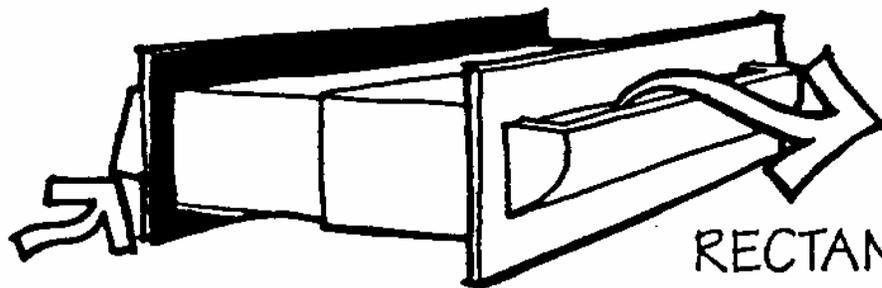
Distribution

- Undercut doors minimum ½” above finished floor
 - Install ducts, grilles, or transoms
-

INTEGRAL WITH WINDOW



ROUND
THROUGH-WALL



RECTANGULAR
THROUGH-WALL

Supply Ventilation

- **Can be integrated with existing furnace ductwork**
 - **Furnace air handler is used as the fan**
 - **Not recommended in cold climates**
 - **Furnace systems use a lot of energy**
 - **Accurate CFM requires testing**
-

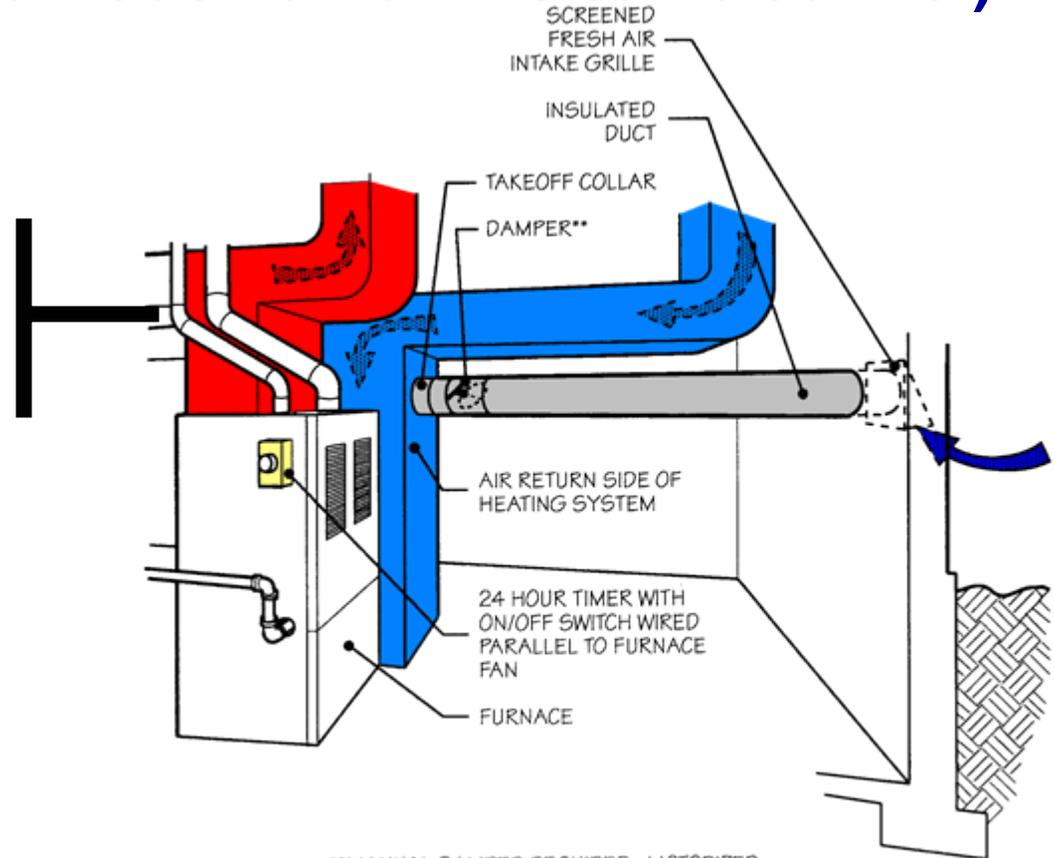
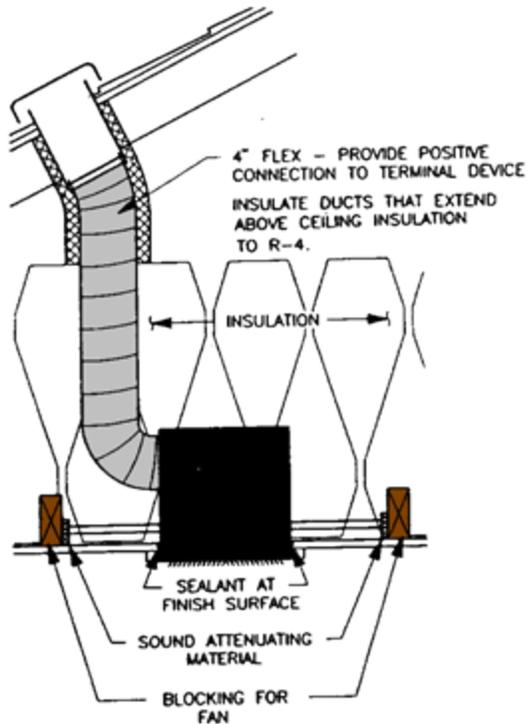
What is an Air Cycler?

- Notes furnace on-time for heating or cooling
- Only adds additional ventilation run time if needed



Old School Balanced Ventilation

(Put the furnace and exhaust fan on the same control)



**MANUAL DAMPER REQUIRED. MOTORIZED DAMPER RECOMMENDED IN SOME LOCATIONS.

Integrated System Requirements

- “Readily accessible” timer

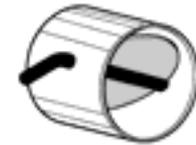
Testing is the only way to know the flow.

- Volume damper

A mechanical damper should be required.

- Terminal element outside the building

TYPES OF DAMPERS



MANUAL DAMPER



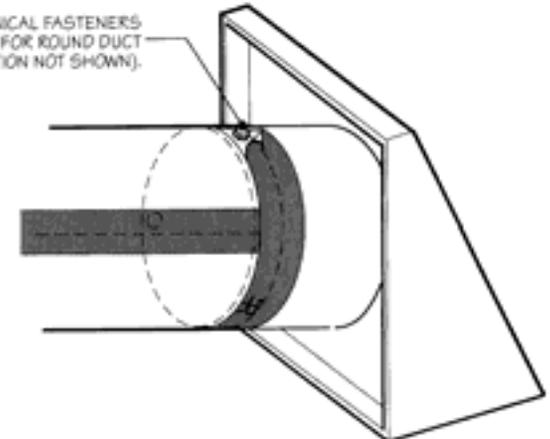
CONSTANT AIRFLOW
REGULATOR

BLADDER EXPANDS AND
CONTRACTS WITH
CHANGES IN AIR FLOW



MOTORIZED
DAMPER

THREE MECHANICAL FASTENERS
PER JOINT FOR ROUND DUCT
(INSULATION NOT SHOWN).

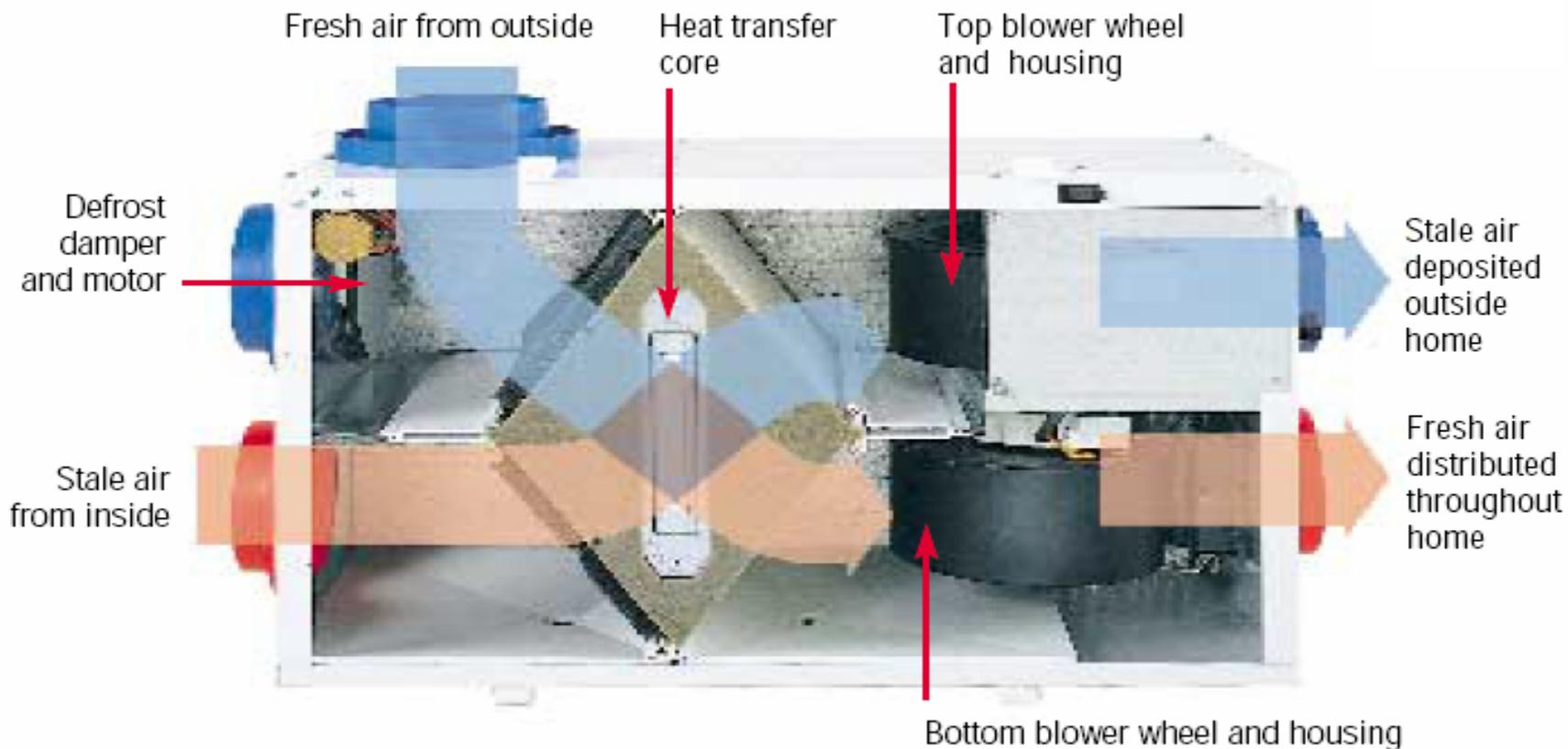


Ventilation Using a Supply Fan

- Requires a dedicated fan
 - Fresh air duct connected to furnace supply plenum or dedicated whole house ventilation duct
 - Clock timer
 - A filter
-



HRV is most likely path for balanced ventilation



ASHRAE 62.2 – 2004 Back Drafting Standard

- **Natural Vented Appliances (gas, oil and solid fuel)**
- **62.2, 6.4 Limits Unbalanced Exhaust of the two largest fans to 15 CFM /100 SF**

Example: 1500 SF home < 225 CFM

Clothes Dryer 135 CFM +

Range Hood 100 CFM = 235 CFM

Exceeds back draft standard

Combustion Air Requirements for Wood Burning Appliances*

- Must come from outside the building structure
- Must originate from a point below the firebox
- Enter through a duct
 - 4" diameter for stoves
 - 6 in² for fireplaces
 - Maximum duct length is 20'
 - Must be directly connected to the appliance

**Combustion air requirements from WA State Ventilation Code-should be considered as a good practice*

Radon Resistive Construction IRC Appendix F

- Radioactive soil gas
- Colorless
- Odorless
- Naturally occurring

***EPA estimates 5,000 to 20,000 lung cancer deaths each year.
Second only to smoking.***

World Famous **HEALTH MINE**

FREE
• BROCHURES
• DOCTOR'S REPORT

World Famous
**FREE ENTERPRISE
HEALTH MINE**
STOP HERE



America's Own
**FREE ENTERPRISE
RADON HEALTH MINE**
INFORMATION CENTER



Radon Mitigation System

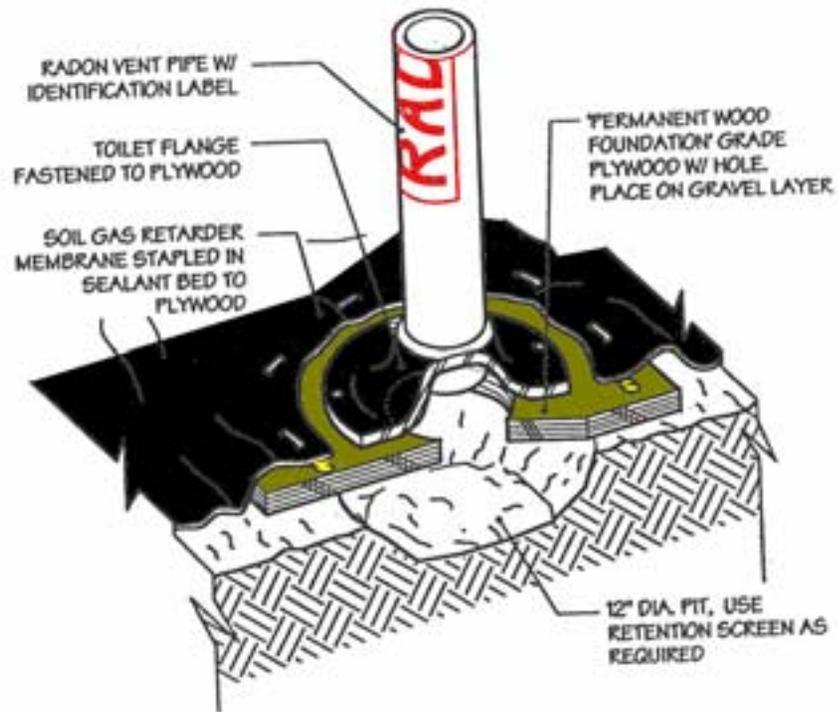
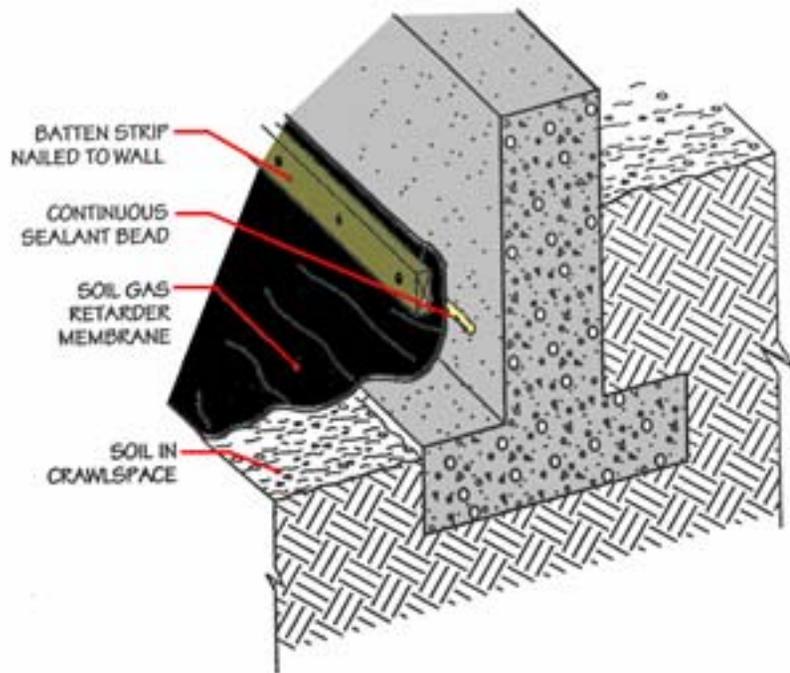
- **Parts of the system**
 - **Aggregate**
 - **Soil-gas retarder membrane**
 - **Radon vent**
 - **Location for a vent fan**
 - **Wiring**
 - **Labeling**
-

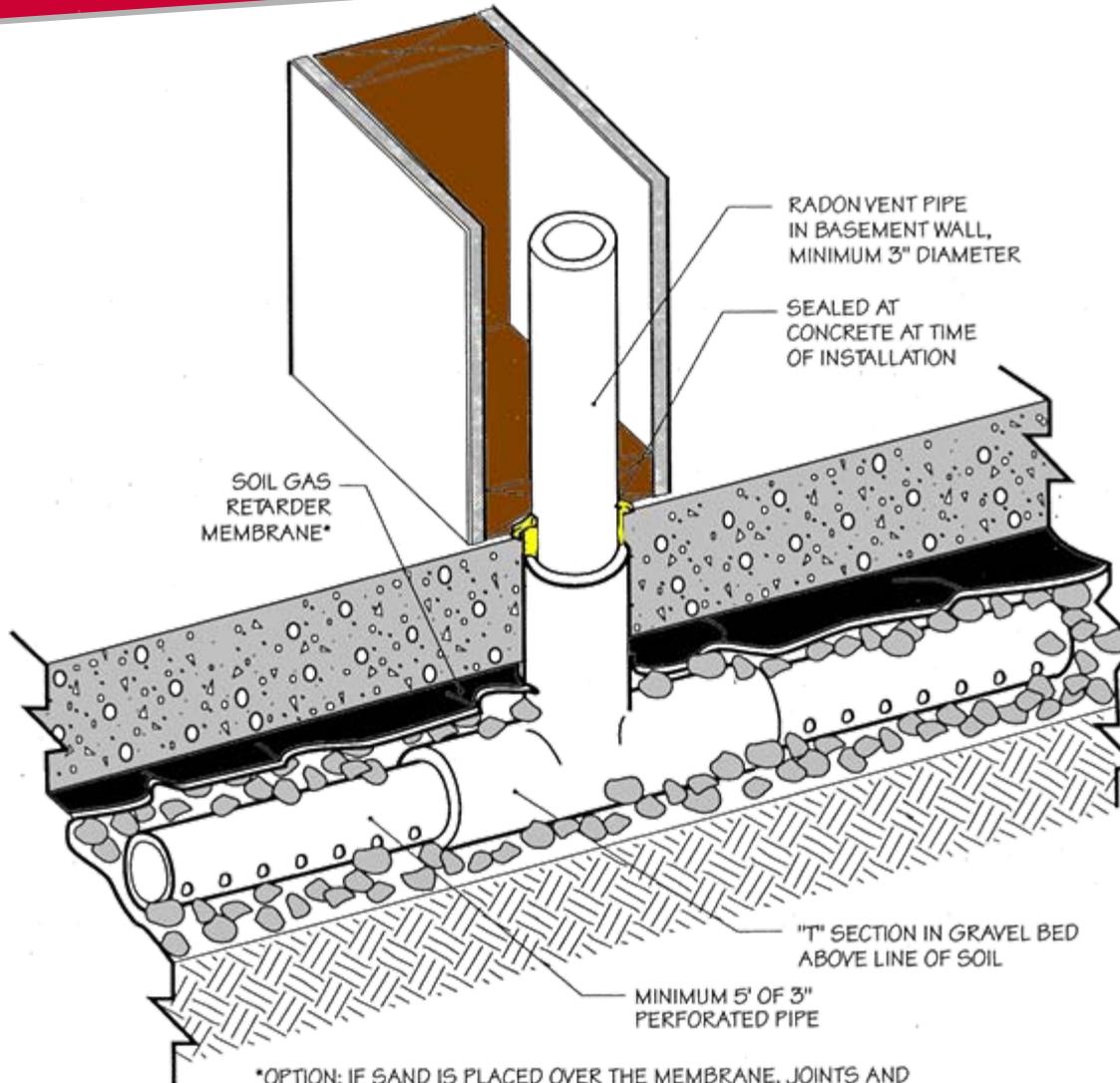
Radon Vents

- Minimum 3” diameter
 - Schedule 40 PVC, ABS or approved equal
 - Terminate 12” above eaves (minimum)
 - Terminate 10’ horizontally from chimneys or operable windows
 - Should be sloped to drain
 - Visibly labeled “**Radon Vent**”
 - Located within the thermal envelope to the extent practicable
-

Concrete Slabs

- **Placed on a minimum 4"-thick layer of graded aggregate**
 - **Placed directly on a soil gas retarder membrane**
 - **Can be placed on a 2" bed of sand or pea gravel**
 - **Soil gas retarder membrane should be overlapped 12"**
 - **Sealed at all penetrations to limit entry of radon into indoor air**
 - **Connected directly to a radon vent**
-





*OPTION: IF SAND IS PLACED OVER THE MEMBRANE, JOINTS AND PENETRATIONS IN THE MEMBRANE MUST BE SEALED.

“Our Opinion”

- **Adopt ASHRAE 62.2 – 2004**
 - **Require local exhaust**
 - **Encourage upgrading the local exhaust fans to meet the ASHRAE whole house standard.**
 - **Put a label on the control: “Whole house ventilation, operate continuously”.**
 - **Provide Instructions to the home owner.**
 - **Only provide more aggressive ventilation strategies when the occupant has specific respiratory problems. (i.e. HRV at high rates)**
-