B.S. 101

(building science)

for

Home Energy Upgrades

Durable • Healthy • convenient • Resource-efficient • Practical

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LaHouse Home and Landscape Resource Center
LSU AgCenter Research & Extension
Building America U.S. Department of Energy Research Toward Zero Energy Homes

A House is a System

of *dynamic*, interacting systems…

Thermal Envelope System ⟺ Air Barrier System

HVAC System ⟺ Moisture Control System

Plumbing System ⟺ Electrical System

Building Envelope:

The Driving Forces

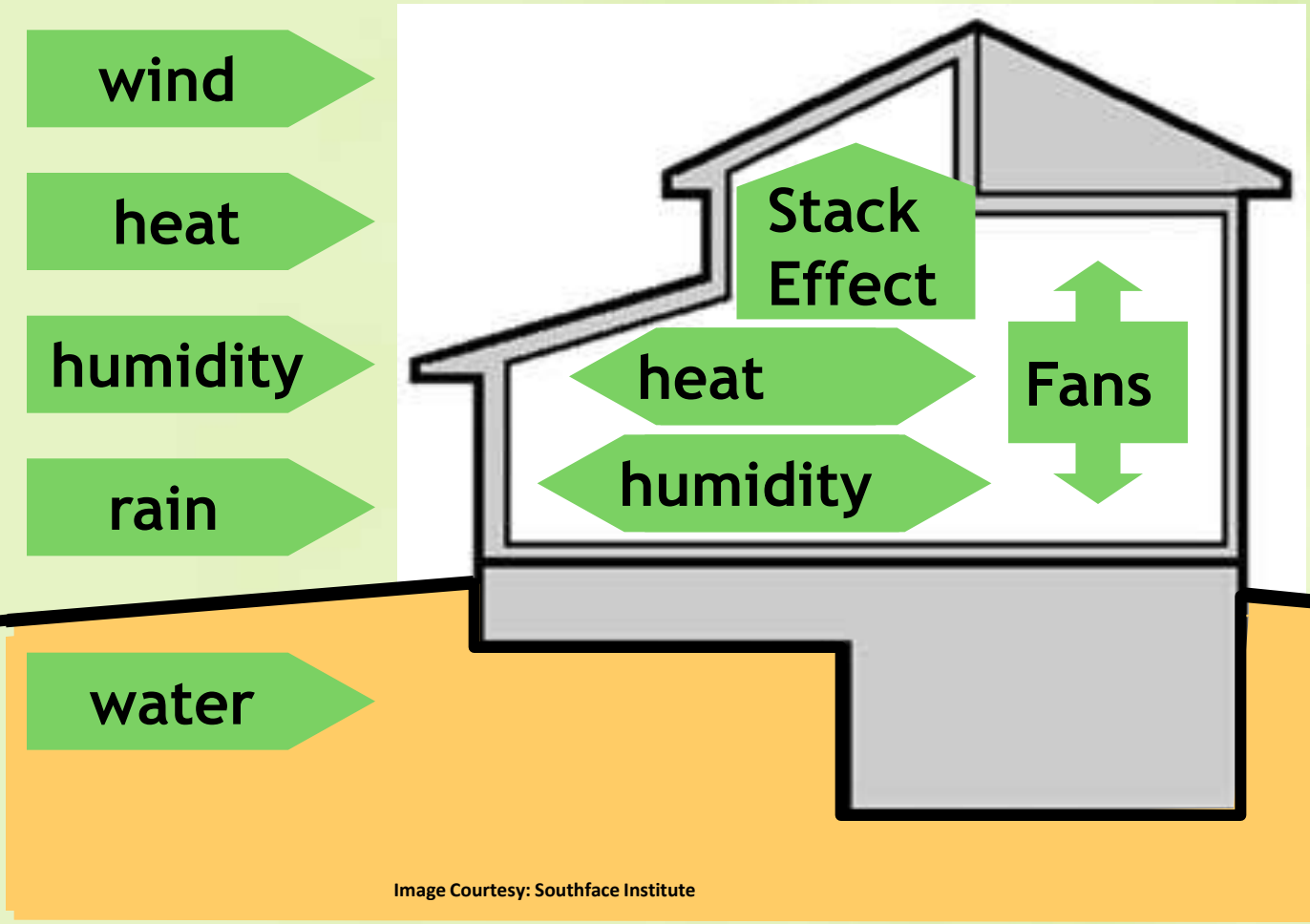
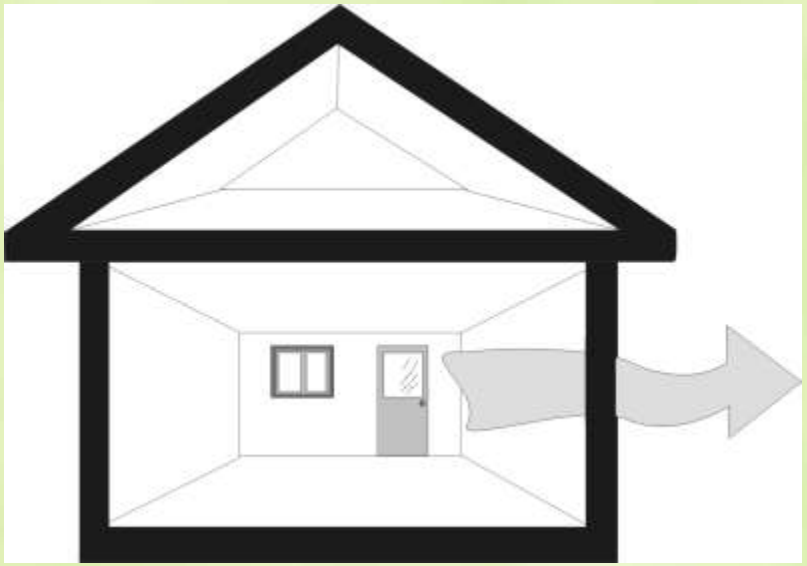


Image Courtesy: Southface Institute

How Heat Flows

Conduction

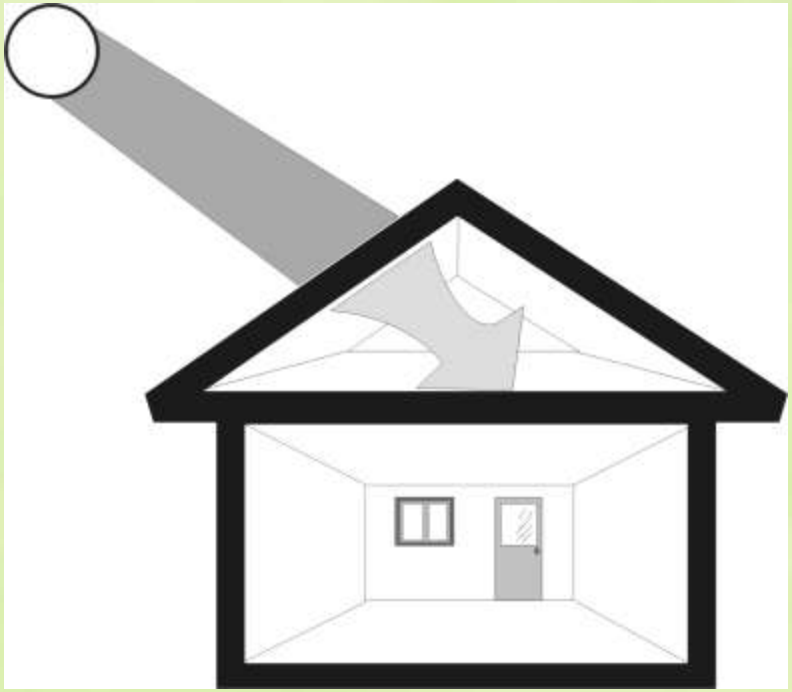
- The transfer of heat through solid objects.
- Insulation, multiple layers of glass in windows, reduce conduction.



How Heat Flows

Radiation

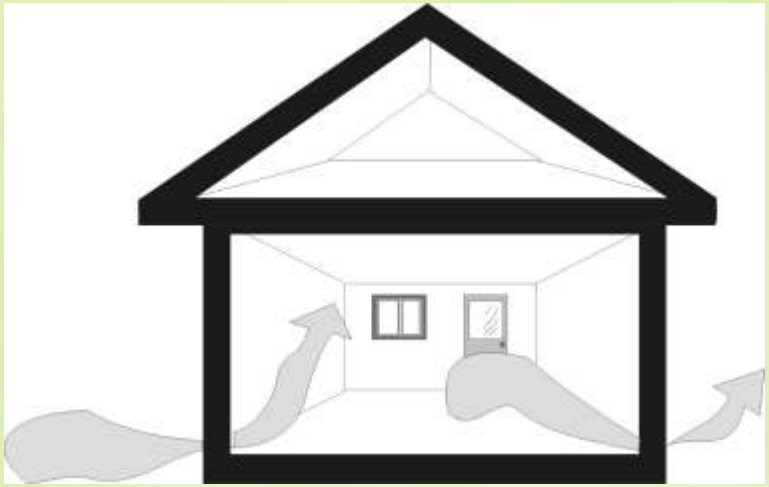
- **Movement of radiant energy *across empty space* from warmer to cooler objects.**
- **Examples:**
  - Sunshine (solar heat) heats roof deck and brick veneer.
  - Hot roof deck radiates to attic floor; brick veneer to wall.
  - Solar and radiant heat from pavement passes through clear glass,heats floor.



How Heat Flows

Convection

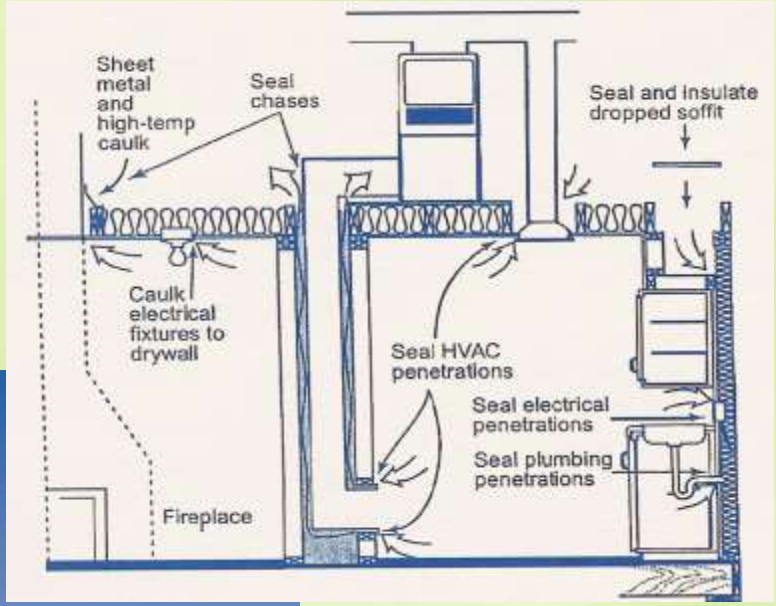
- The flow of heat by currents of air.
- As air warms, it rises; as it cools, it gets heavier and sinks.
- Air flow into a home is *infiltration*;
- Outward flow is called *exfiltration.*
- *Air leakage* is both.



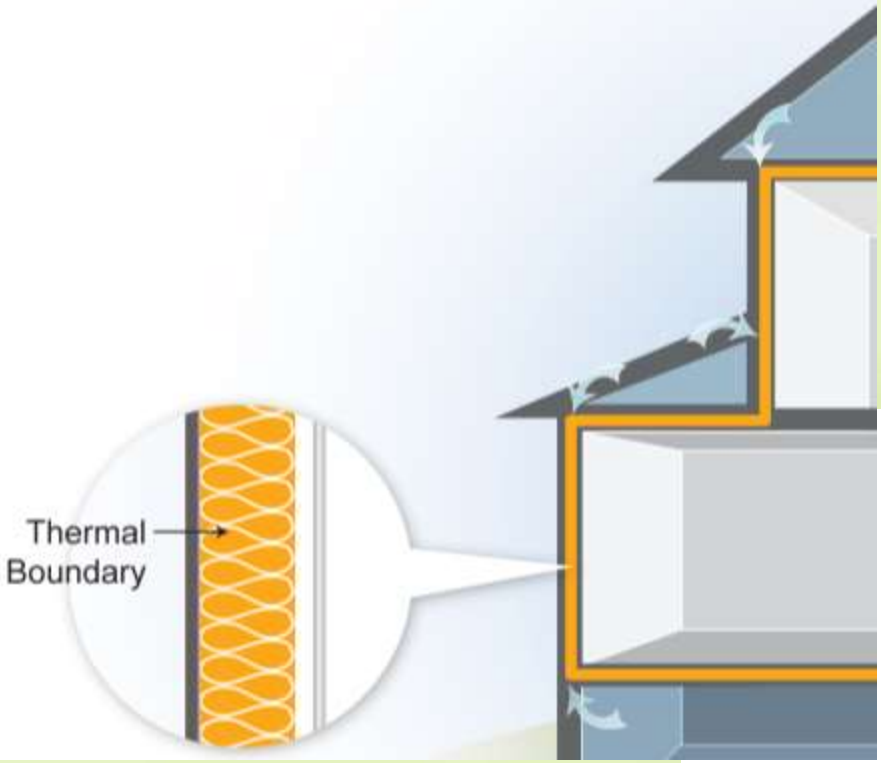
Air leakage

Typical Air Bypasses (Leaks)

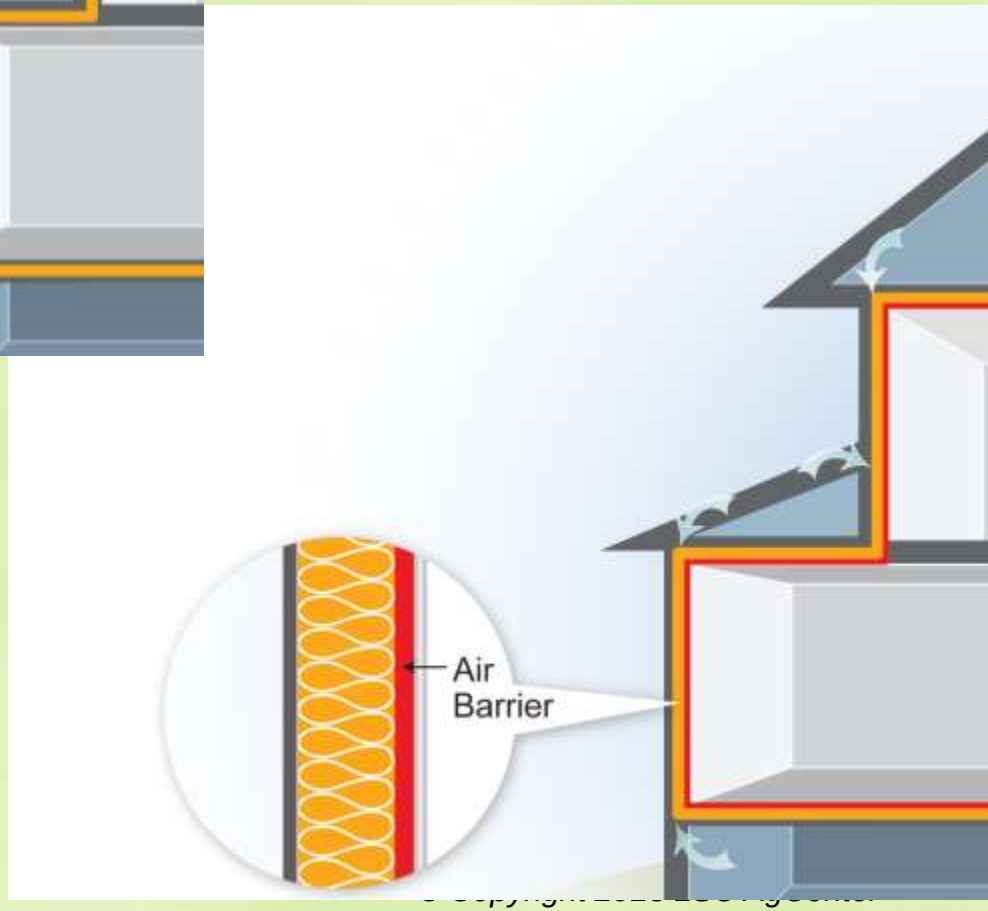
largely *to the attic and crawl space*



Where is the boundary of the conditioned space?



The thermal (insulation) and air barrier boundaries must be in direct contact.



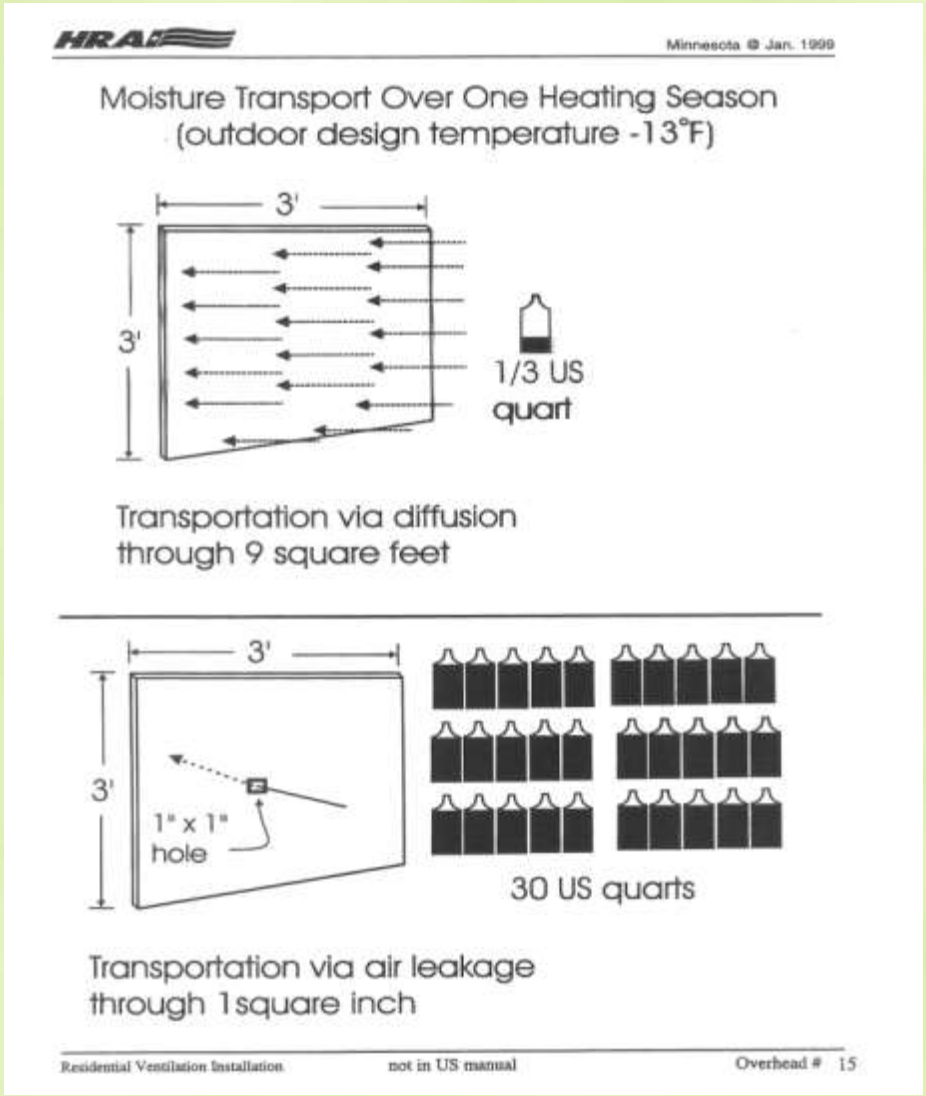
An ice chest full of holes won't keep your beer cold.

A house thermal blanket full of gaps and thin spots will need a lot more ice.

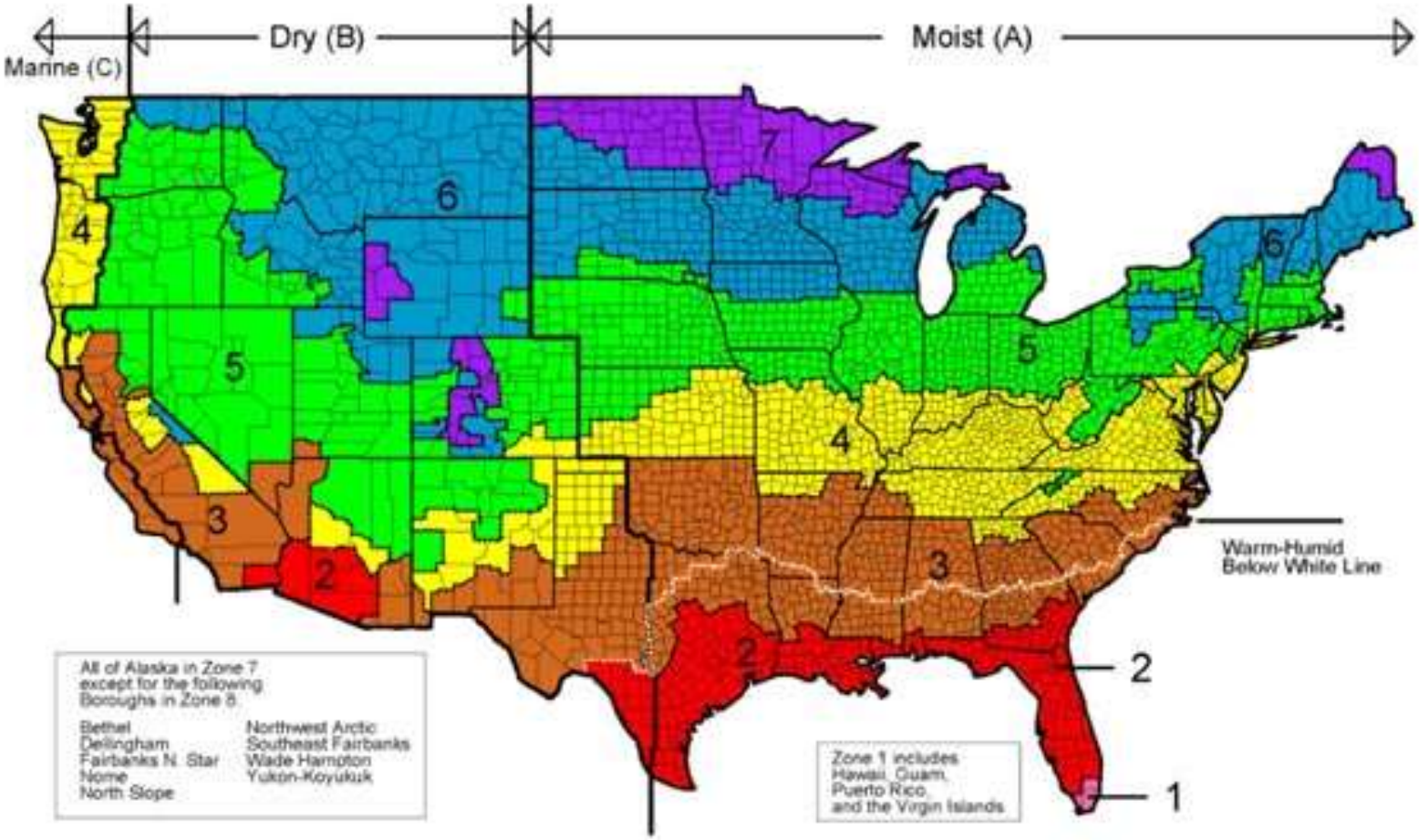
A *Continuous* Air Barrier

Why so important?

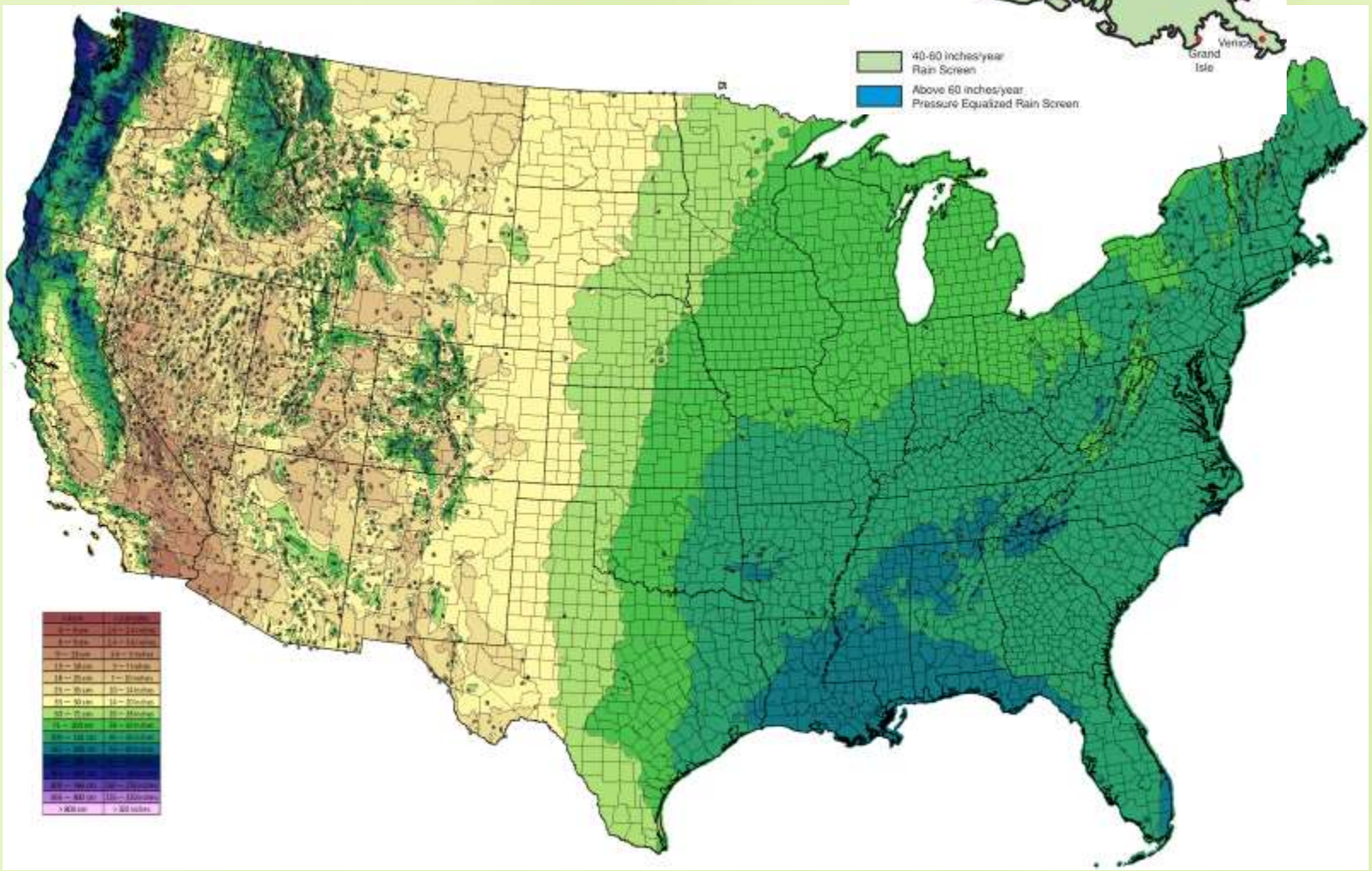
- Saves **energy**
- Saves **money**
- Controls **air quality**
- Increases **comfort**
- Reduces **moisture into building cavities**



Climate Zones



Rainfall



Keeping It Dry

Rain and Moisture Management

Wet happens…
but can it dry???

Moisture Dynamics

Liquid water flows downward,

except when it doesn't

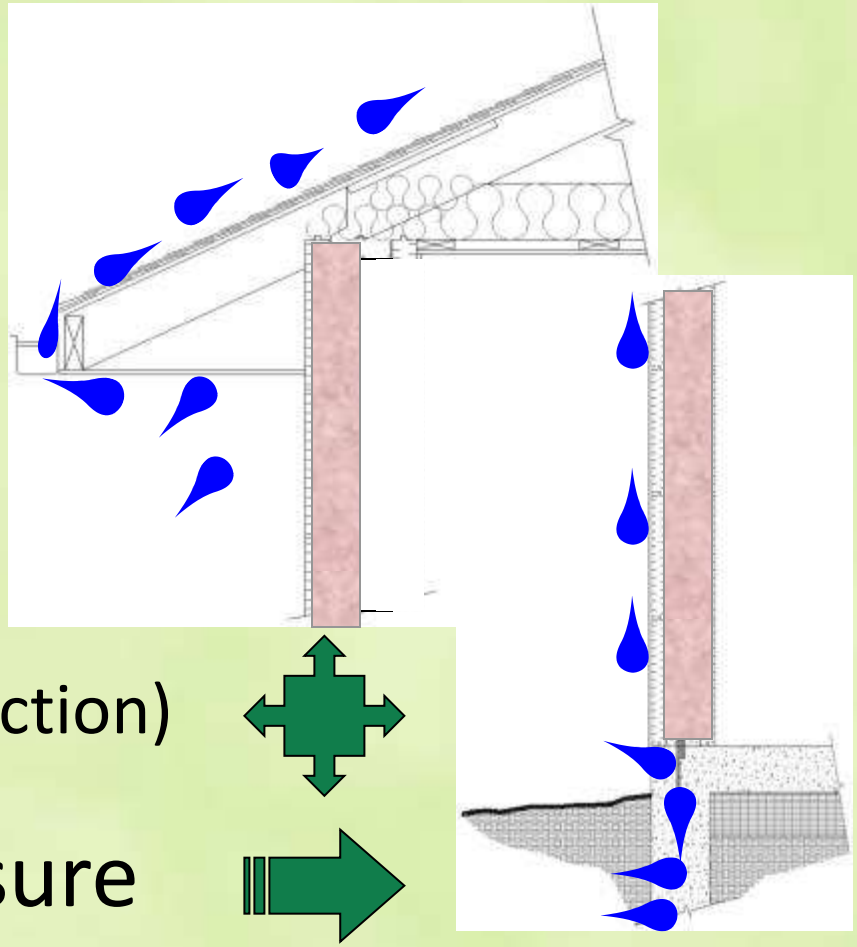
Gravity

Adhesion

Wind

Wicking (capillary action)

Hydrostatic pressure

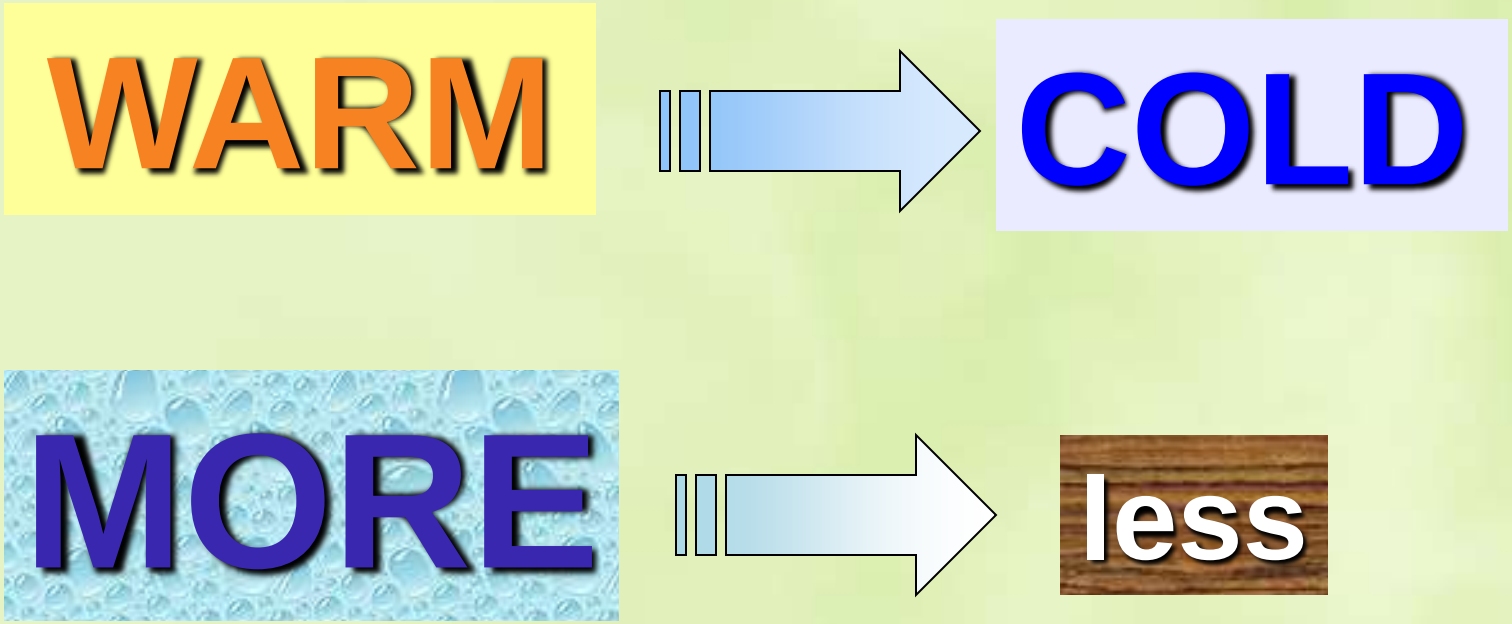


Water *Vapor* Moves by:

Air transport

Diffusion
through materials

Moisture Flows…



So….

Which way does it flow?

?

Which is wetter?
Which is warmer?

a. Outside air

b. Inside air

So….

Which way does it flow?

Cold, dry outside
Cozy inside

Hot, humid outside
Cool, dry A/C inside

Relative Humidity (RH)

$$\frac{\text{Amount of } H_2O \text{ in air}}{\text{Amount of } H_2O \text{ air can hold at that temperature}}$$

Humid air + cold surface = condensation

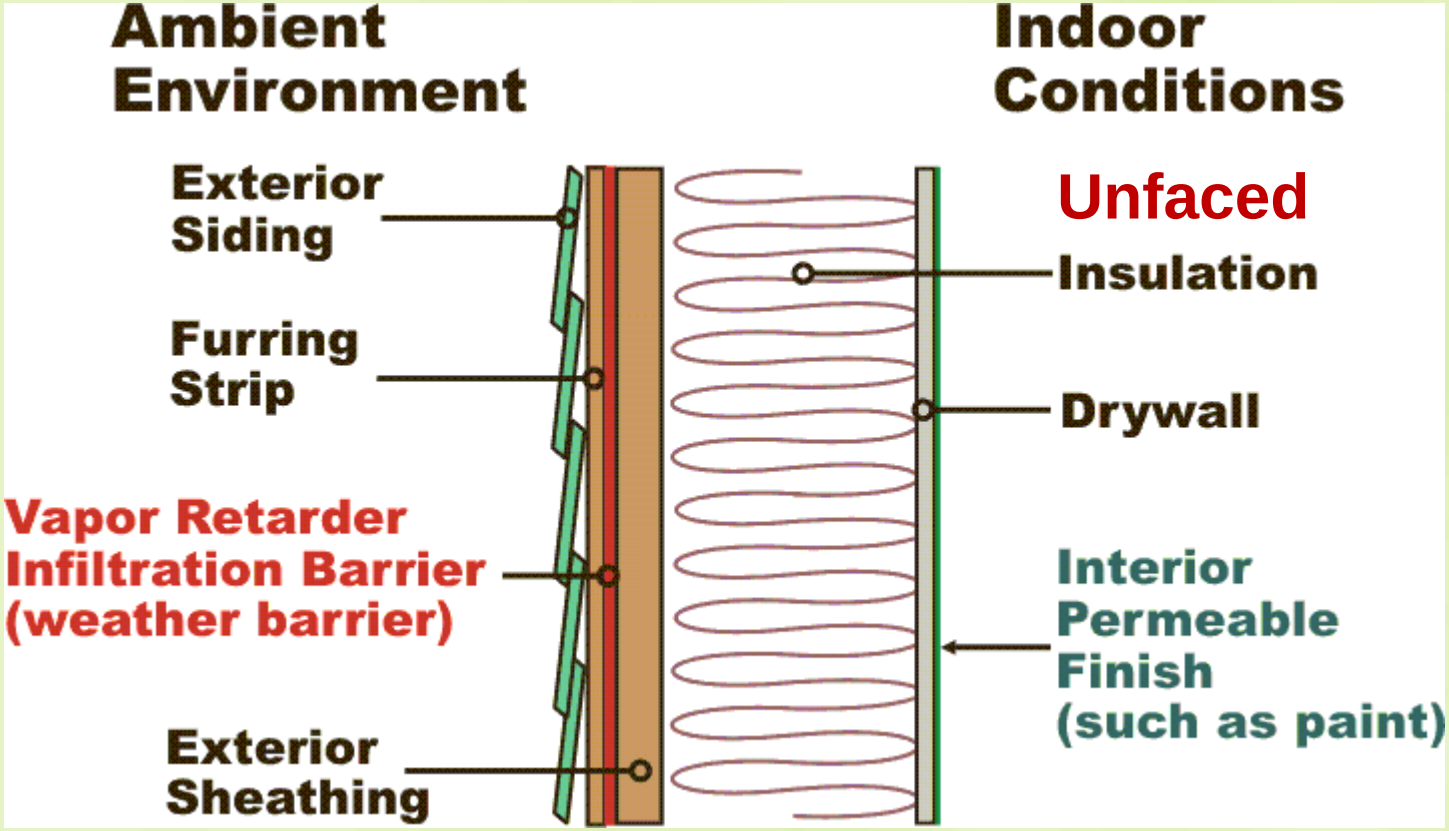
Recipe for lawyer wealth

Warm, wet weather
+ cool A/C
+ vinyl wallpaper
= mold

Water Vapor Permeability

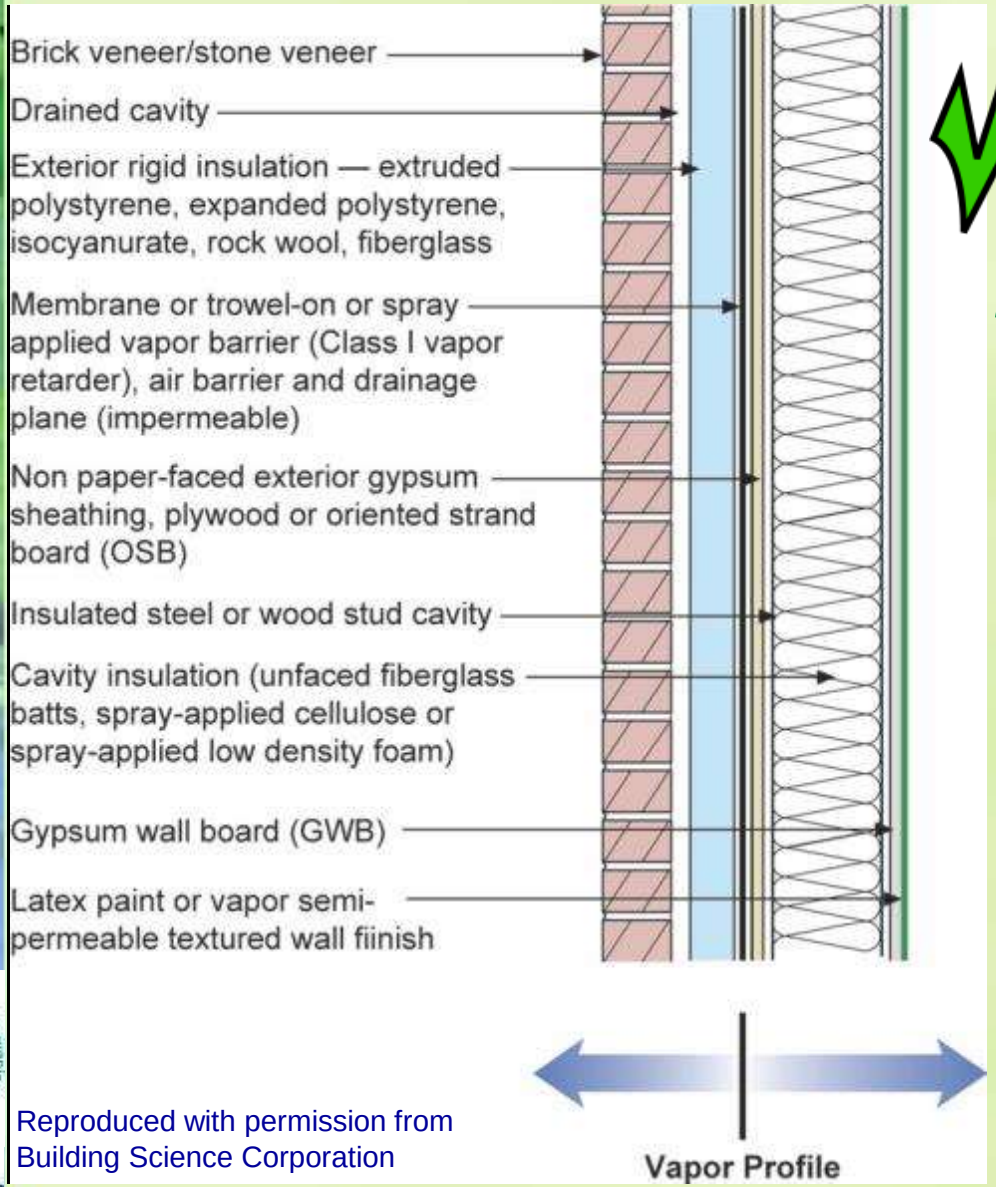
Perm Rating	Class	Descriptor
≤ 0.1	1	Vapor barrier
> 0.1 ≤ 1.0	2	Vapor retarder
> 1.0 ≤ 10	3	Semi-permeable vapor retarder
> 10	4	Vapor permeable

Warm, Humid Climate Assembly



Low permeability **High permeability**

Dries to the inside



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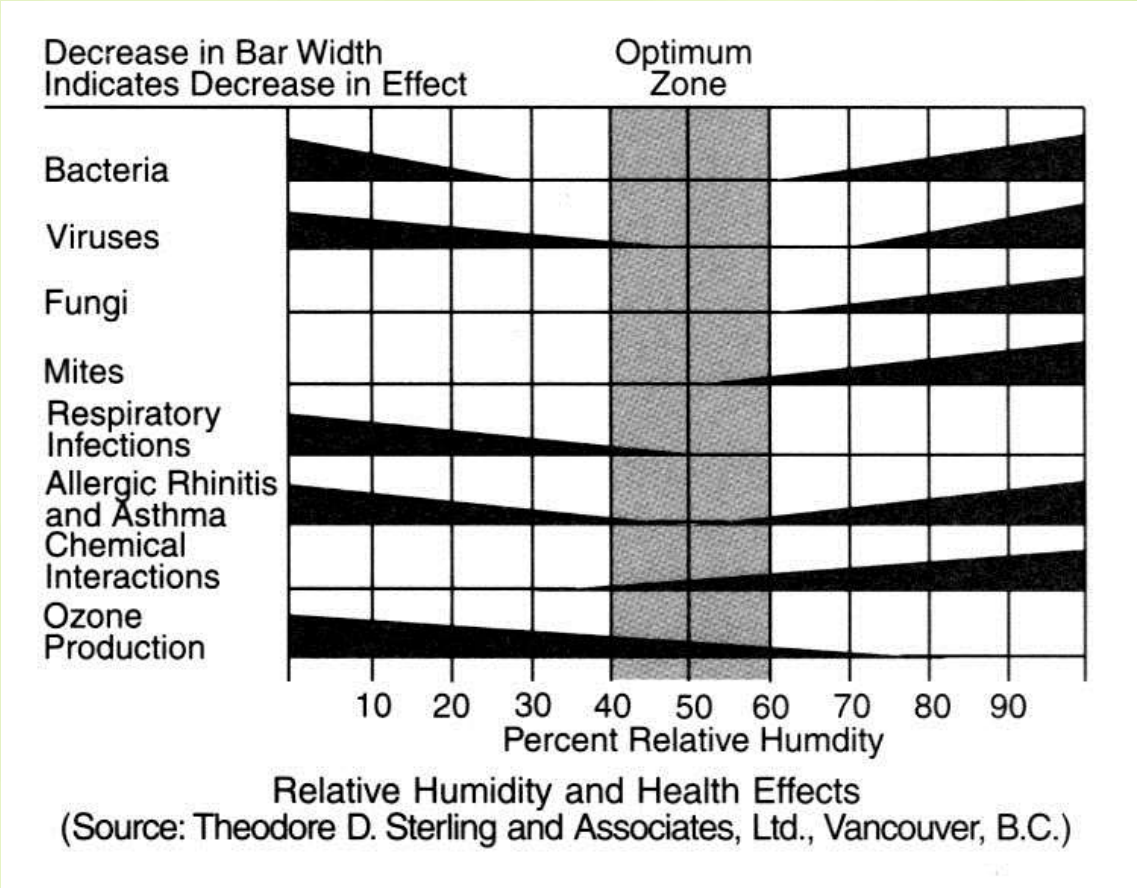
All-Climate High-Performance Solution

- ***in summer*, foam board provides exterior vapor barrier**
- ***in winter,* foam board interior not cold enough for condensation within wall cavity**

Indoor Air Quality Goal
RH 40-60%



Relative Humidity and Health Effects
(Source: Theodore D. Sterling and Associates, Ltd., Vancouver, B.C.)

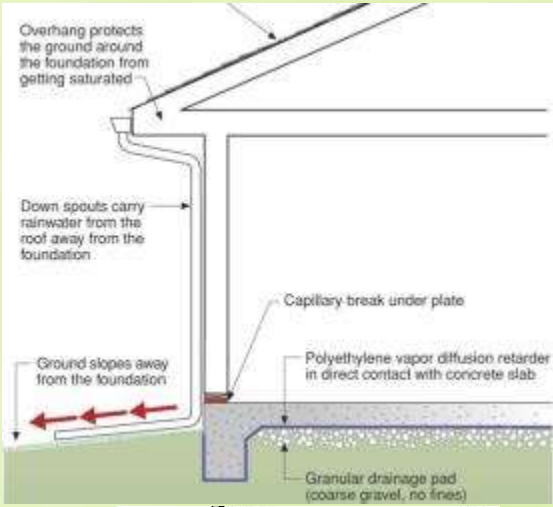
In leaky homes, A/C runs long = big bills, but good dehumidification.

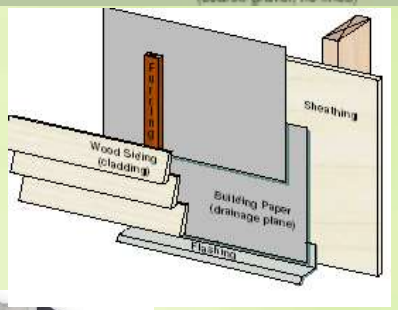
In tight, efficient homes, little temp. load, but humidity load remains.

Indoor Humidity Control

extra important in warm climate energy-efficient homes

- **Moisture protected (dry) foundation or subfloor**
- **Rain and moisture managed walls and roof**
- **Bath, kitchen exhaust fans (low noise)**
- **Right sized A/C *(bigger is NOT better)***
  - **with SHF < .75 (25% dehumidification)**
- **If not enough, add dehumidifier**





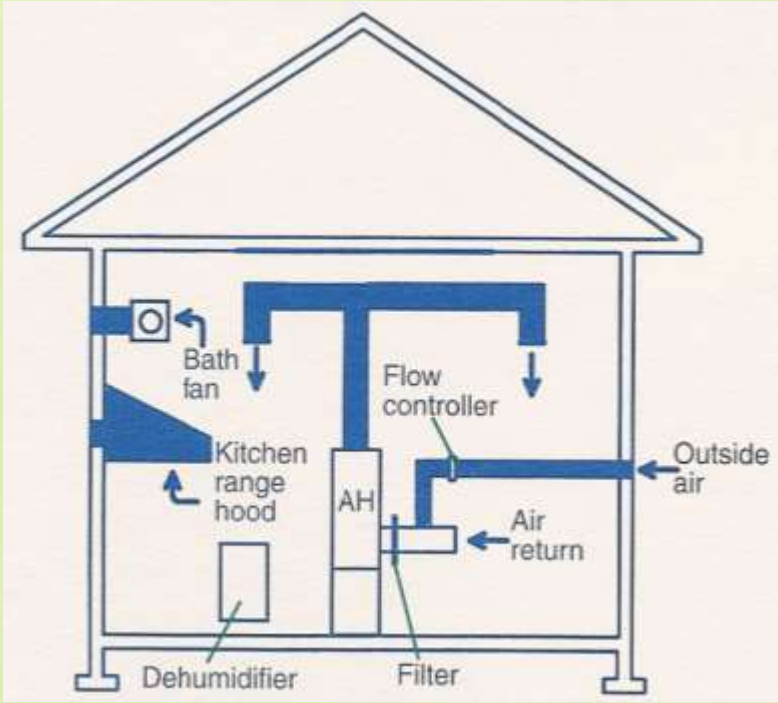
Oversized A/C - *Bad Idea*

- **Cost more to buy**
- **Cost more to operate – *less efficient***
- **Shorter life**
- **Less comfort – *poor dehumidification***

Healthy Housing Principle

Proper Ventilation

1. **Combustion Ventilation** supply and exhaust; direct vent sealed combustion when indoors
2. **Local Exhaust Ventilation** to remove moisture, odors, other contaminants at the source.
3. **Fresh Air Ventilation** to reduce indoor contaminants by dilution.
4. **Control of Airflow** to filter air, distribute air, minimize energy and manage humidity.



Build tight, vent right
with controlled, filtered fresh air

Keep it Properly Ventilated

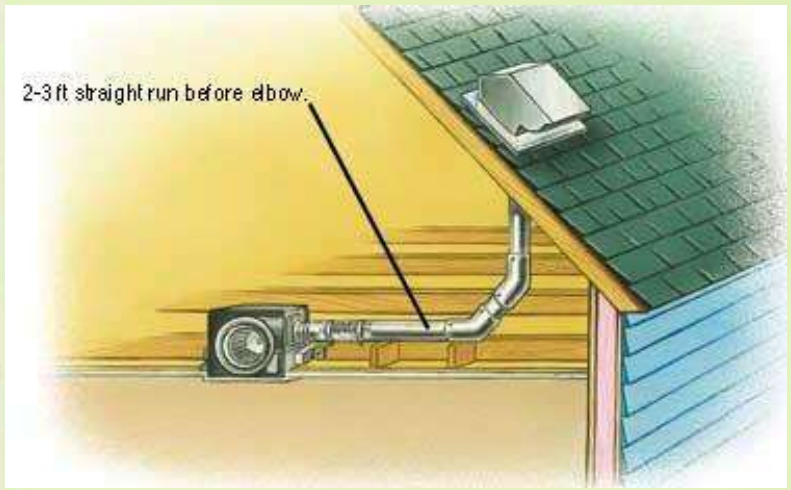
Quiet fans + proper duct installation = effective exhaust

Energy Star, Quiet Exhaust Fan

- < 0.3 sone at 80 cfm
- Moisture sensor or timer control

High Performance Hood

- < .3 sone at normal speed
- Extends over all burners



Correct Duct Installation

- Min. and smooth curves
- Larger, smooth duct

How much ventilation?

The old, the new, and the future

Ventilation Standards

7.5 cfm/person (# BRs + 1)

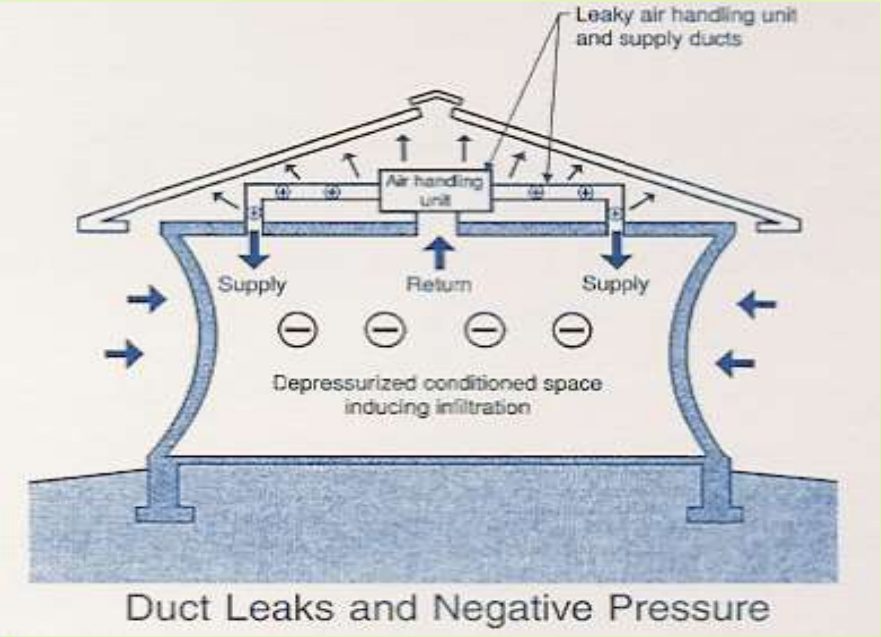
plus

1-3 cfm/100 sq. ft. of conditioned area

*Example: 2000 sq. ft. 3 BR house = **50-90** cfm depending upon….*

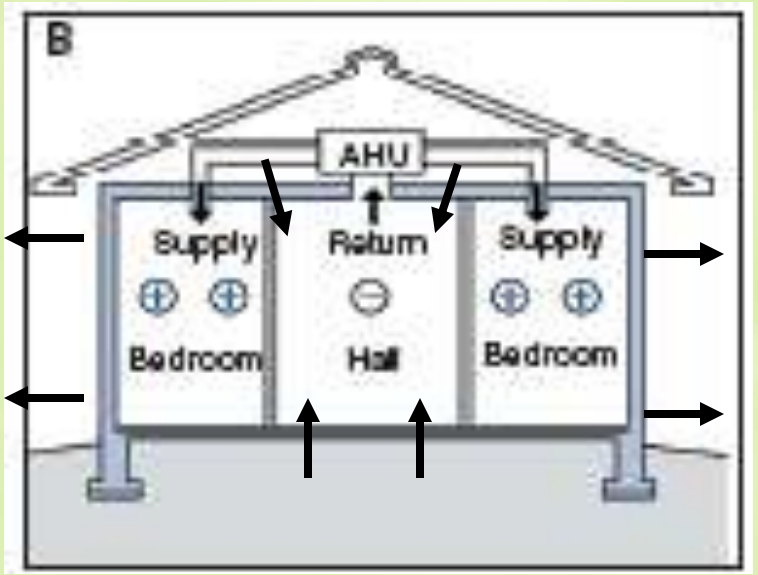
Are leaky houses with "natural ventilation" and exhaust-only systems the best strategy?

Is this good or bad ventilation?



Courtesy of Building Science Corporation

Why?



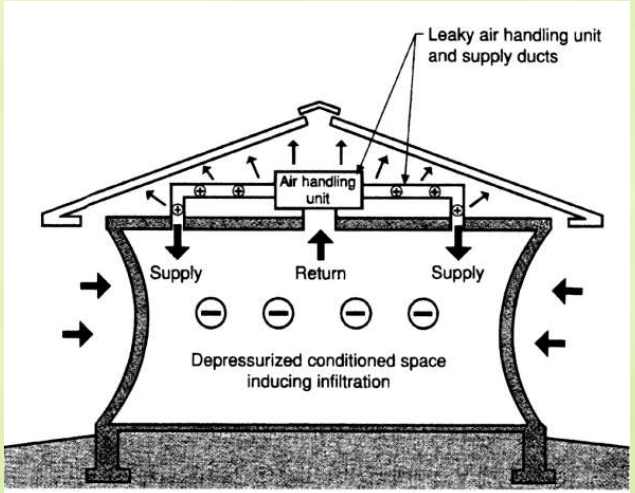
Avoid negative pressure in the south!

Infiltration of warm, humid air:

- **into walls**
- **through chases**
- **to cool interiors**

can cause

- ***hidden condensation***
- ***mold***
- ***backdrafting***
- ***higher energy bills***



Negative Pressure Caused by Leaky Ducts


Behind vinyl wallpaper

Best Practice – Aim for a slight positive pressure.

Energy and Comfort-Saving Home Improvements

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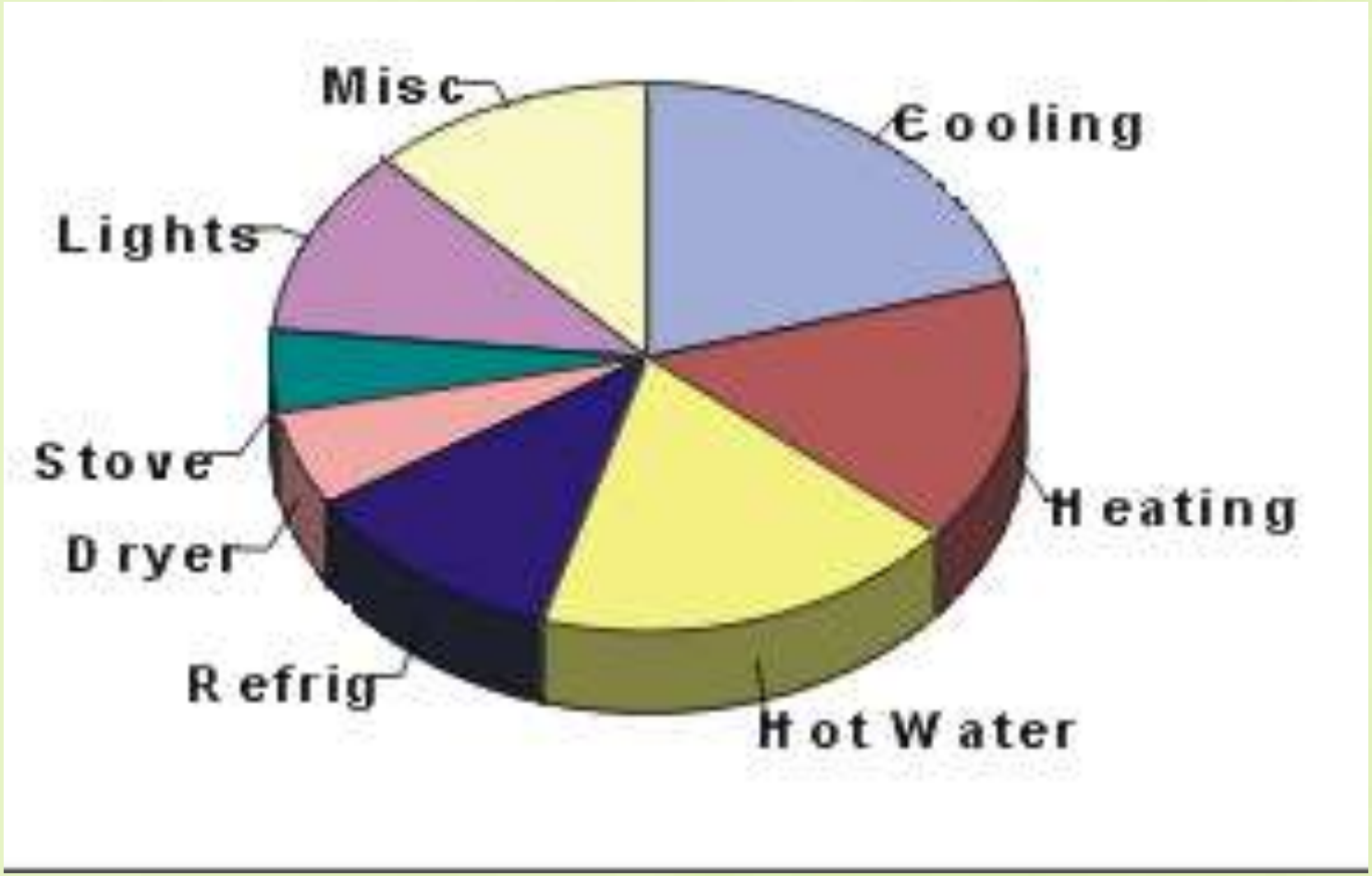
Home & Landscape Resource Center

LSU AgCenter
Research & Extension

Building America
U.S. Department of Energy
Research Toward Zero Energy Homes

Louisiana Department of Natural Resources

Home Energy Usage
in Climate Zone 2



Typical Priority of Improvements

COOLING, HEATING, BOTH

1. HVAC – service, seal leaks, insulate ducts, upgrade, *educate!*
2. Air seal house – *the big holes*
3. Switch to CFLs
4. Sun control
5. Improve water heater
6. Improve attic insulation
7. Appliances – maintain, buy Energy Star
8. Improve moisture control
9. Consider floor or wall insulation, if…

1. HVAC

Service, Seal Leaks, Insulate Ducts, Upgrade, *Educate!*

Forced air **means….**

Inside Equipment Maintenance

- ***Educate:* Change filters!!!!!**
  - **Select pleated MERV 8-10**
- **Have equipment serviced yearly**

  UF study: 75% were undercharged 15% or more.
  - 10% refrigerant under-charge = 8.3% lower efficiency.
  - 15% refrigerant under-charge = 19.6% lower efficiency
- **Use drain pan tablets (NOT bleach) to keep lines clear**

EVAPORATOR DRAIN LINE

Should be insulated the FULL length around the FULL circumference

Why?

Does ALL return air go through the filter?

Leaking return air pathway causes:

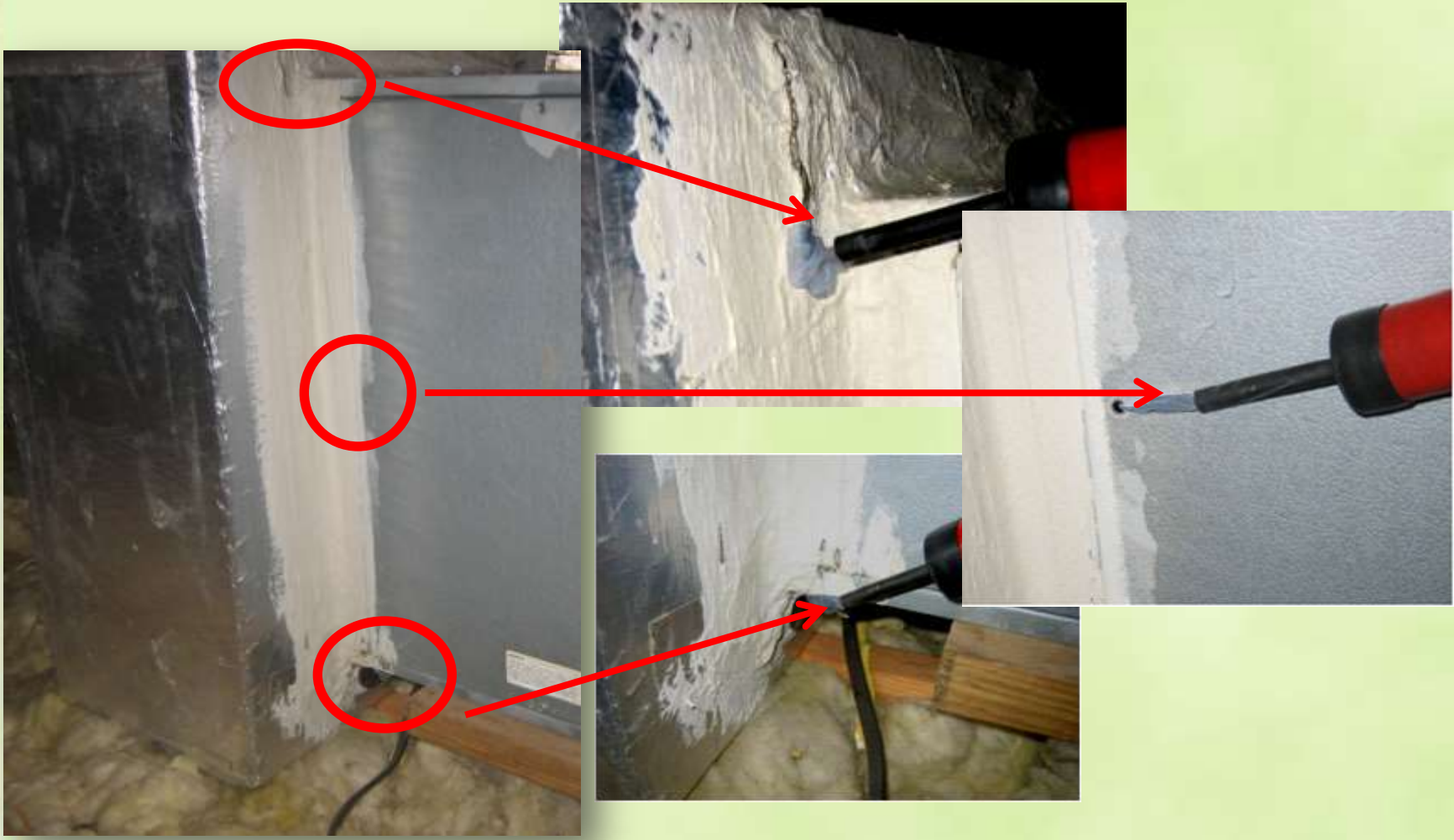
- **dirty wet coils,**
- **dirty fan & ducts,**
- **mold throughout**
- **polluted air.**

EXAMPLES OF "INSIDE" EQUIPMENT LEAKAGE

Return plenum leaks – draw in attic air. BAD!

EXAMPLES OF "INSIDE" EQUIPMENT LEAKAGE

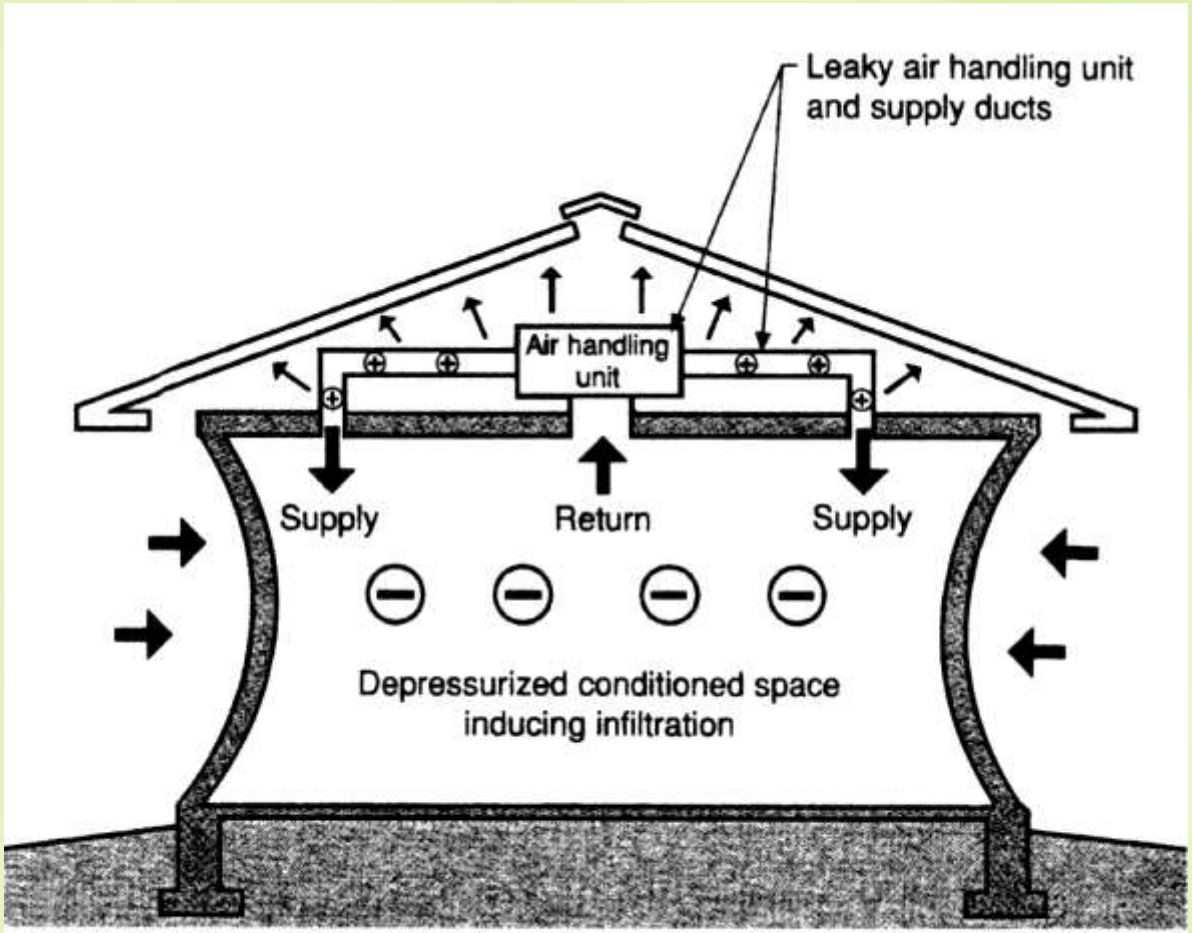
Sucking in the smoke… and what else?



EXAMPLES OF "INSIDE" EQUIPMENT LEAKAGE

Duct tape – 1000 good uses, but NOT here!

30% energy loss is common!



Negative Pressure Caused by Leaky Ducts

TERMINAL DEVICE:

Poor Duct Attachment Example

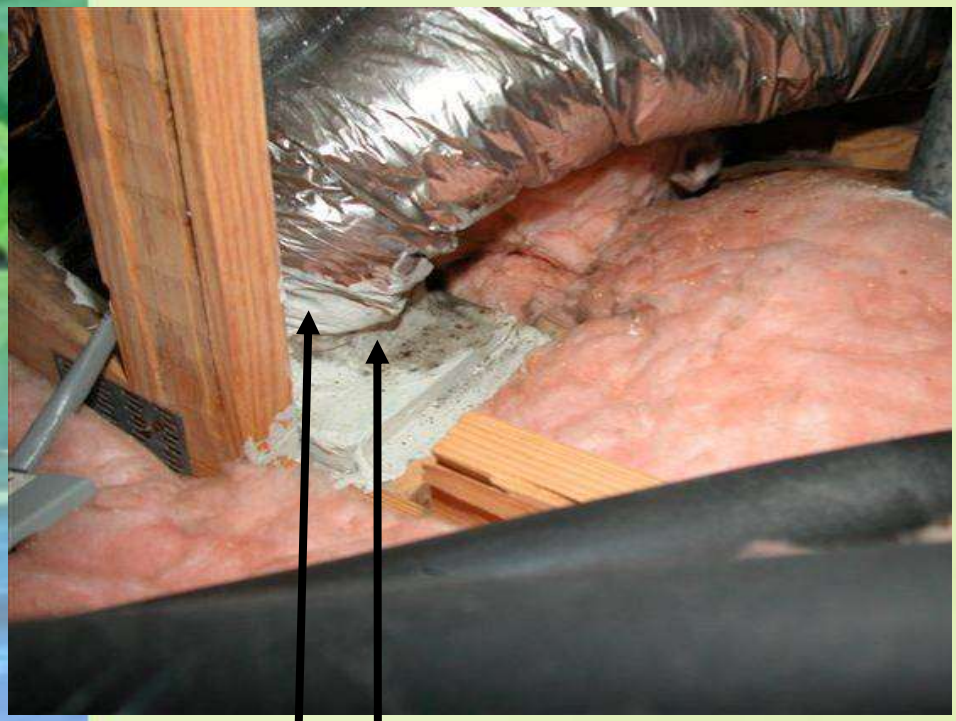


Photo by Hanner

- Crimped duct
- Boot poorly insulated
- Allows surface temperature to fall below attic dew point
- Mold grows
- Poor duct design

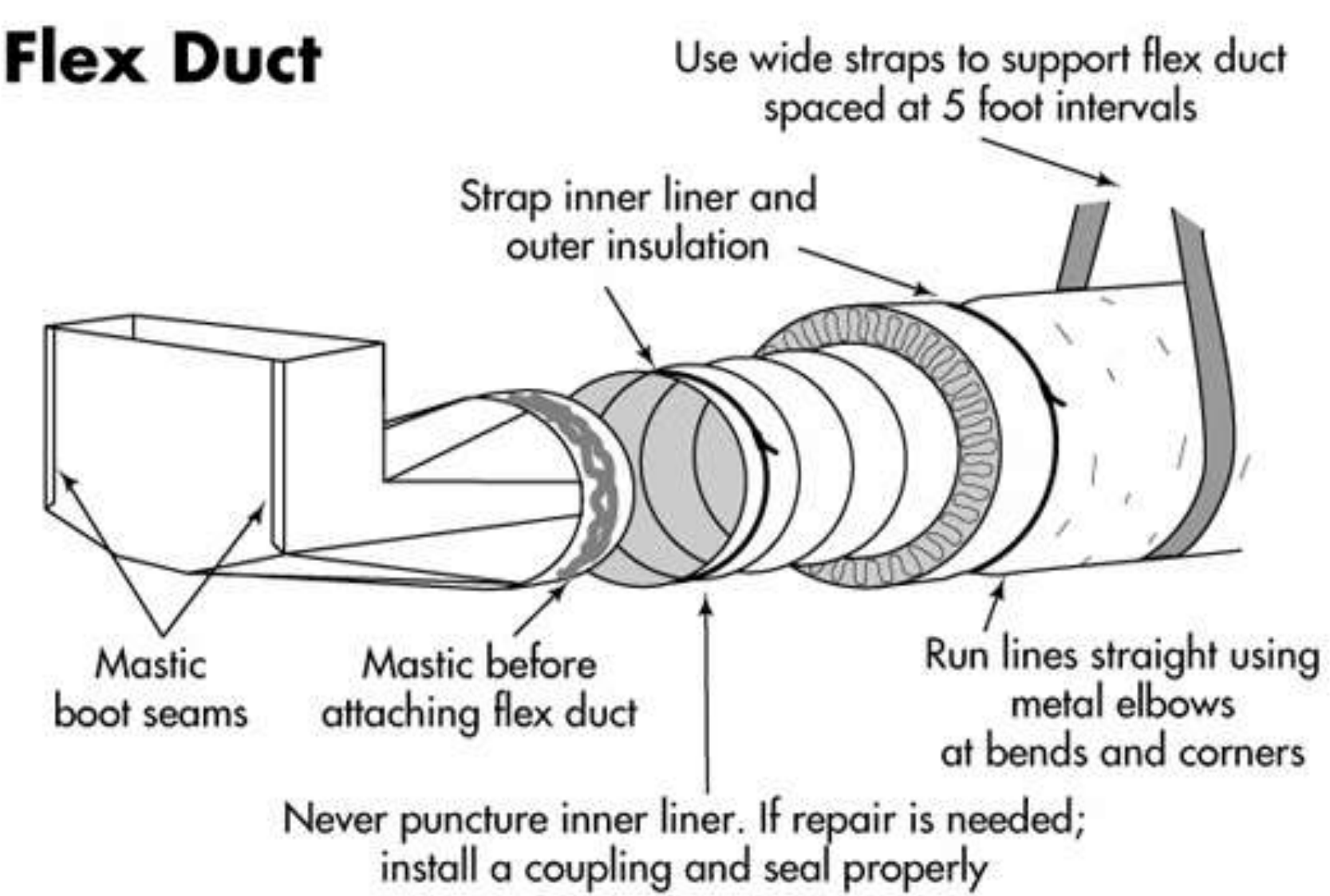
THE RIGHT MASTIC

UL Labeled

UL Listed

Use UL 181A

Seal with mastic, connect and hang properly



Unvented Attic System

- Solve HVAC, duct losses, so save $, can downsize
- No wind driven water risk
- Clean, comfortable space
- BUT, can reduce life of dark shingles
- Need airtight insulation (spray foam), so more expensive
- **No combustion** except direct vent, sealed type

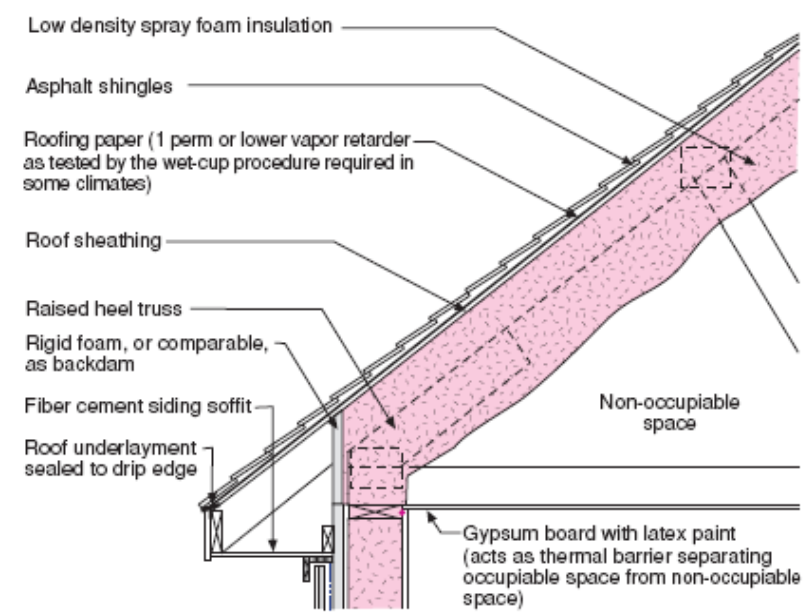


Figure 8
Air Impermeable Spray Foam Insulation

When it's time to replace, choose Energy Star HVAC

A/C	SEER ≥ 14.5
Air-Source Heat Pump	SEER ≥ 14.5 HSPF ≥ 8.2
Gas	AFUE ≥ 90% (>80% OK in south La.)
Geothermal Heat Pump	EER ≥ 14.1 COP ≥ 3.3

Sizing:
The Wrong and Right Ways

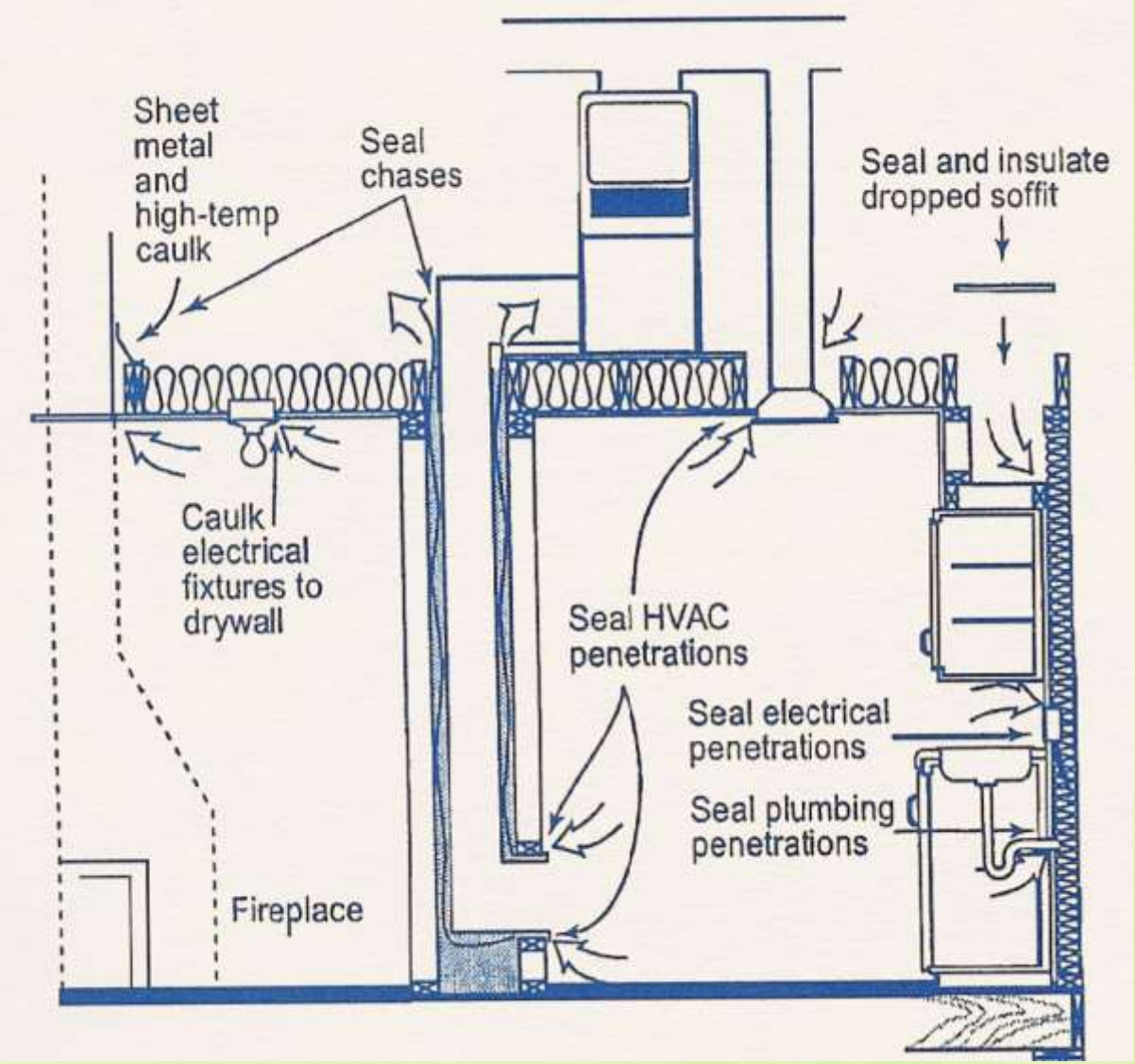
✗ By floor area and convenience	✓ By Manual J and Manual D
✗ Old rule of thumb for standard homes = 1 ton/500 sq.ft.	✓ Load for energy-efficient home = 1 ton/800-1000 sq.ft.
✗ one duct size fits all	✓ designed duct system

2. Air Seal

Typical House Air Leakage Proportions

the BIG holes

Top Priority: Seal Air Bypasses *to the attic and crawl space!*



First: Look for *the Big Holes*

Typical big square hole around round chimney

Seal with metal collar, high temp. caulk. Add metal insulation dam

SEAL FIREPLACE CHASE

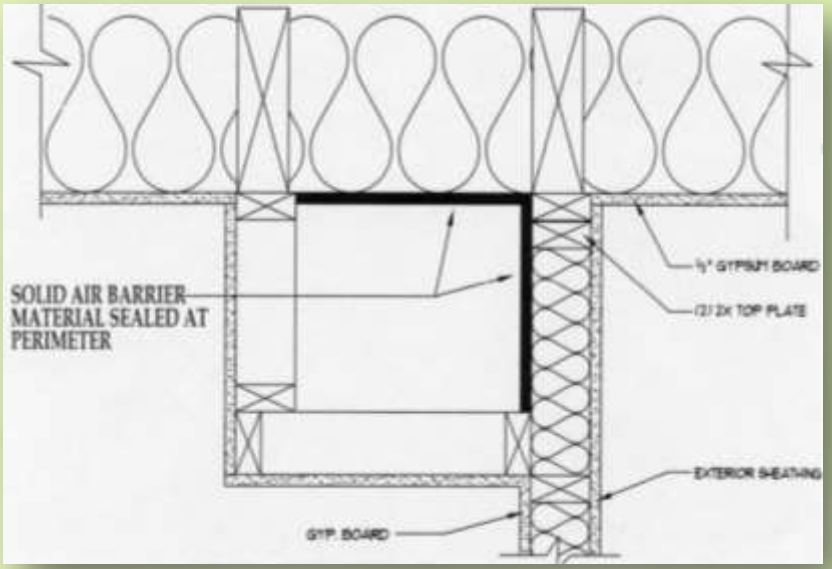
Image courtesy of Building Science Corp.

Plug the Big Holes

Use insulation stuffed plastic bags to fill and seal

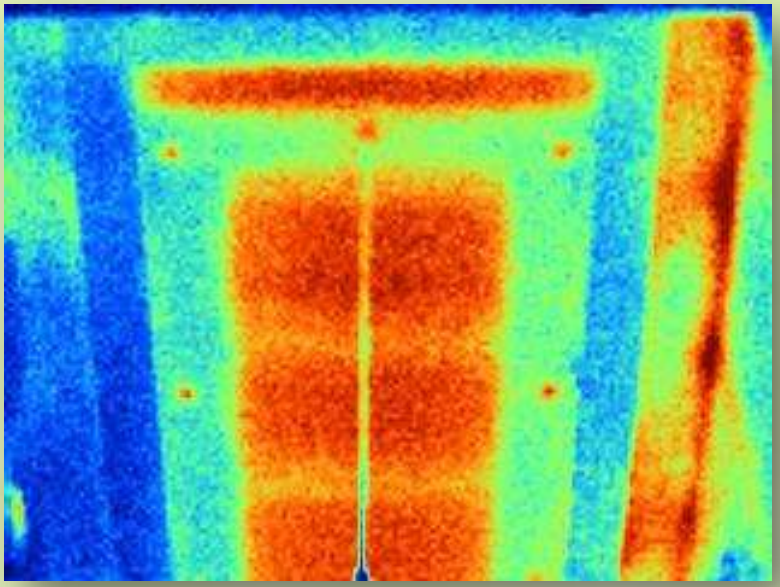
<u>under attic kneewalls</u>

PLUG THE BIG HOLES



Use rigid foam, drywall, or glue foil faced batts to framing over dropped ceilings or soffits

ATTIC ACCESS LEAKAGE



Images courtesy of Energy Services Group

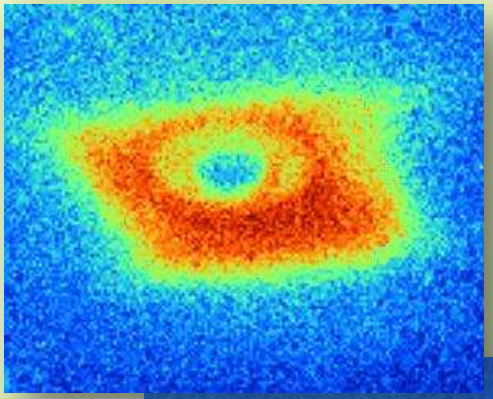
SEAL AND INSULATE ATTIC ACCESS

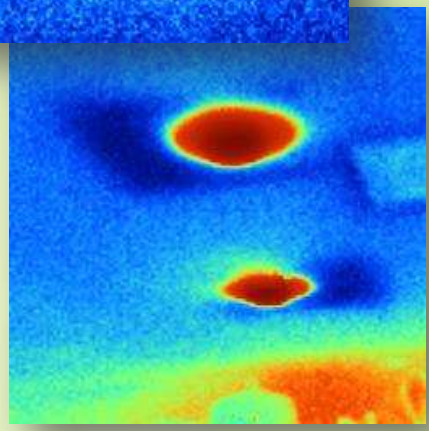
Attic access doors/panels/stairs

RECESSED CAN LIGHTS

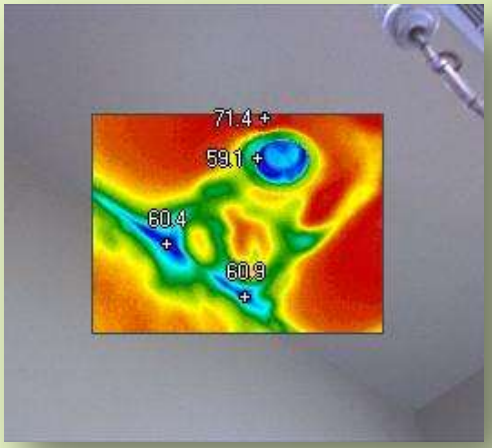
"CAN" LIGHT THERMAL LEAKAGE

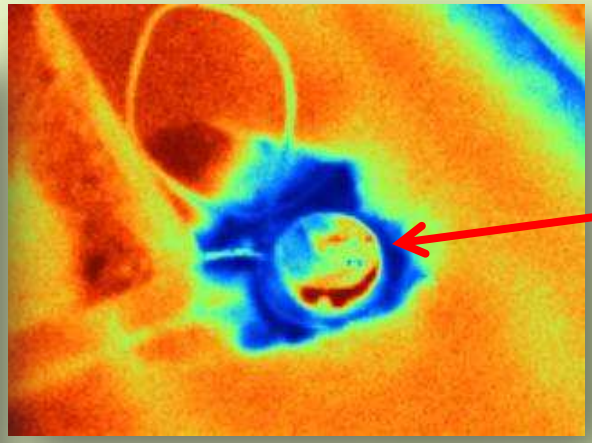
Each un-insulated recessed light
= **2 sq.ft. thermal hole to attic**





Light gets hot, creates draft,
pulls conditioned air out of house

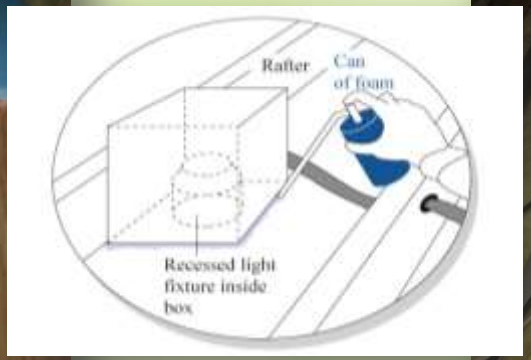


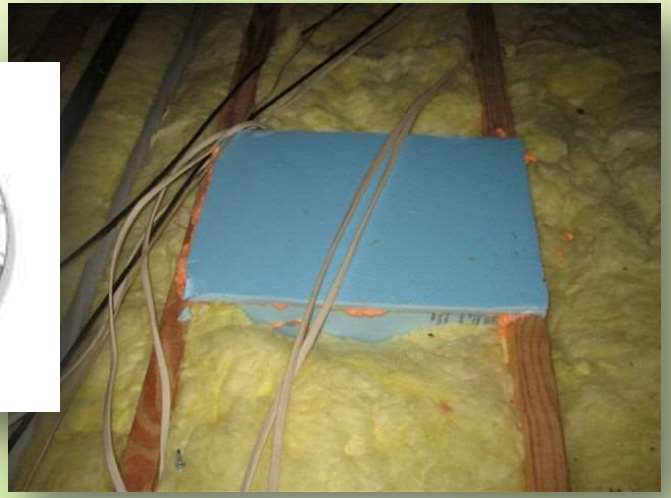


View from the attic – cold air leaking into attic from the house

Image courtesy of Energy Services Group

BOXING RECESSED CAN LIGHTS

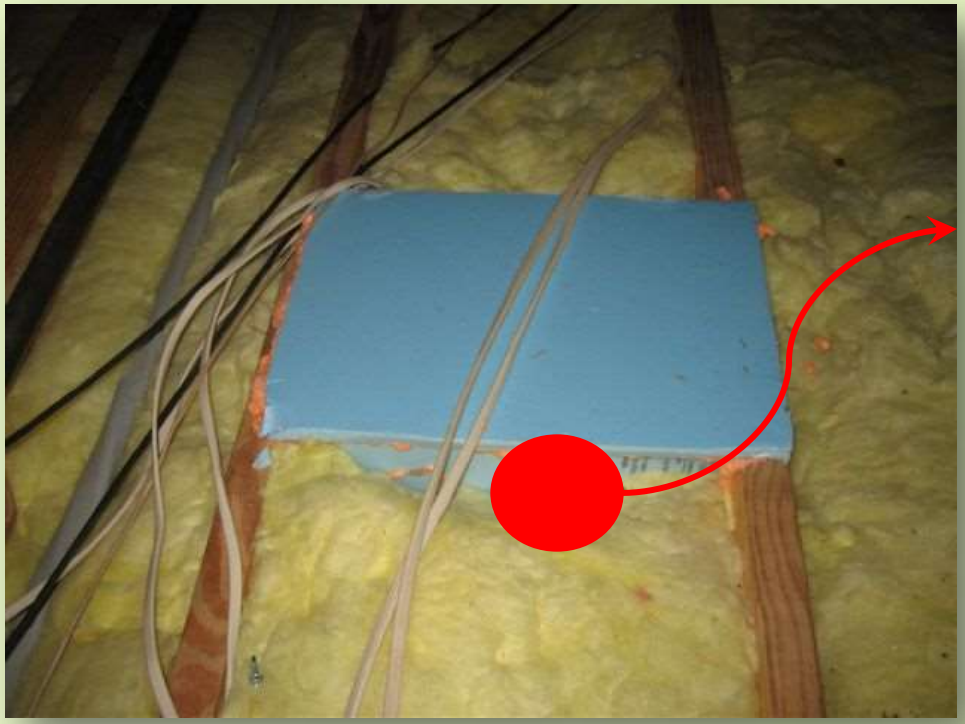




NOTE: Need min. 4” clearance between box and fixture!

OR,
Replace with
ICAT fixtures

BOX LEAKY EXHAUST FANS



Remember to cut a hole for the ductwork to pass through!

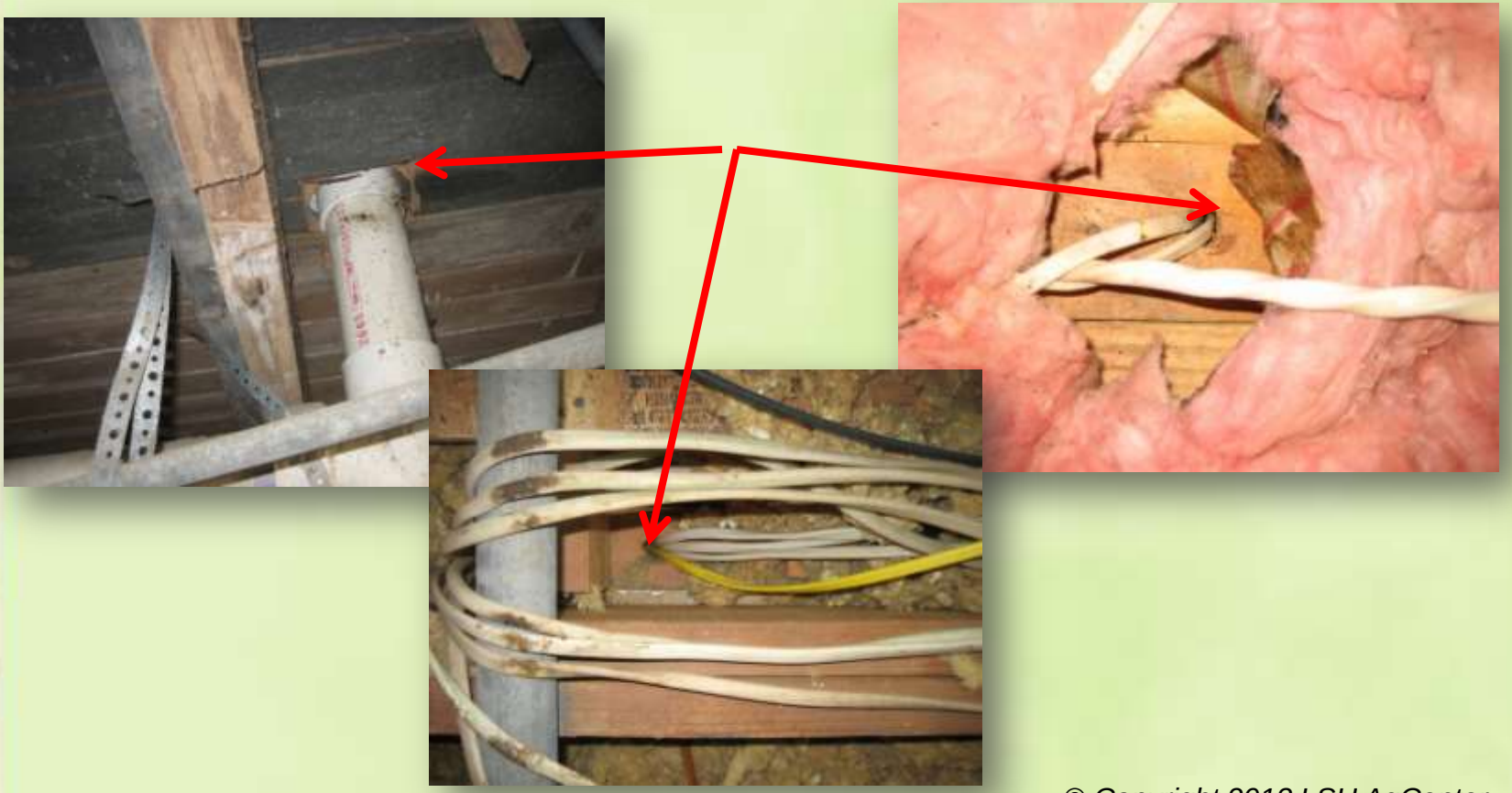
Box and insulate exhaust fan, if leaky
(same method as for recessed light)

MECHANICAL CLOSET PENETRATIONS

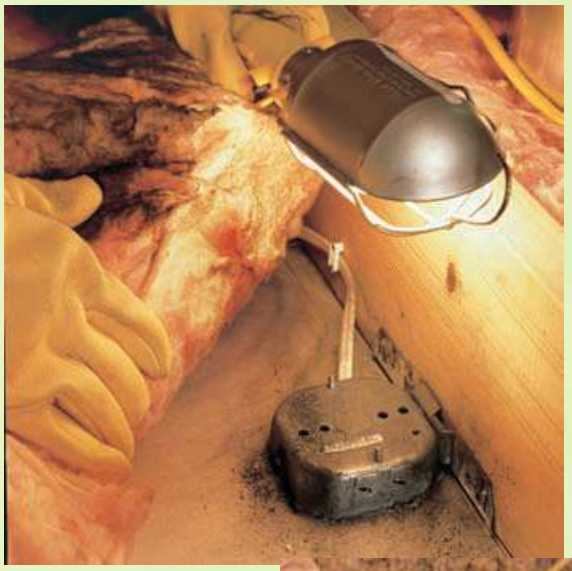
Mechanical closets for air handlers or water heaters are often open to the attic or subfloor…

ATTIC & SUBFLOOR PENETRATIONS

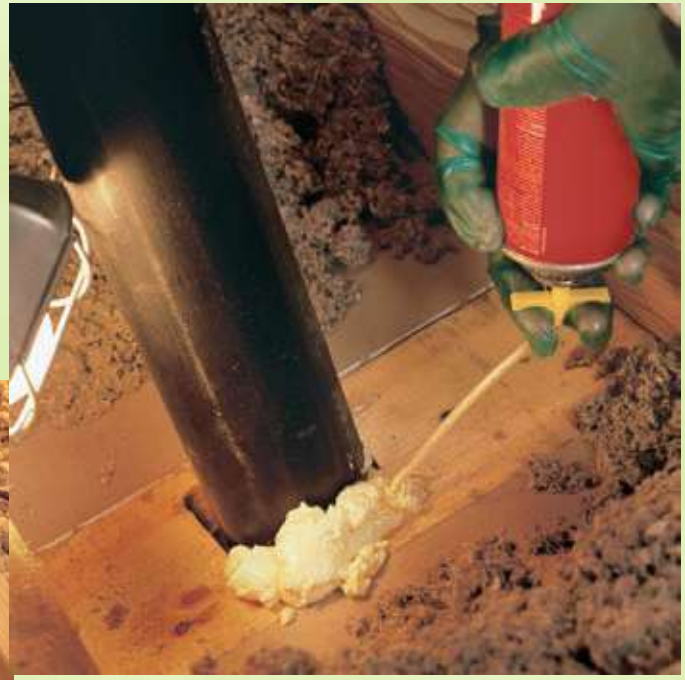
Any hole made for wiring, piping, etc.
lets outside air into wall cavities or interior rooms



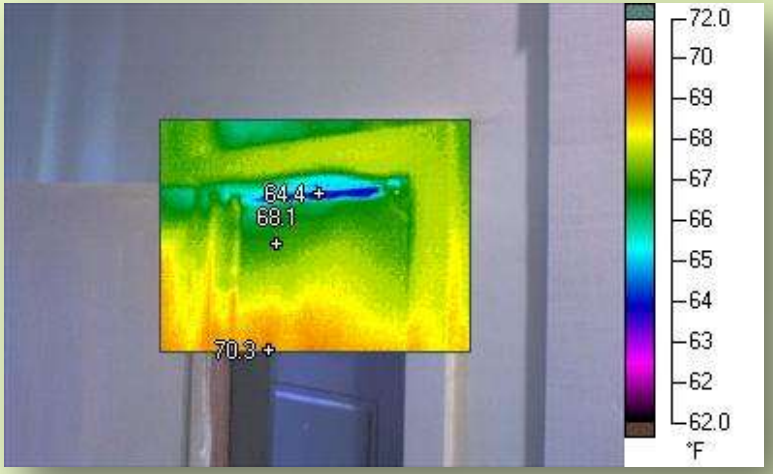
FIND AND SEAL PENETRATIONS

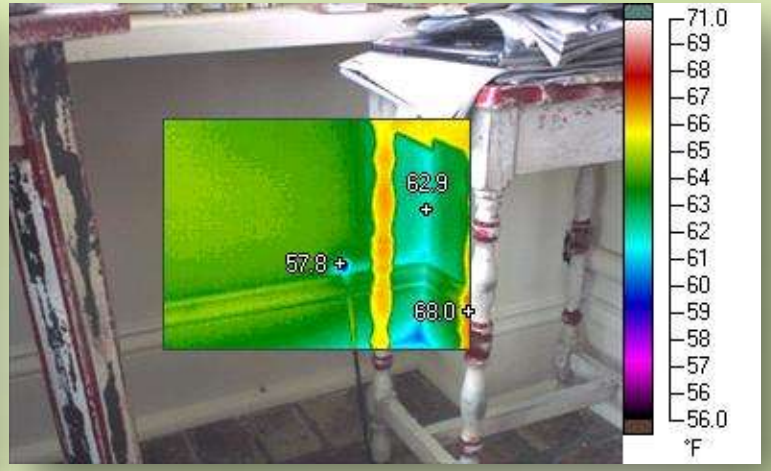


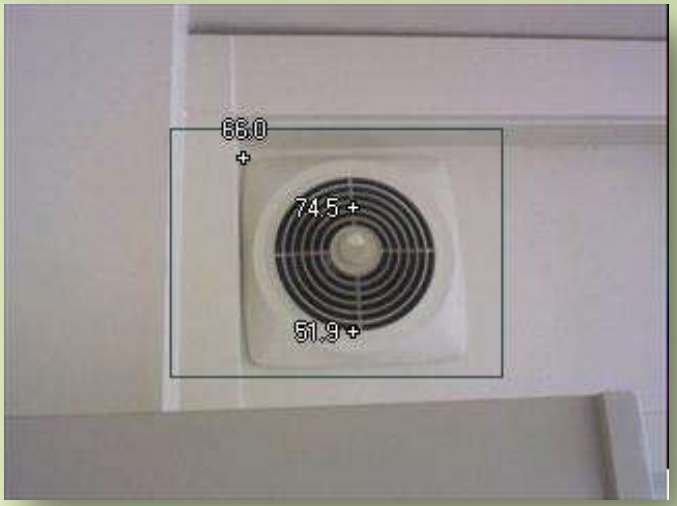
Fill top plate holes with foam or caulk.

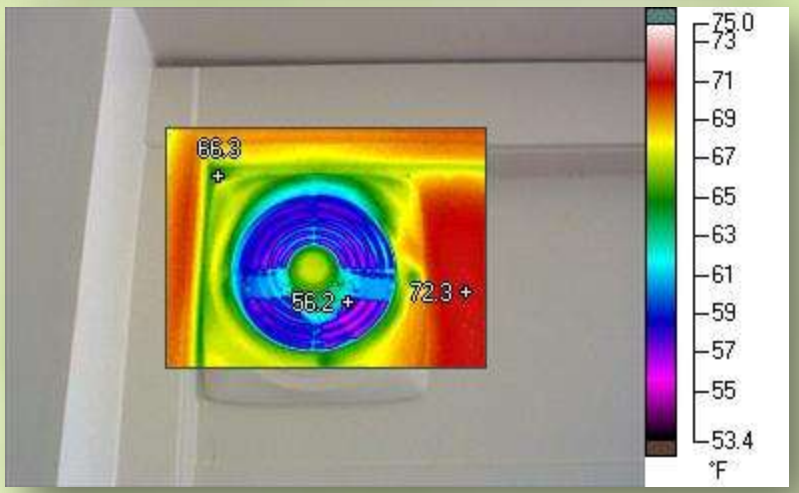


WALL PENETRATIONS









Cold air leaking in (winter).

WALL PENETRATIONS

- **Caulk or foam seal interior gaps, pipe penetrations, sill plates, etc.**
- **Insert outlet, switch gaskets**

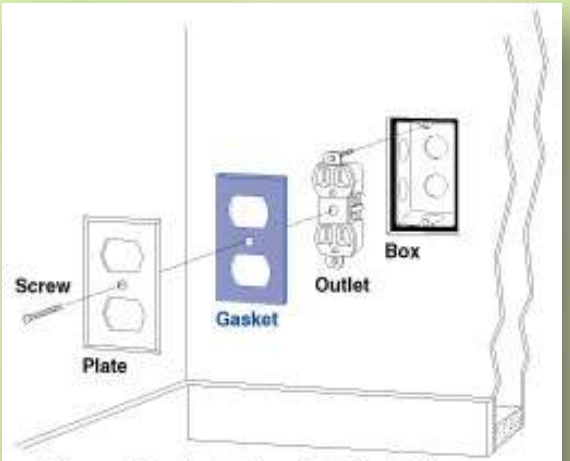
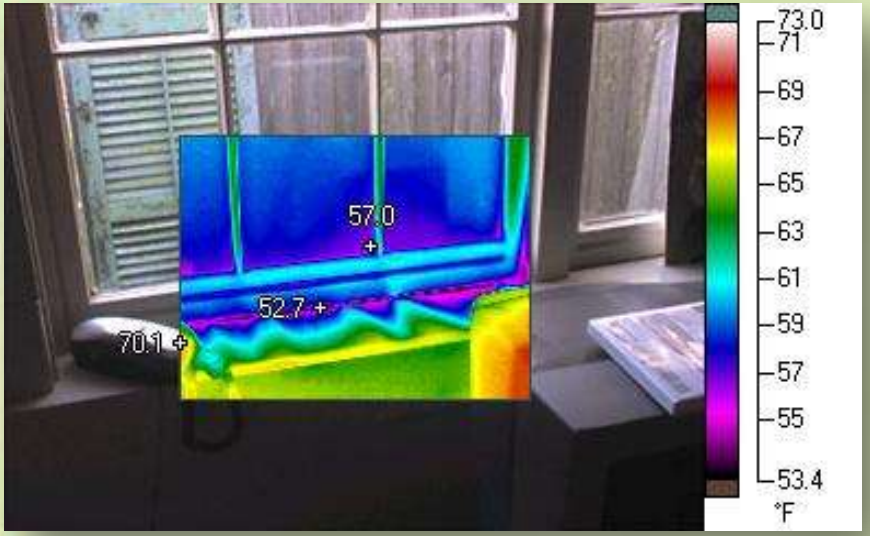


Figure 16 - Install gaskets behind cover plates in all electrical outlets and switches, including those on interior walls. Turn off power before installing gaskets.

WINDOW & DOOR LEAKAGE



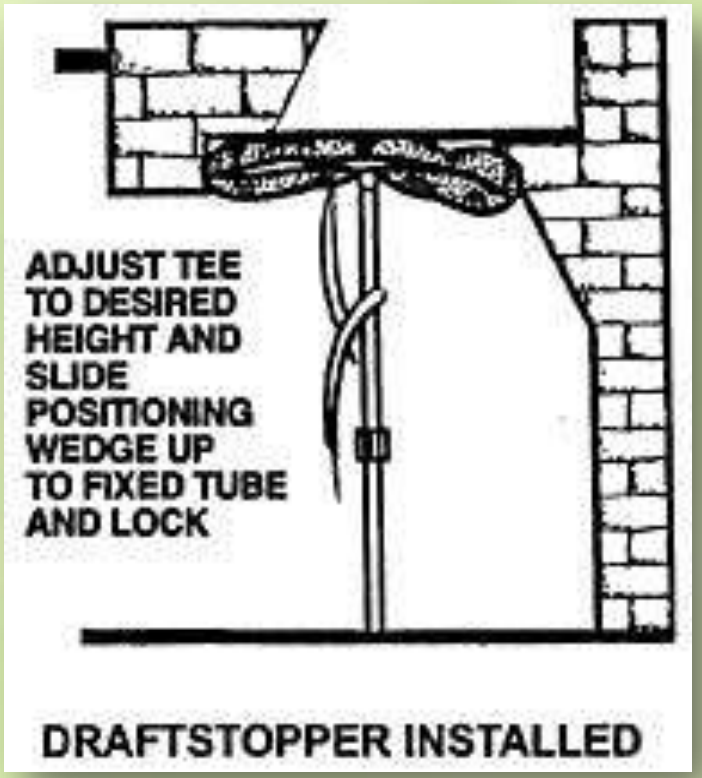
Cold outside air leaking in

Need effective weather-stripping!

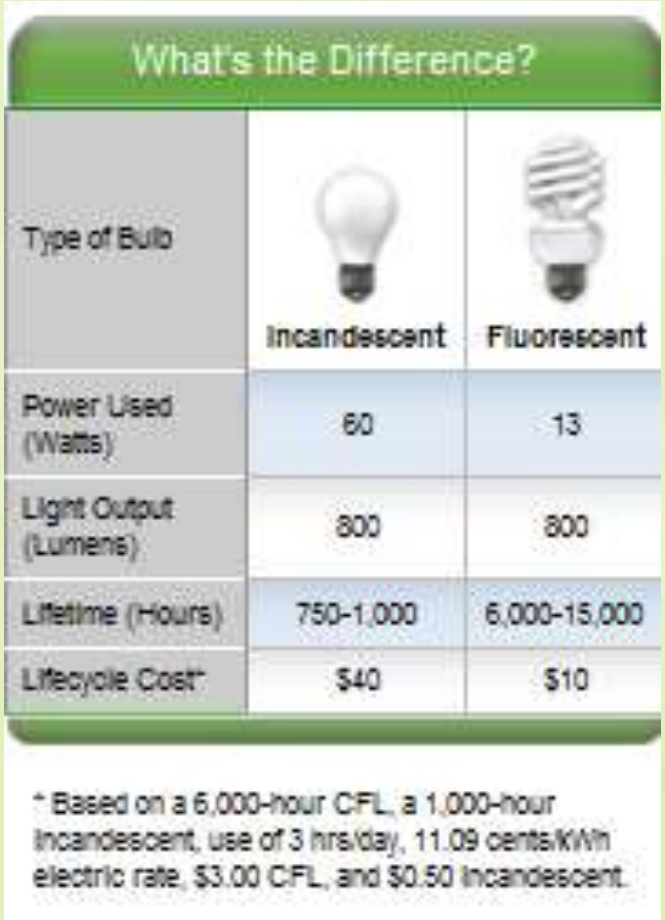
WEATHER STRIPPING DOORS AND WINDOWS

- **Apply to clean, dry surface**
- **Measure twice before you cut**
- **Weatherstrip entire door jamb.**
- **Apply one continuous strip along each side**
- **Should meet tightly at corners.**
- **Should compress when the window or door is shut.**

FIREPLACE BALLOONS



3. Switch to CFLs



What's the Difference?

Type of Bulb	Incandescent	Fluorescent
Power Used (Watts)	60	13
Light Output (Lumens)	800	800
Lifetime (Hours)	750-1,000	6,000-15,000
Lifecycle Cost*	$40	$10

* Based on a 6,000-hour CFL, a 1,000-hour incandescent, use of 3 hrs/day, 11.09 cents/kWh electric rate, $3.00 CFL, and $0.50 incandescent.

Energy Star Lighting and Ceiling Fans

Today's Fluorescents:

- Use 75% less energy
- Create 75% less heat
- Last 5-7 years
- High color
- No flicker or hum
- Less mercury

New Options

T5 & T8, LED, Induction

Choosing The Right Lighting

LIGHT OUTPUT EQUIVALENCY

To determine which ENERGY STAR qualified light bulbs will provide the same amount of light as your current incandescent light bulbs, consult the following chart:

INCANDESCENT LIGHT BULBS	MINIMUM LIGHT OUTPUT	COMMON ENERGY STAR QUALIFIED LIGHT BULBS
WATTS	LUMENS	WATTS
40	450	9-13
60	800	13-15
75	1,100	18-25
100	1,600	23-30
150	2,600	30-52

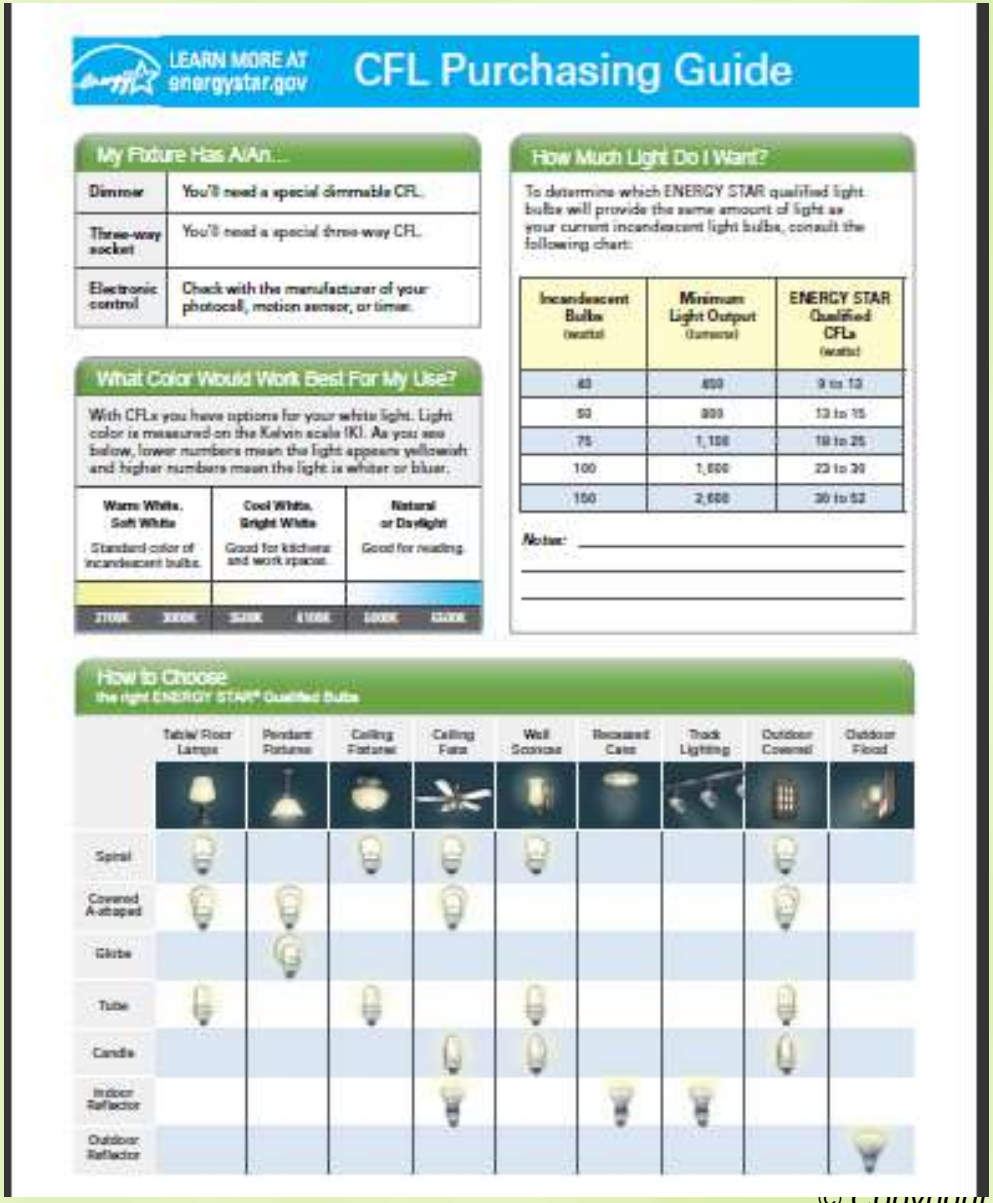
LEARN MORE AT energystar.gov

2700K – Warmer light

3500K – Cool light

Shade of light is measured in Kelvins (K)
Lower K (2700-3000) = Warmer Light
Higher K (3500K, 4100K, 5000K, 6500K) = Cool blue/white light

More info at www.energystar.gov



LEARN MORE AT energystar.gov

CFL Purchasing Guide

My Fixture Has A/An...

Dimmer	You'll need a special dimmable CFL.
Three-way socket	You'll need a special three-way CFL.
Electronic control	Check with the manufacturer of your photocell, motion sensor, or timer.

What Color Would Work Best For My Use?

With CFLs you have options for your white light. Light color is measured on the Kelvin scale (K). As you see below, lower numbers mean the light appears yellowish and higher numbers mean the light is whiter or bluer.

Warm White, Soft White	Cool White, Bright White	Natural or Daylight
Standard color of incandescent bulbs.	Good for kitchens and work spaces.	Good for reading.

How Much Light Do I Want?

To determine which ENERGY STAR qualified light bulbs will provide the same amount of light as your current incandescent light bulbs, consult the following chart:

Incandescent Bulbs (watts)	Minimum Light Output (lumens)	ENERGY STAR Qualified CFLs (watts)
40	450	9 to 13
50	800	13 to 15
75	1,100	18 to 25
100	1,600	23 to 30
150	2,600	30 to 52

Notes: _____

How to Choose

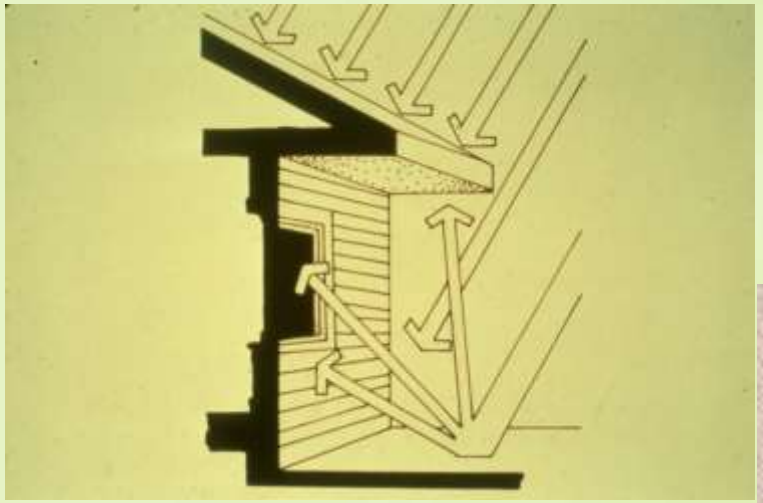
the right ENERGY STAR® Qualified Bulbs

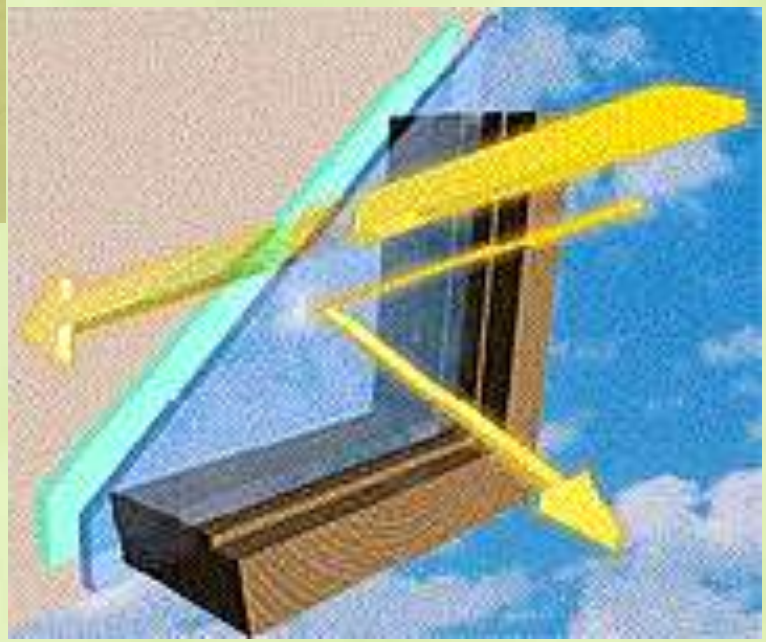
	Table/ Floor Lamps	Pendant Fixtures	Ceiling Fixtures	Ceiling Fans	Wall Sconces	Recessed Cans	Track Lighting	Outdoor Covered	Outdoor Flood
Spiral	✓		✓	✓	✓			✓	
Covered A-shaped	✓	✓		✓				✓	
Globe		✓							
Tube	✓		✓		✓			✓	
Candle				✓	✓			✓	
Indoor Reflector				✓		✓	✓		
Outdoor Reflector									✓

Lagniappe…

Choose light colors inside and out when you repaint!

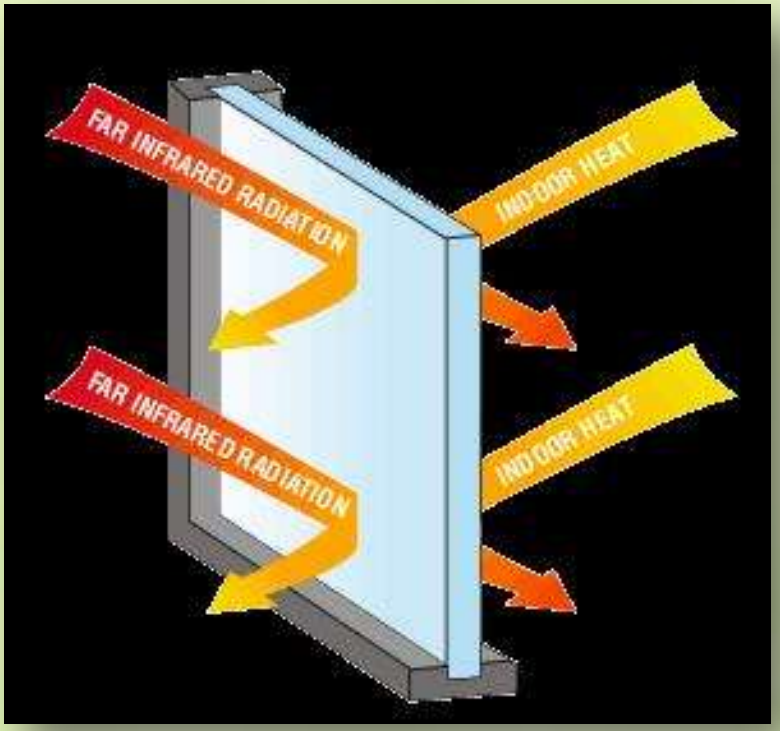
4. Sun Control
to Cut Heat Gain





LOW-E FILMS

- **Add to clear, single-paned glass to reduce solar and reflected heat gain and loss**
- **Saves energy, cooling**
- **Reduces fading**
- **Increases comfort**



Seek and find:

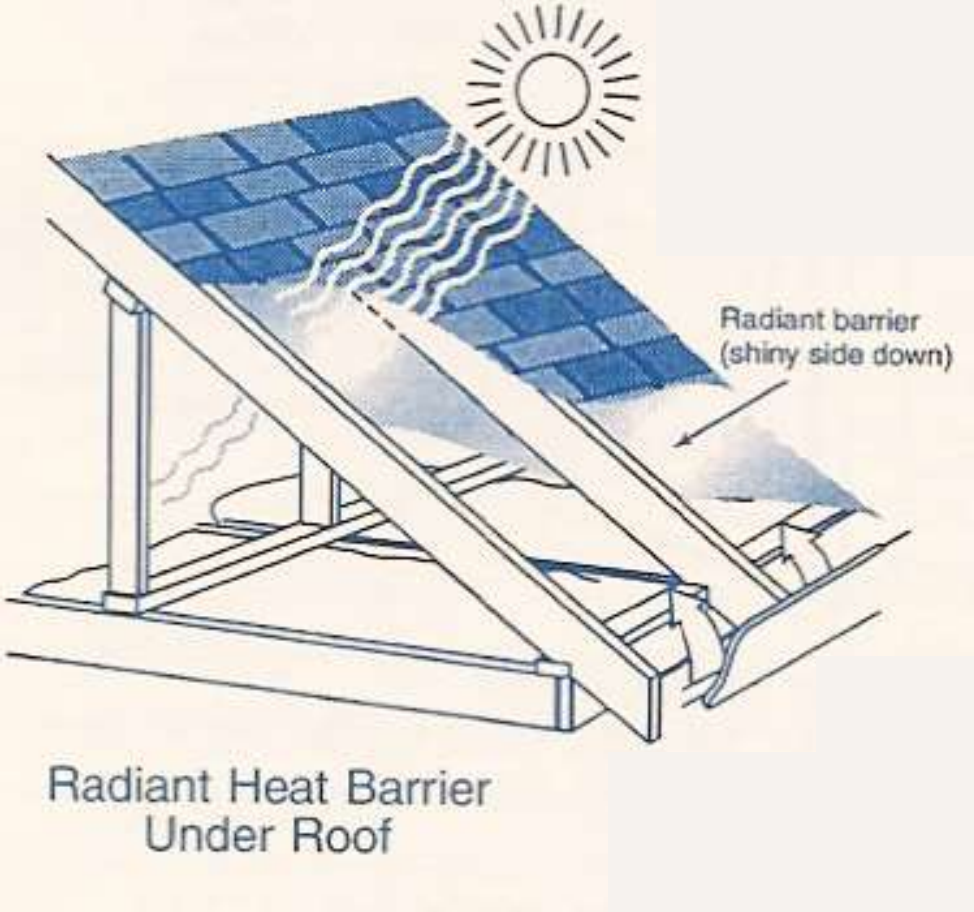
SHGC – the *lower* the better

VL – the *higher* the better

Sun Control Alternatives

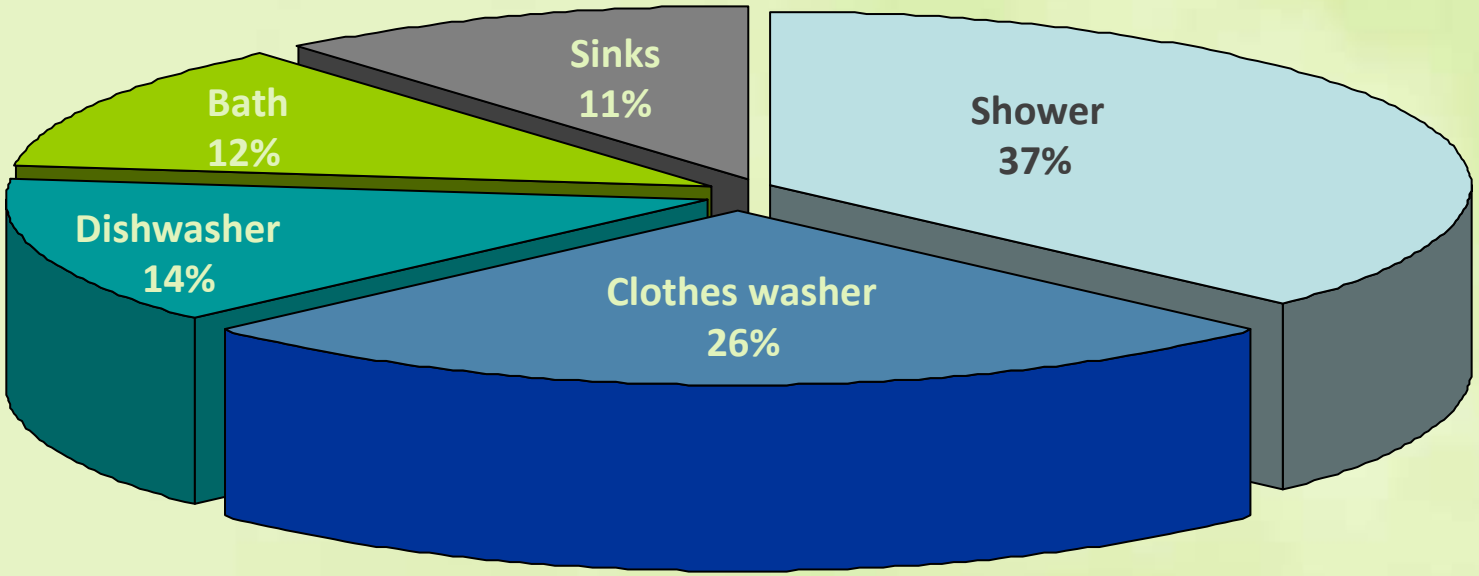
Radiant Barrier

to reduce heat in vented attic, on ducts, ceiling



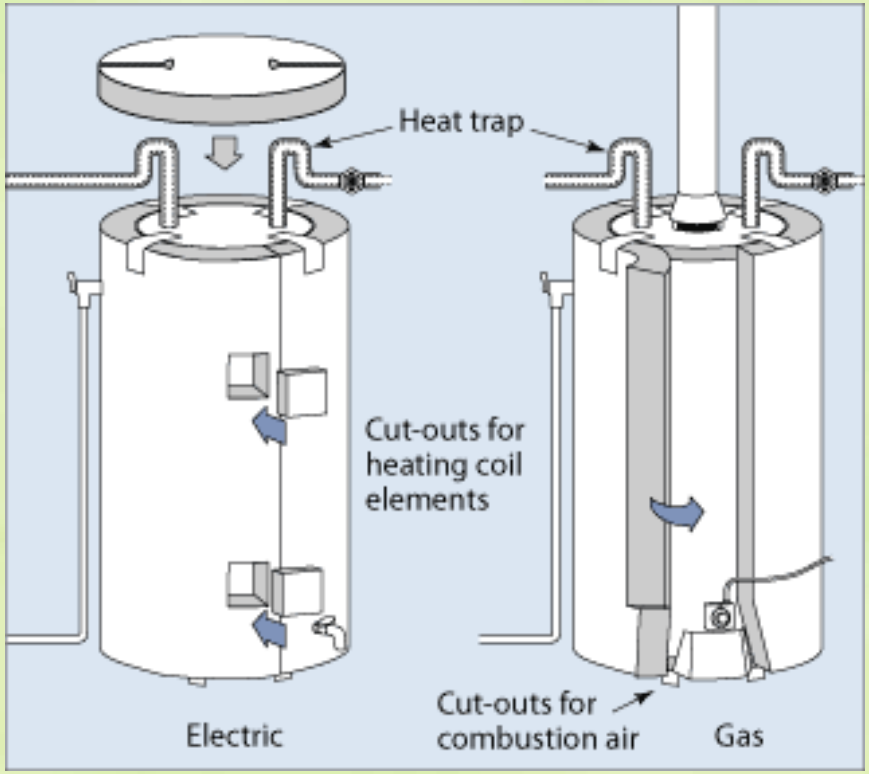
- Blocks “emission” of radiant heat only
- Must face an air gap
- Shiny side down to avoid dust
- Direction of energy flow matters
- Under roof deck is most beneficial

5. Improve Water Heater



WATER HEATER IMPROVEMENTS

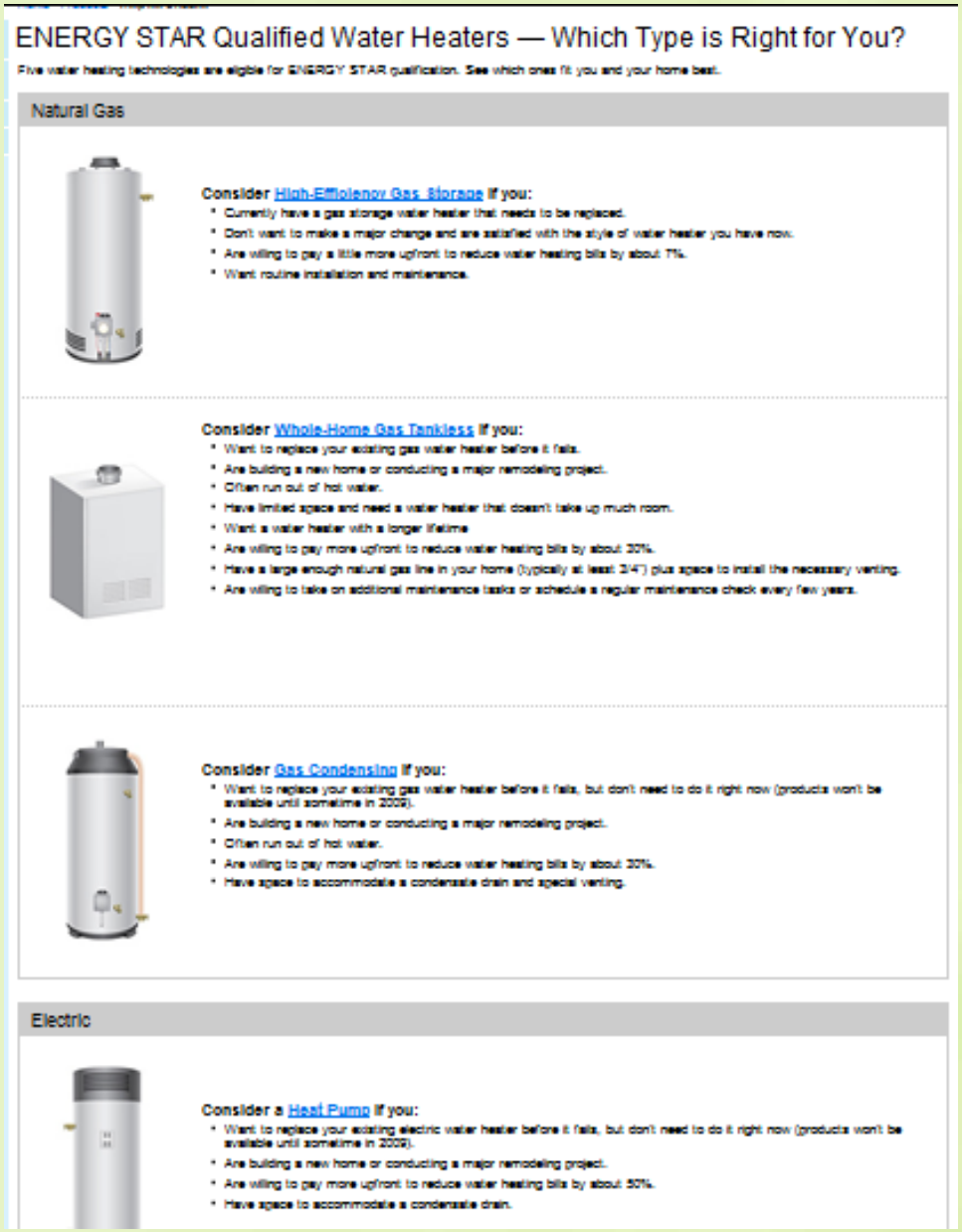
- Lower temperature setting
  - 135 Degrees F (upper element)
  - 120 Degrees F (lower element)
- Wrap tank & pipes with insulation
- Insulate under electric WH with rigid insulation board.



Water Heater Improvements

- Insulate at least 10 feet of all pipes
- For electric WH, consider electronic timer
- Maintain your water heater (drain sediment)
- Add heat trap to pipes
  going out and coming into
  top of tank.

Replace with More Efficient Unit



ENERGY STAR Qualified Water Heaters — Which Type is Right for You?

Five water heating technologies are eligible for ENERGY STAR qualification. See which ones fit you and your home best.

Natural Gas

Consider High-Efficiency Gas Storage if you:

- Currently have a gas storage water heater that needs to be replaced.
- Don't want to make a major change and are satisfied with the style of water heater you have now.
- Are willing to pay a little more upfront to reduce water heating bills by about 7%.
- Want routine installation and maintenance.

Consider Whole-Home Gas Tankless if you:

- Want to replace your existing gas water heater before it fails.
- Are building a new home or conducting a major remodeling project.
- Often run out of hot water.
- Have limited space and need a water heater that doesn't take up much room.
- Want a water heater with a longer lifetime
- Are willing to pay more upfront to reduce water heating bills by about 20%.
- Have a large enough natural gas line in your home (typically at least 3/4") plus space to install the necessary venting.
- Are willing to take on additional maintenance tasks or schedule a regular maintenance check every few years.

Consider Gas Condensing if you:

- Want to replace your existing gas water heater before it fails, but don't need to do it right now (products won't be available until sometime in 2009).
- Are building a new home or conducting a major remodeling project.
- Often run out of hot water.
- Are willing to pay more upfront to reduce water heating bills by about 30%.
- Have space to accommodate a condensate drain and special venting.

Electric

Consider a Heat Pump if you:

- Want to replace your existing electric water heater before it fails, but don't need to do it right now (products won't be available until sometime in 2009).
- Are building a new home or conducting a major remodeling project.
- Are willing to pay more upfront to reduce water heating bills by about 50%.
- Have space to accommodate a condensate drain.

Compare and choose higher ER (electric) or AFUE (gas) rating

6. Improve Attic Insulation

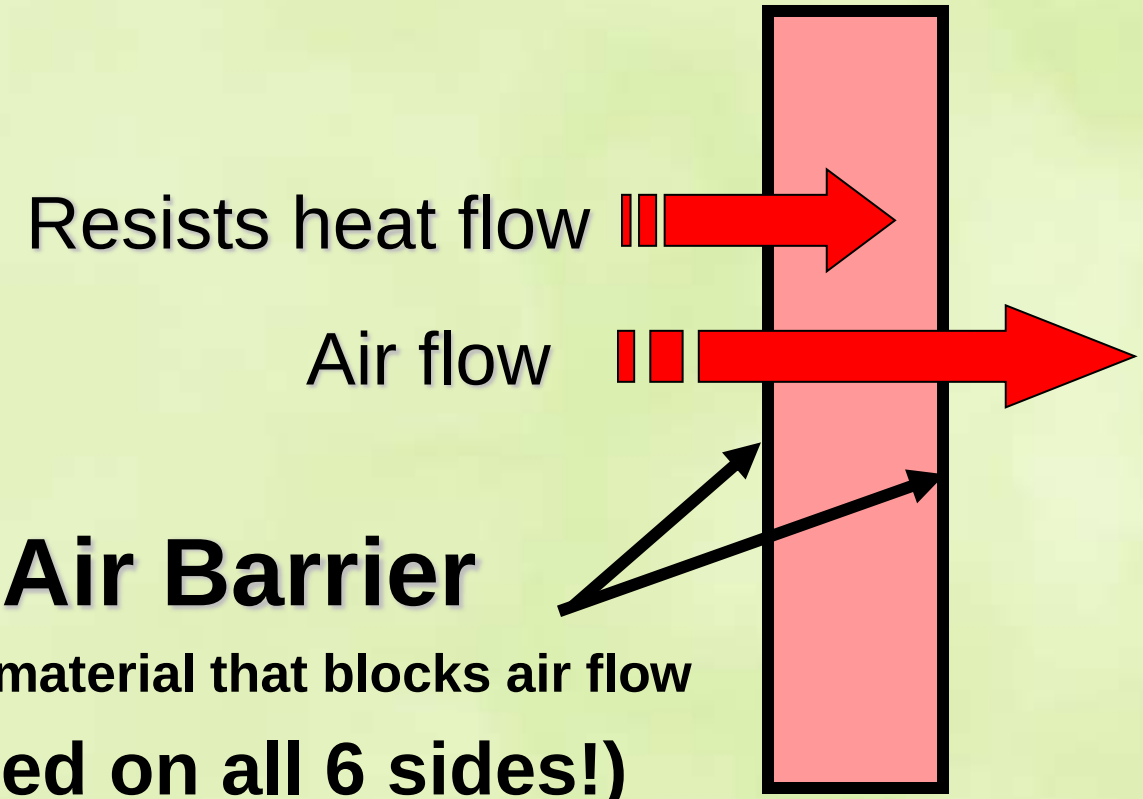
INSULATION FLAWS

Overlay to reach R-38 without gaps

Maintain attic ventilation pathway

THE LIMITS OF INSULATION

- **Insulation is not an air barrier**

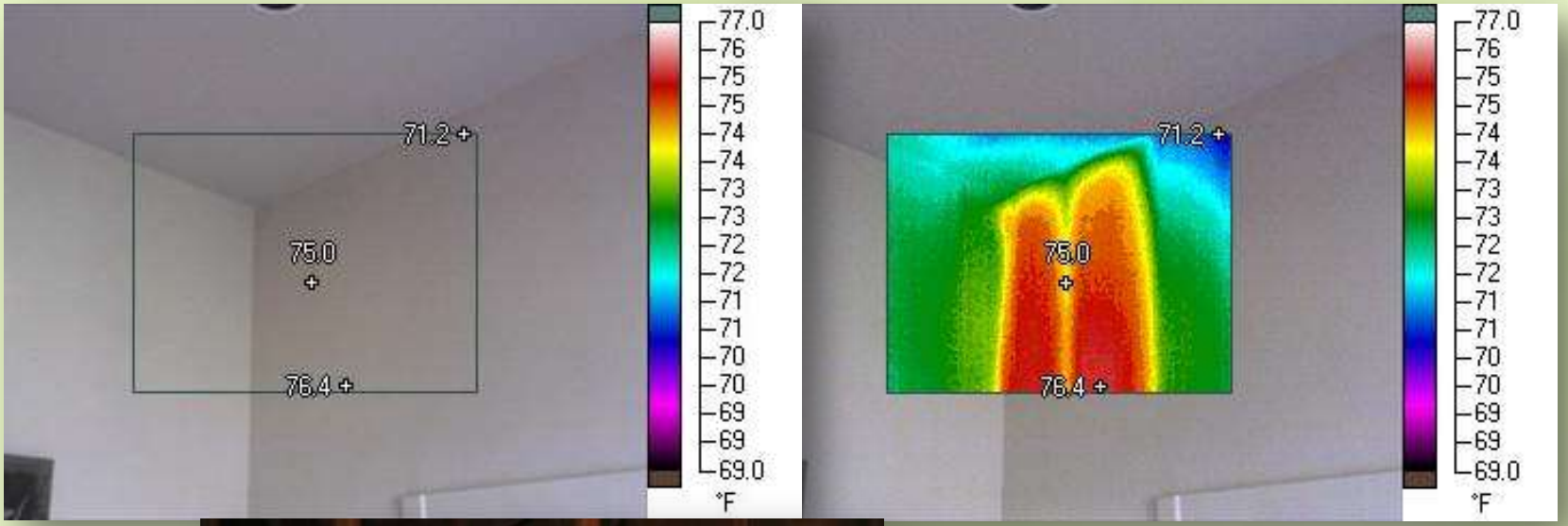


…need Air Barrier

Any solid material that blocks air flow

(needed on all 6 sides!)

UNSEALED INSULATION



Knee walls, cathedral ceilings need air barrier on attic side

7. Appliances
Maintain, Buy Energy Star

APPLIANCE CHECKS

Refrigerator/freezer

- Check seals with dollar bill test.
  - Should feel tension on the bill as you pull it out.
- Vacuum coils
- Keep freezer full

APPLIANCE MAINTENANCE

Dryer

- Clean exhaust duct and vent
- Clean moisture sensors
- *Educate:*
  - Clean lint screen before every load
  - Use fast washer spin

DRYER DUCTING

Metal ducts are safer and more efficient, since they don't sag and trap lint.

Foil and plastic ducts encourage lint buildup in sags and bends.

Consumer Reports.org. Feb. 2008. Consumer Reports.org. 15 Jan. 2009 <http://www.consumerreports.org/cro/appliances/laundry-and-cleaning/clothes-dryers/dryer-fire-caution/index.htm>.

Buy Energy Efficient Appliances and Electronics

Based on standard U.S. Government tests

ENERGYGUIDE

Refrigerator-Freezer
With Automatic Defrost
With Side-Mounted Freezer
Without Through -the-Door-Ice Service

XYZ Corporation
Model ABC-W
Capacity: 23 Cubic Feet

Compare the Energy Use of this Refrigerator with Others before You Buy.

This Model Uses
776 kWh/year

Energy Use (kWh/year) range of all similar models

Uses Least Energy
742

Uses Most Energy
836

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 22.5 to 24.4 cubic feet and the above features are used in this scale.

Refrigerators using more energy cost more to operate. This model's estimated yearly operating cost is:

$68

Based on a 1995 U.S. Government national average cost of 8.4¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

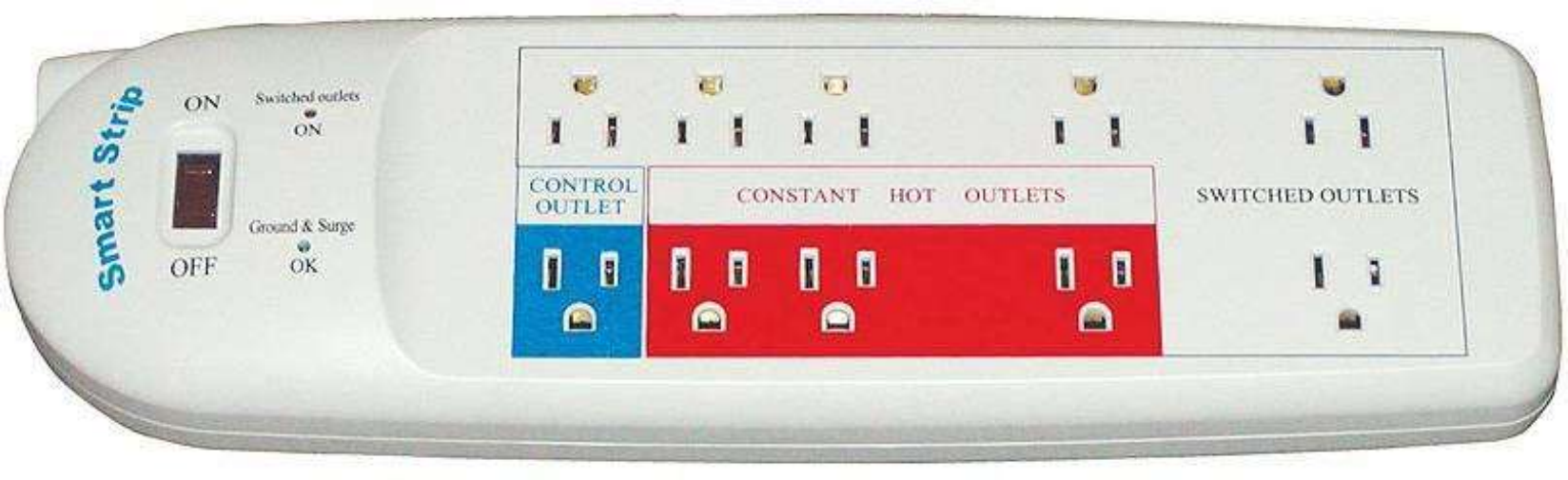
Important: Removal of this label before consumer purchase is a violation of Federal law (42 U.S.C. 6302).

1

2

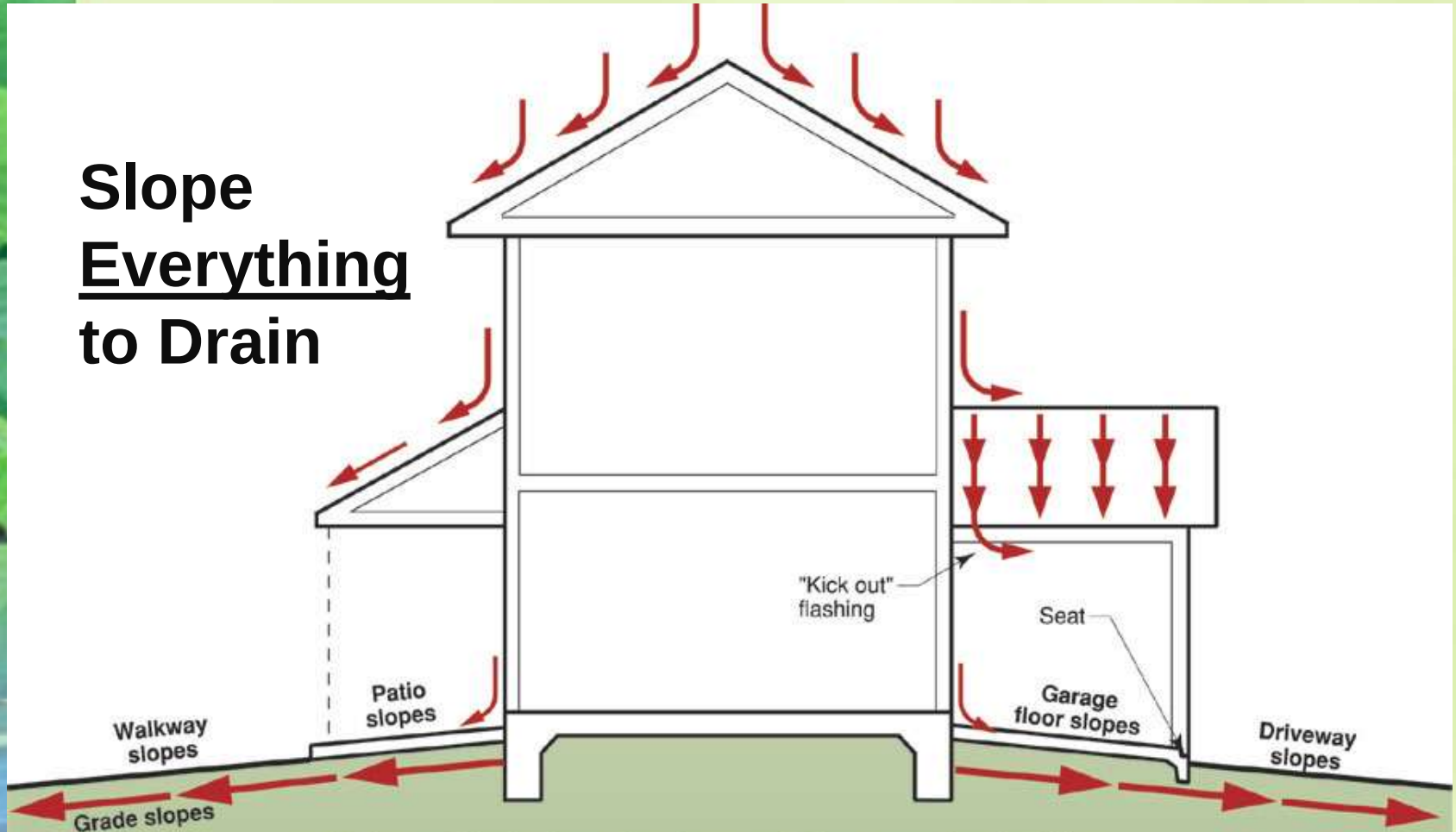
SMART STRIPS

- **Smart Strips eliminate “vampire” loads**

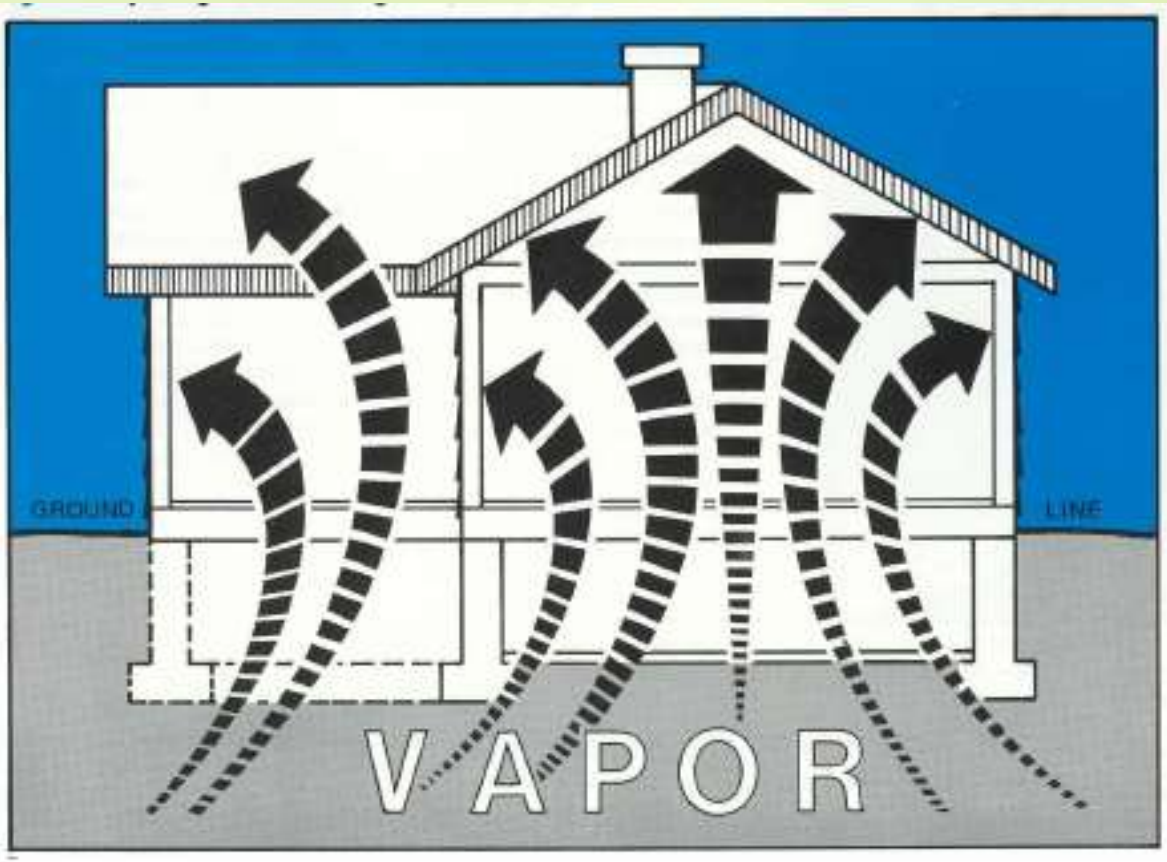


8.Improve Moisture Control

Slope <u>Everything</u> to Drain



- Patios and decks lower than floors and slope away from building
- Garage floor lower than main floor and slope away from building
- Driveway lower than garage floor and slope away from building
- Grade lower than main floor and slope away from building
- Stoops and walkways lower than main floor and slope away from building
- Kick out flashings or diverters direct water away from walls at roof/wall intersections



HUD Research Paper # 28 states that in a building which does not have a moisture protection system, 80% of the moisture within the building originates from building site ground water.

Keep it Dry, Keep it Healthy

Build Tight, Vent Right

Good ventilation includes:

- ✓ **Local exhaust** to remove moisture, odors, other pollutants at the source.
- ✓ **Fresh air ventilation** to reduce pollution by dilution.
- ✓ **Control of airflow** into and through house to filter air, confine contaminants, minimize energy losses and humidity, distribute air, provide comfort.

LaHouse Home and Landscape Resource Center | LSU AgCenter Research & Extension | Building America U.S. Department of Energy Research Toward Zero Energy Homes

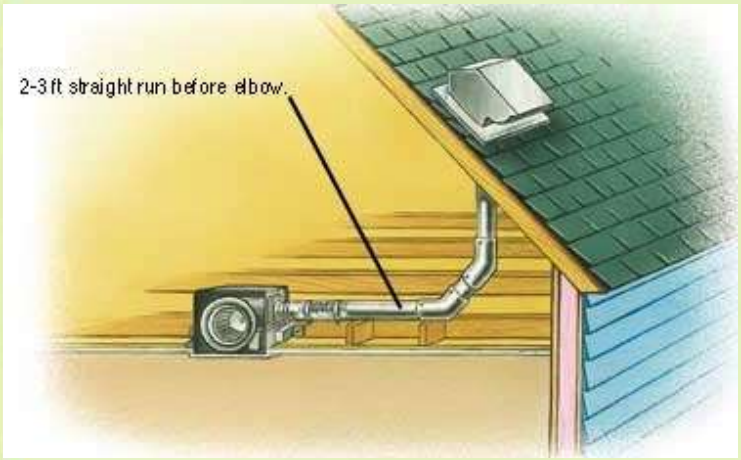
Quiet fans + proper duct installation = effective exhaust

Energy Star, Quiet Exhaust Fan

- **< 0.3 sone at 80 cfm**
- **Moisture sensor or timer**

High Performance Hood

- **< 0.3 sone at normal speed**
- **Extends over all burners**



CORRECT Duct Installation

- **Min. and smooth curves**
- **Larger, smooth duct**

Find the Flaws…

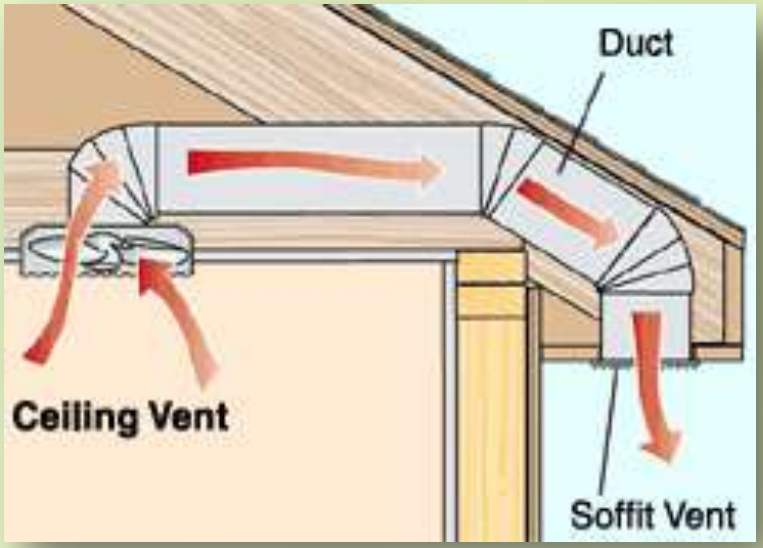
Dryer damper OK?

Ducted ok?

Exhaust Fan Check

Exhaust fan not ducted to soffit.

Make sure dampers are in place and flaps turn <u>out</u> - not in

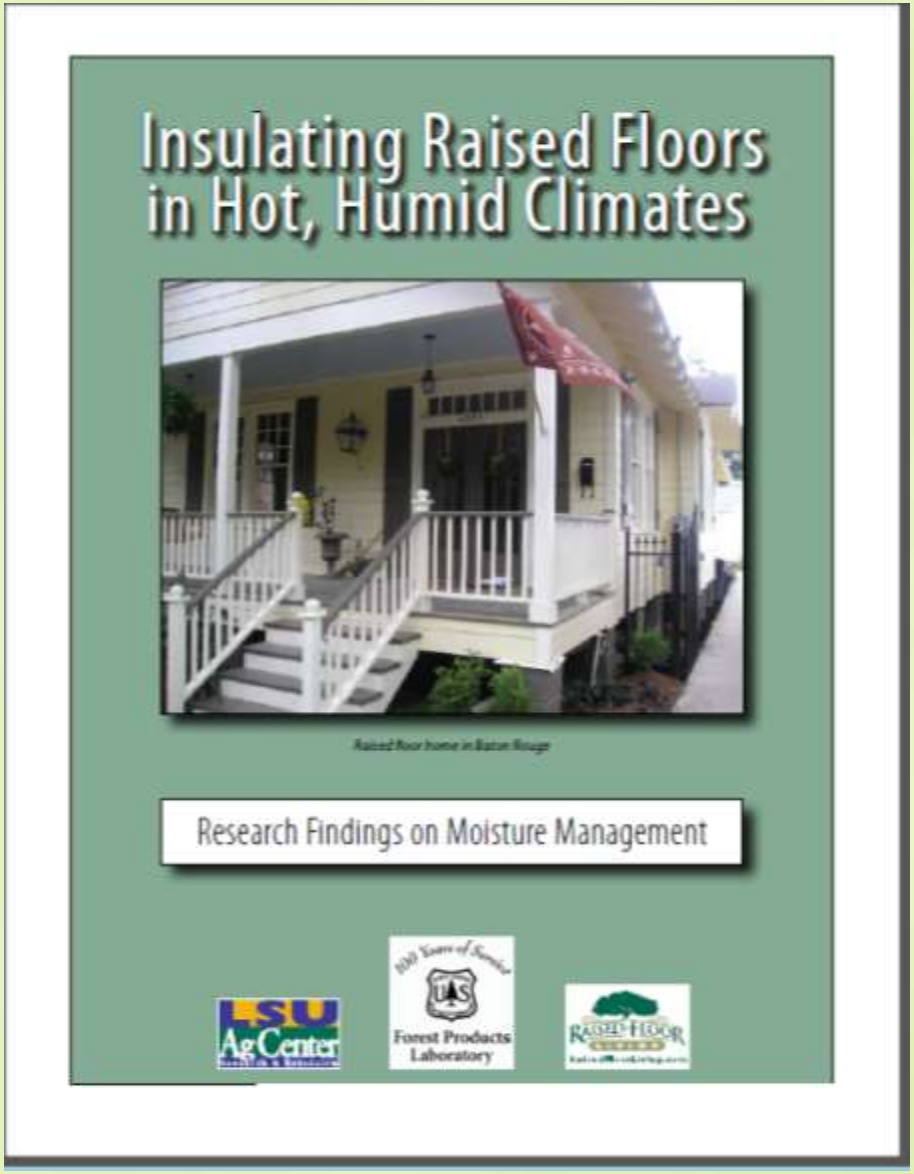


Exhaust to outside (not into attic)

Smooth curves, straight run, full size

9. Consider Insulating Walls or Floors, *IF*…

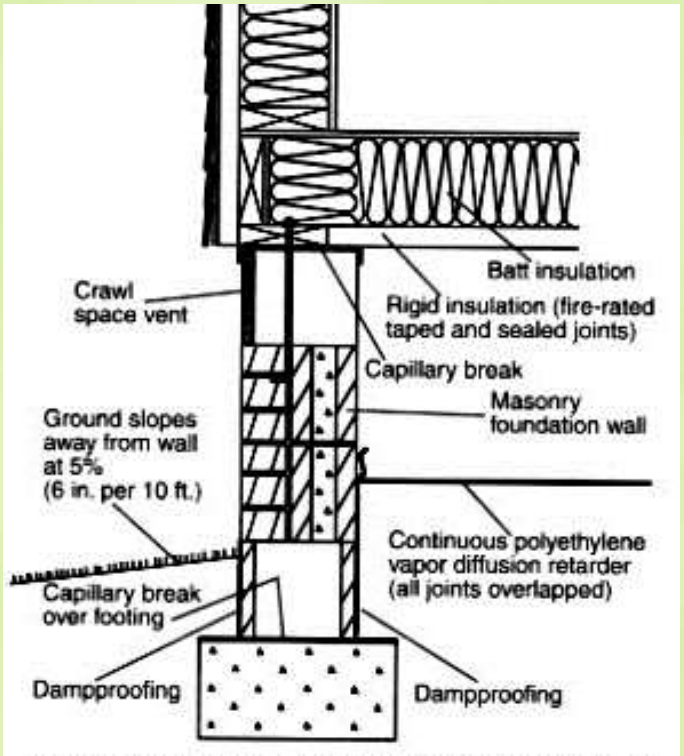
- **Dense-pack cellulose in walls only if…**
  - sufficient weather barrier to keep it dry
  - + no vinyl wallpaper or oil based paint
- **Insulate raised floor or crawl space**
  - If leaky, cold floor – want winter comfort
  - Batts OK ***if no A/C***
  - Otherwise – use airtight, impermeable insulation system



Available at LaHouse Resource Center and web site

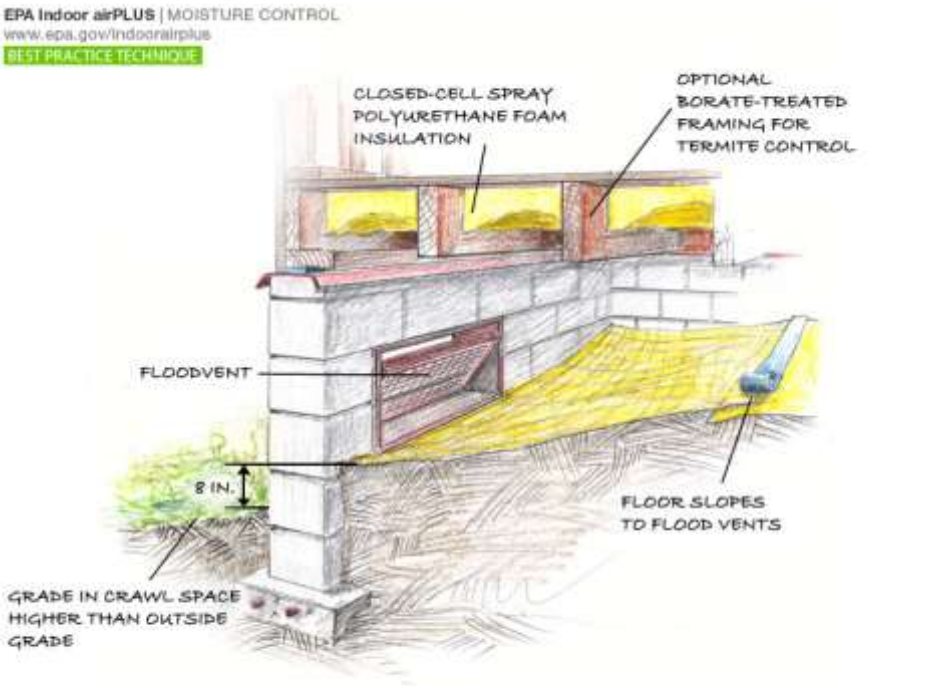
Foil-faced Rigid Foam Panels Under Floor Joists

- **Airtight, low-perm insulation system**
  - Tape seams, foam seal edges & penetrations
  - Spray foam insulate rim
- **Inside grade higher than outside**
  - Plastic ground cover, if not fully open pier and beam
- **Waterproof cap or coating (capillary break)**
- **Termite shield below foam**

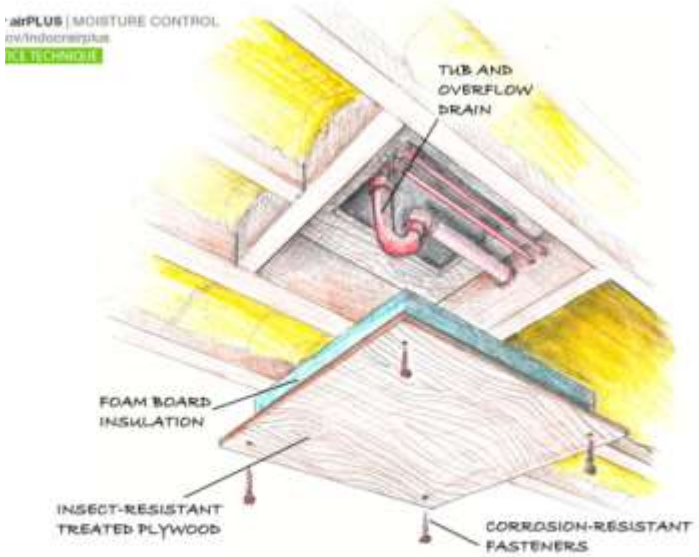


Closed Cell Spray Foam Under Raised Floor

- 2 in. for R-13
- If skirted crawl, coat joists



CRAWL SPACE/FLOOD ZONE: VENTED CRAWL SPACE WITH "FLOOD VENTS"



CRAWL SPACE/FLOOD ZONE: ACCESS HATCH BENEATH TUB

U.S. Environmental Protection Agency's "Indoor air PLUS" new homes labeling program <www.epa.gov/indoorairplus>, see Technical Guidance-Moisture Control; Illustrations- Dennis Livingston, Community Resources.

For more information:

- **www.energystar.gov**
  - Home assessment
  - How-to info
- **www.BuildingAmerica.gov**
  - Hot, Humid Climate Best Practices guide
  - Solution Center
- **www.buildingscience.com**
  - Building guides by climate
  - Homeowner info section
- **fsec.ucf.edu**
  - Florida Solar Energy Center research, info, training
- **www.lsuagcenter.com/LaHouse**
  - *Building Your High Performance Home*
  - Online Training Center
  - My Home and My Landscape articles

LaHouse Resource Center

www.LSUAgCenter.com/LaHouse

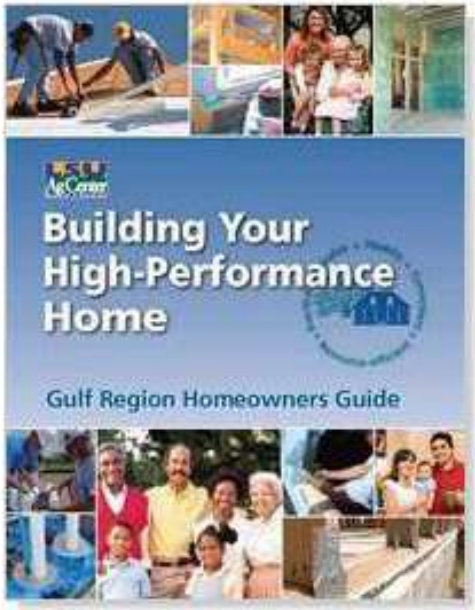
Publications

Available from your parish LSU AgCenter office or www.lsuagcenter.com

Building Your High Performance Home - *Gulf Region Homeowner's Guide* Website link

Our 88-page user-friendly guide to creating a home that:

- keeps comfort affordable with high energy-efficiency and humidity control;
- is protected from storms, floods, termites, mold, and decay;
- is healthy, safe and convenient for a lifetime;
- is a smart investment; and
- protects our environment for future generations.

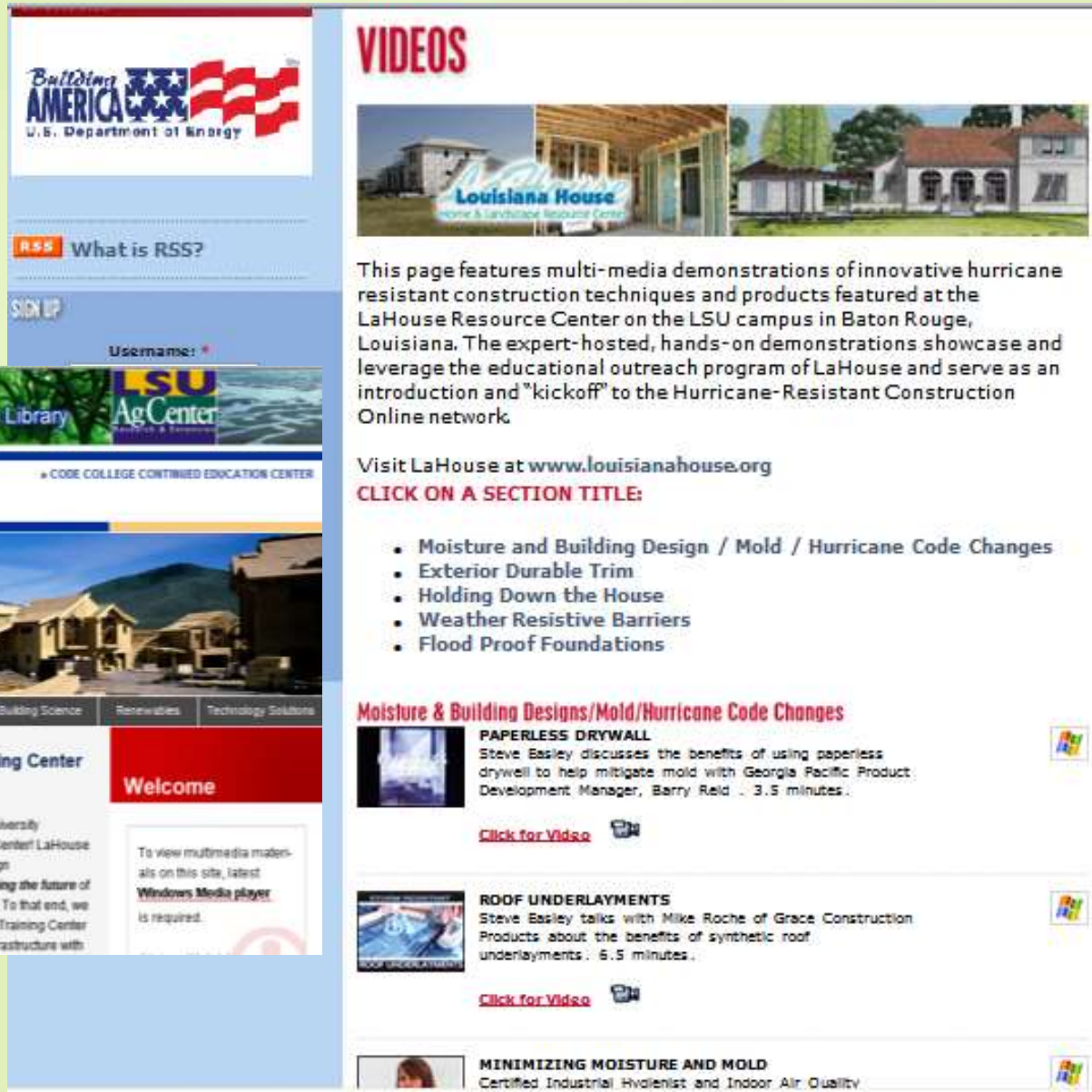


Improve Your Home and Profit

Website link

A six-page fact sheet about ways to get the most from your remodeling investment by including the right energy-saving and hazard-resistant home improvements.

FREE Online Video Library



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GRHP Test

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Viewing the component lesson videos and answering interactive quizzes **may qualify for CEU or PDU credits**; check with your CEU granting authority to determine if they accept online courses.* When you complete a course, you can print a **certificate** of completion and **transcript** on the *My Accounts* page (see link at top of page).

In addition, these courses meet the educational requirements for the ***Gulf Region High Performance (GRHP) Home professional designation*** – a marketing tool for you, and evidence to your customers of your commitment to staying up to date with science based knowledge that is tailored to the region's climate, conditions and hazards.

* These courses are pre-approved by the State of Louisiana Licensing Board for Contractors for CEUs for residential contractors.

LaHouse

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Showcase of Solutions

- 4 *high performance* building systems
- 4 HP foundation systems
- 10 types of windows, doors
- 3 HVAC systems
- 5 attic treatments
- 5 moisture mngt. sytems
- *Fortified for safer living*
- *DOE Building America*
- *Energy Star*
- *Healthy Home / IAQ*
- *Green Building*
- *Universal Design*

Questions?

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Director, LaHouse Resource Center

LaHouse Home and Landscape Resource Center
LSU AgCenter Research & Extension
Building America U.S. Department of Energy Research Toward Zero Energy Homes

U.S. Dept. of Energy Building America Reports BA-1310:

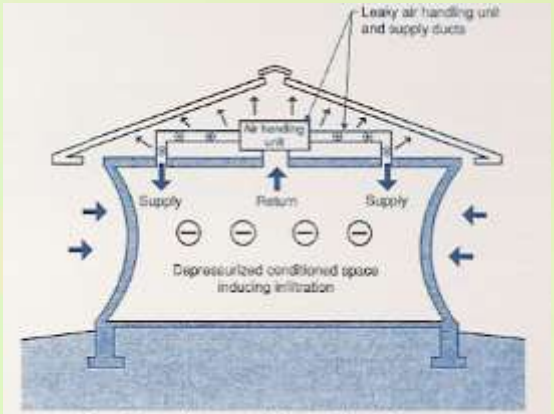
Supplemental Dehumidification in Warm-Humid Climates

By Armin Rudd 2013

Air Handler and Duct Locations

1. **BEST – In conditioned living space**
   - Ducts in furr downs, below sealed ceiling
   - Air handler in closet
2. **Good – In unvented attic**
   - Insulation at roof, not ceiling and air sealed
   - Attic is then semi-conditioned space
3. **Good – Super sealed in vented attic**
   - Mastic, not duct tape + R-8 insulation
   - Return duct, not leaky plenum
   - Air tight ceiling

Vented Attic vs. Unvented, Conditioned Attic



Duct Leaks and Negative Pressure

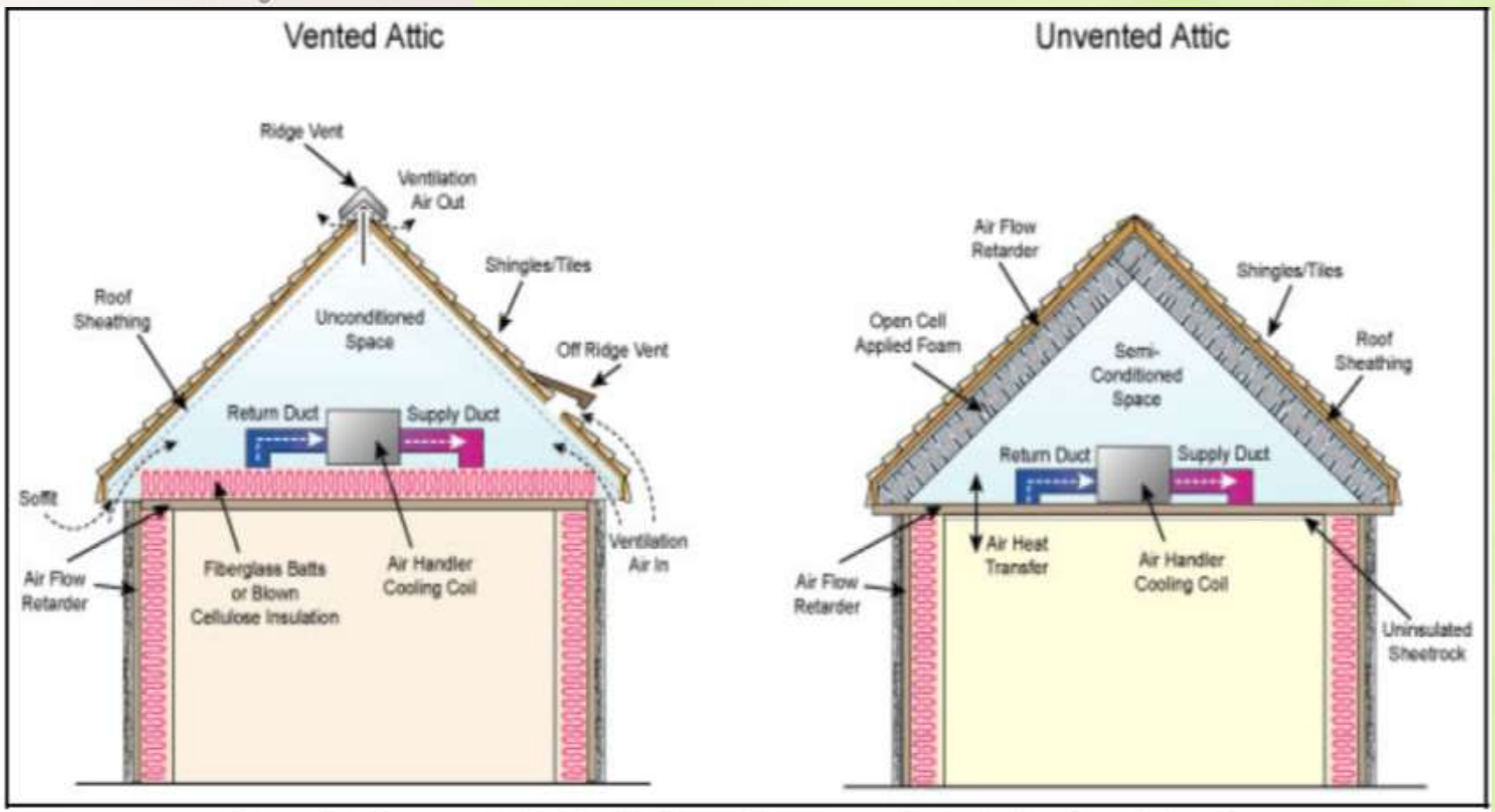


Figure 1. Diagram of Roof/attic thermal processes in vented and sealed attics.

Unvented Attic System

Advantages

- **No HVAC losses to outside, so**
  - Saves energy, money
  - Prevents negative pressure
  - Reduces forced air leakage & dirty attic air infiltration to living space
- **Enables smaller A/C**
  - Offsets higher cost of insulaton system
- **No need to air seal ceiling**
  - No need for ICAT cans, detailing, etc.
- **No attic, soffit vents**
  - No wind driven water risk
- **Can deck attic floor, no insulation**
- **Clean, comfortable attic space**
- **Closed-cell adds wind resistance**

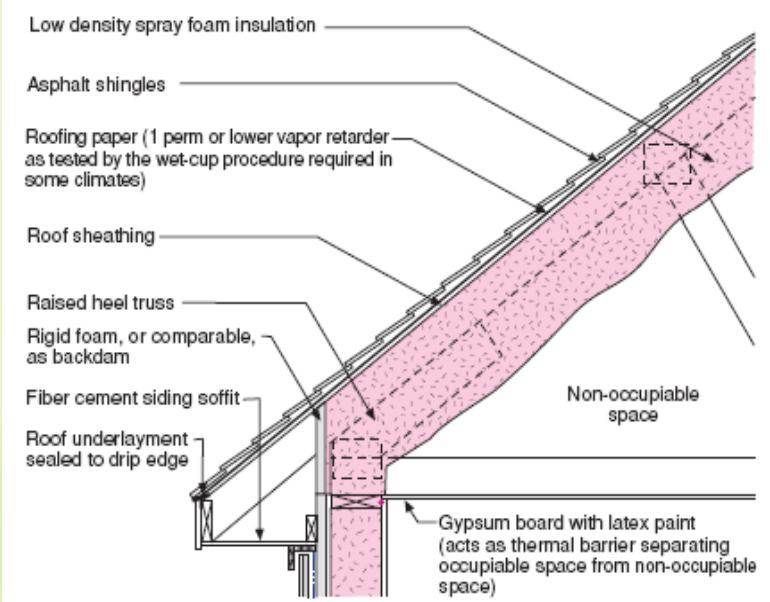


Figure 8
Air Impermeable Spray Foam Insulation

But…

Unvented Attic System

Requirements & Recommendations

- ***Air-impermeable insulation* (spray foam) under roof decking (code)**
  - Or, rigid foam above roof decking
  - To prevent winter condensation at ridge
- **NO vents**
  - Need sealed blocking at roof-wall junction
  - Vents or leaks in humid climate = moisture problem
- **Semi-conditioned space**
  - Don't isolate from living space
  - Need slight A/C supply + return in warm climate for attic humidity control
- **NO combustion equipment**
  - ***Except*** direct vent, sealed combustion type
  - **Critical IAQ and moisture hazard!**
- **Proper installation, curing, safety**
  - Trained workers, correct methods
  - Dry deck, right temperature, right mix
  - No occupants until cured

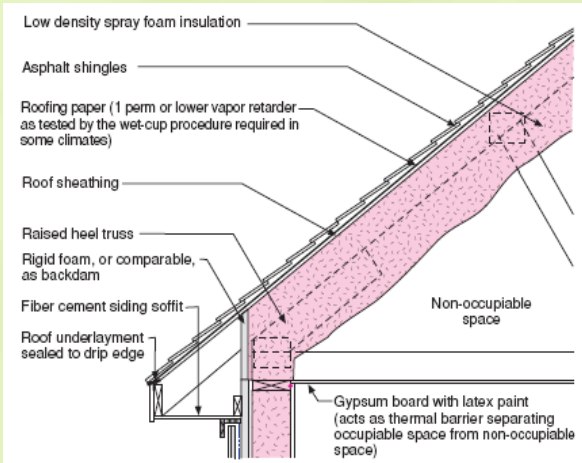
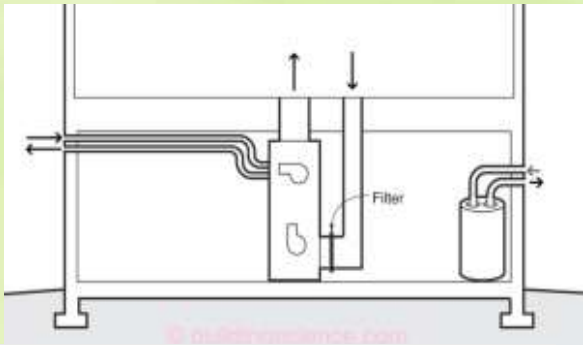


Figure 8
Air Impermeable Spray Foam Insulation



Direct vent, sealed combustion furnace & WH

Unvented Attic System

Requirements & Recommendations

- **Ignition barrier (code)**
  - ES report approved product
  - Or, intumescent coating, gypsum, etc. covering
- ***Low perm* underlayment**
  - Synthetic felt or adhesive membrane
  - Stops vapor drive into decking to prevent swelling and buckling
- **Heat tolerant or cool roofing**
  - Metal, tile, slate, concrete
  - Light or “cool color”, high quality shingles
- **Only closed cell in cold climates**
- **Open cell in warm, rainy gulf region…**
  - OK with indoor humidity control
  - More forgiving of roof leak, vapor drive
- **R-value higher than in walls** (R 20-30 in La.)
  - **No** insulation on attic floor
  - No radiant barrier under roof

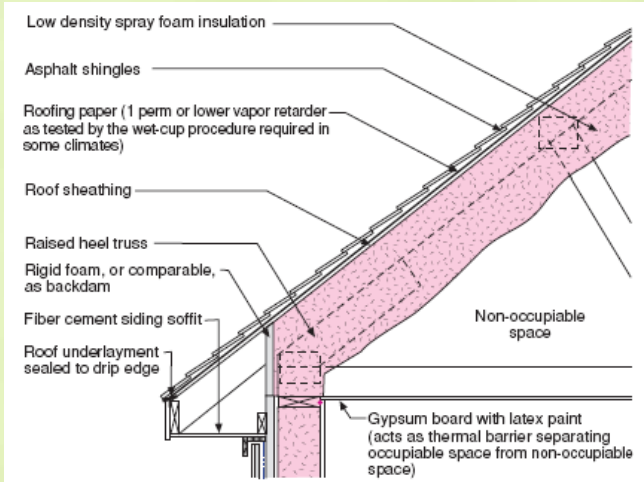
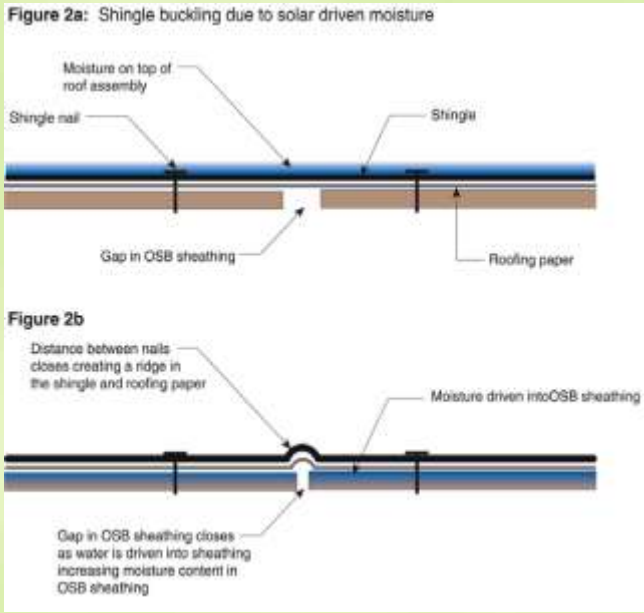


Figure 8
Air Impermeable Spray Foam Insulation



Roofing buckling due to solar driven moisture vapor drive into decking