Air Leakage and Sealing

Funding

Funding for this class was provided by the Alaska Housing Finance Corporation (AHFC).

This course is designed to empower homeowners with the knowledge to live in and maintain a safe, energy efficient home.

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Topics for today:

- AHFC programs
- Building Science review
- Tools
- Attic air sealing priorities
- Foundation air sealing priorities

AHFC Energy Efficiency Programs:

- Home Energy Rebate Program
- Weatherization Assistance Program
- New Home Rebate
- Second Mortgage for Energy Conservation
- Energy Efficiency Rate Reduction Mortgage
- www.ahfc.us

Air Leakage

Buildings leak

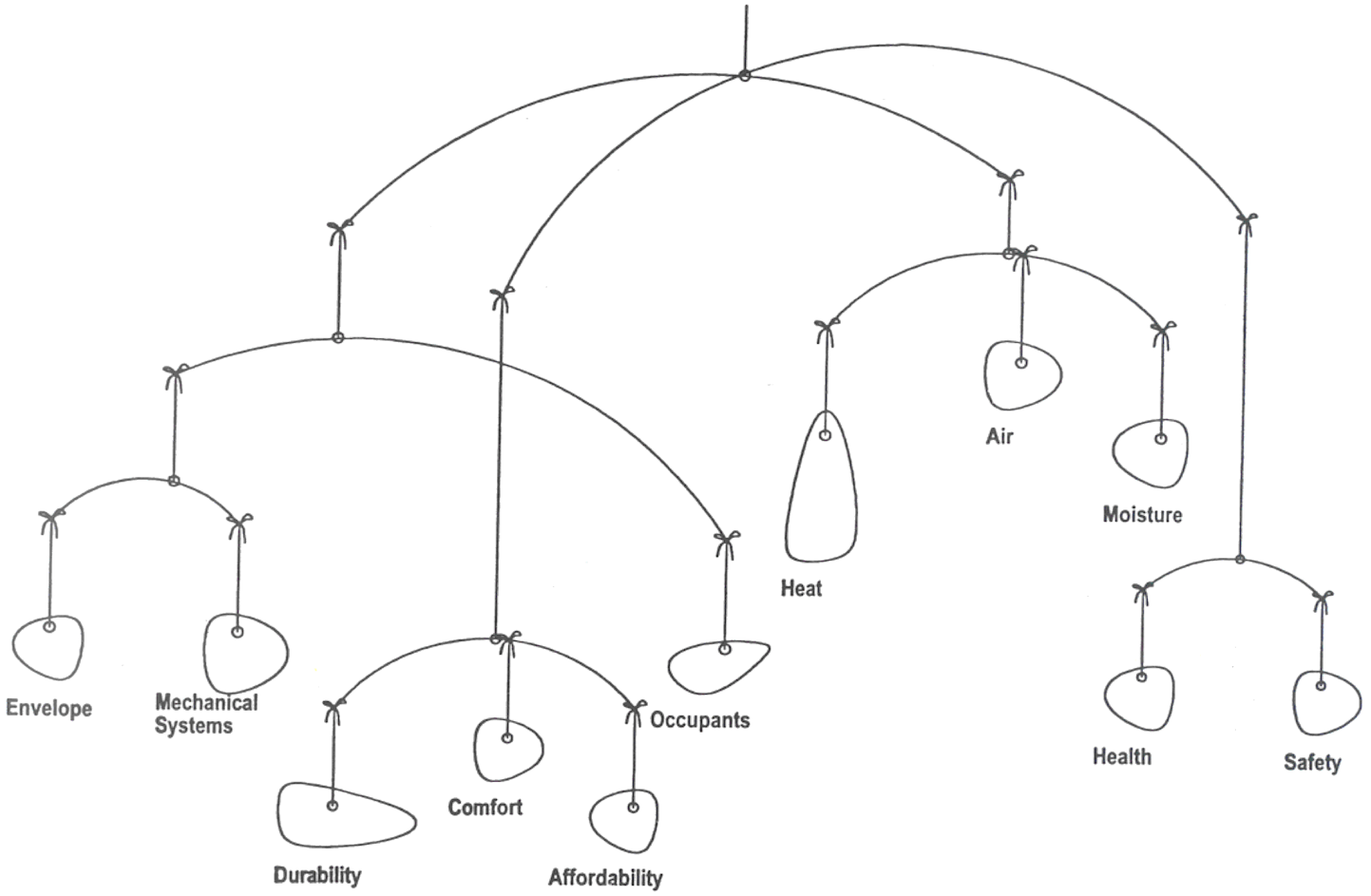
At least a little bit…

Unfortunately, unplanned air leakage…

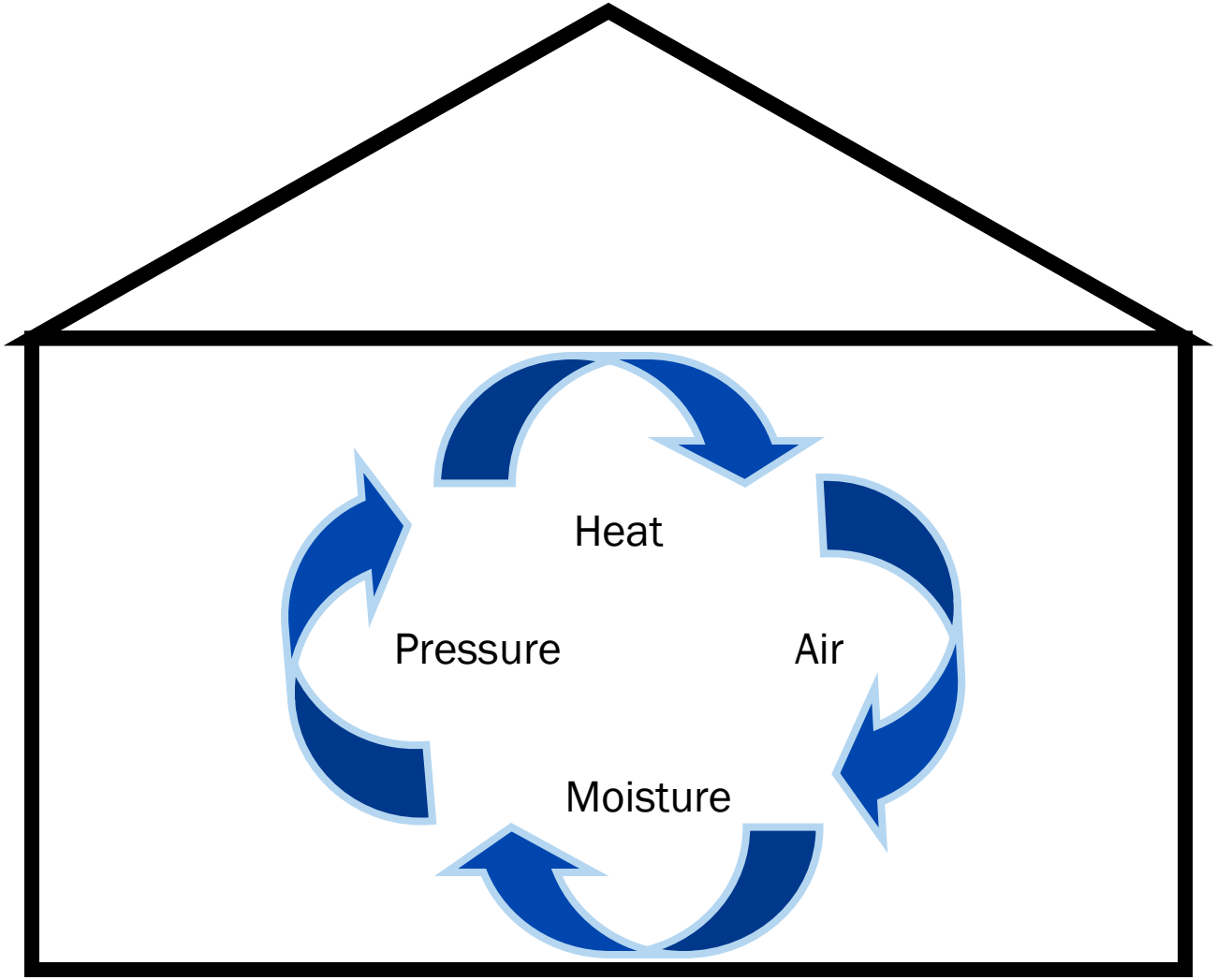
- Is common in existing buildings

- Must be dealt with during weatherization or retrofits

The house is a system



At home with the PHAM



Where buildings leak

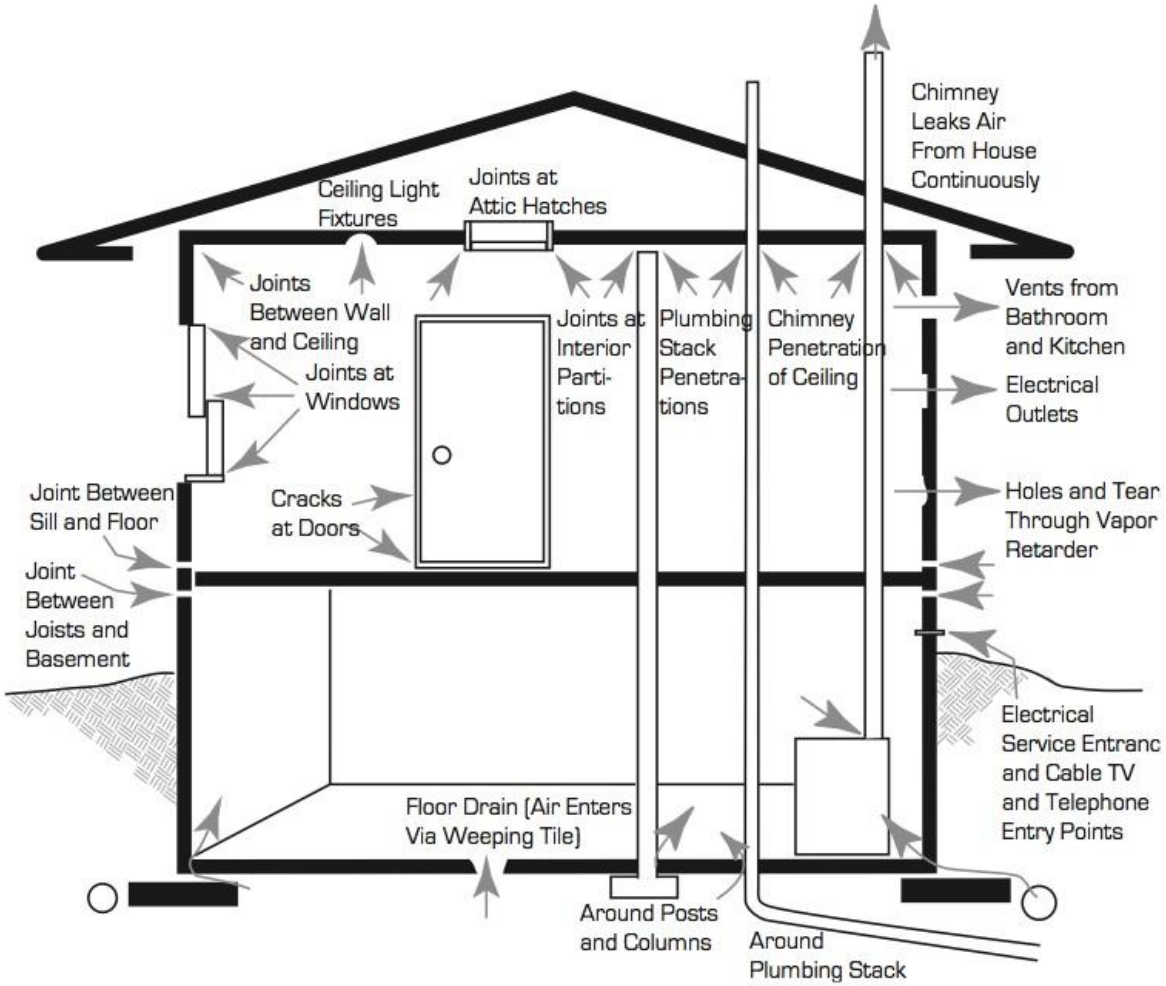


Figure 2.8: Air leakage points in a house.

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Air sealing is often the most important step in weatherizing a building

but it is not always easy

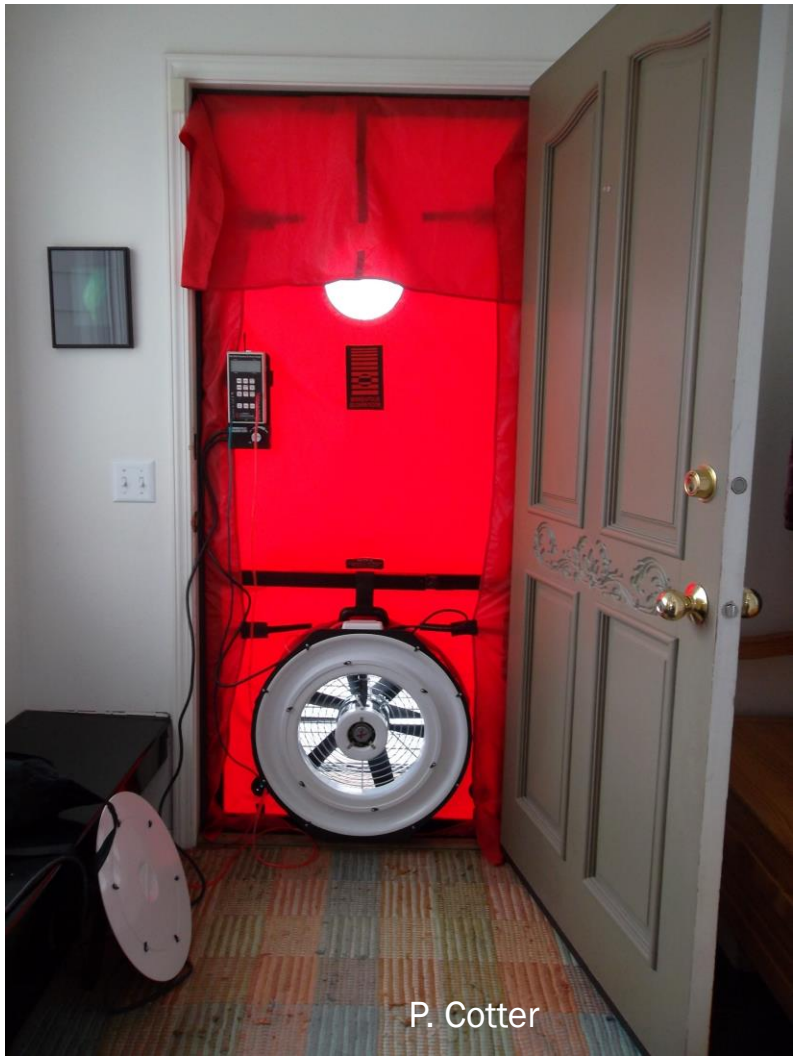
Why control air leakage?

- Save energy
- Increase comfort
- Prevent moisture problems
  - From inside
  - From outside
- Prolong building durability

Fundamental rules of air leakage

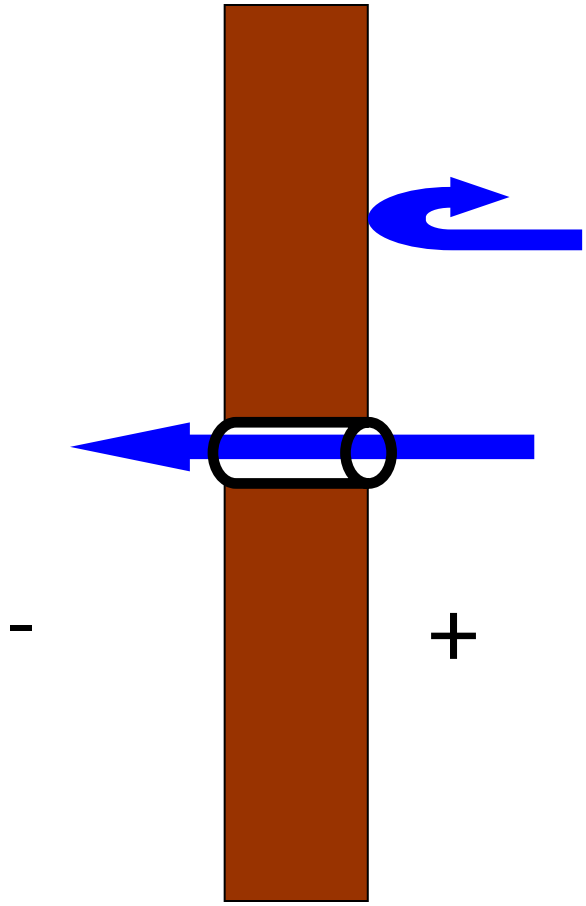
- Air DOES leak through holes and cracks
- Air DOES NOT leak through solid objects
- Direction of air leakage depends on direction of pressure gradient
- Air seal on the warm side of the insulation
- Adequate ventilation must be provided
  - seal it tight, ventilate right

Quantifying air leakage



A blower door system

Air leaks thru connections/gaps



Air follows pressure gradients

Not always this simple, of course

Seal it tight, ventilate right

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Install ventilation system prior to or during air sealing operations

Table R-A4.1a, Ventilation Air Requirements, cfm

Floor Area (ft^2)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500	35	55	75	95	115
1501-3000	50	70	90	110	125
3001-4500	65	85	105	125	145
4501-6000	80	100	120	140	160
6001-7500	95	115	135	155	175
>7500	110	130	150	170	190

Alaska Amendments, April 3, 2013

Unintended air flow results in

- Heat loss

- Increased likelihood of moisture problems

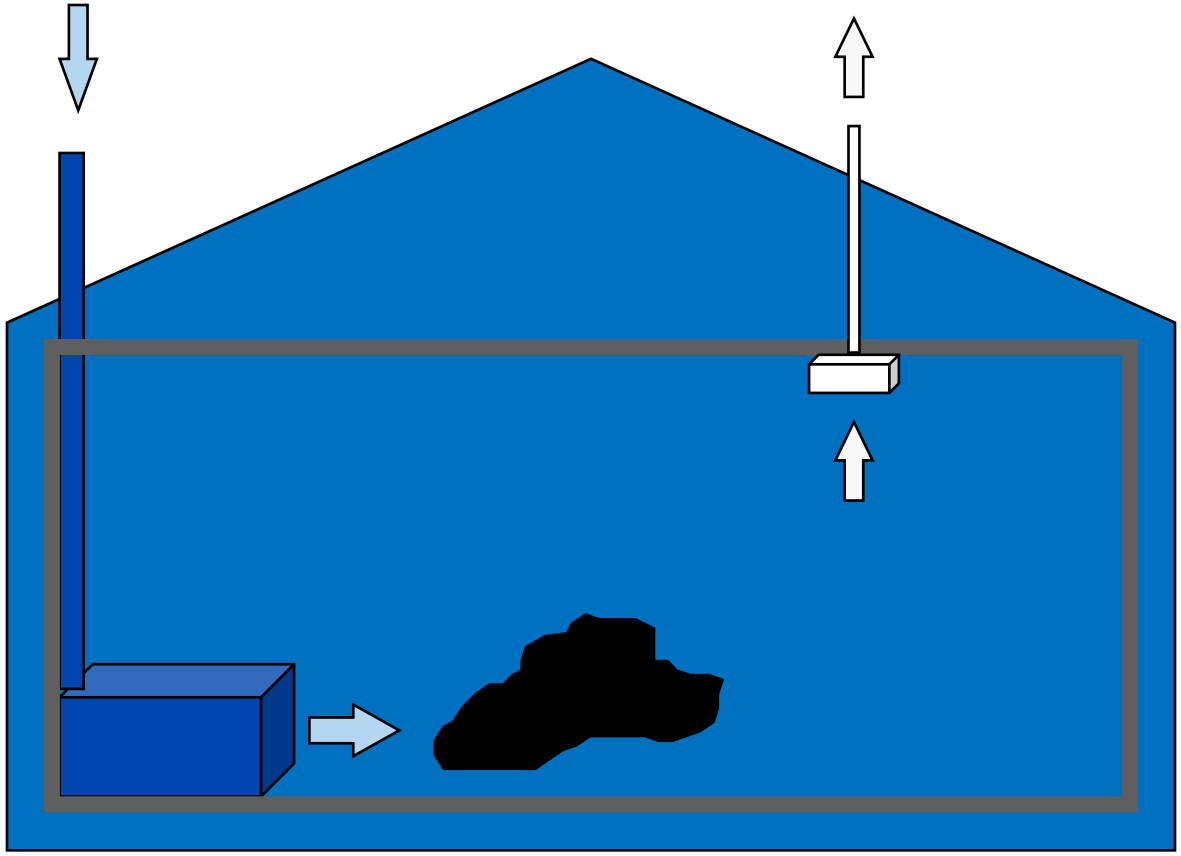
Sealing air leaks* can reduce

- heat loss

- likelihood of moisture problems

*Care must be taken – excessive air sealing without proper precautions may be extremely dangerous

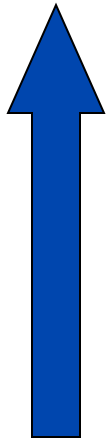
Combustion gases and tight homes: Be careful of backdrafting



Building Air….

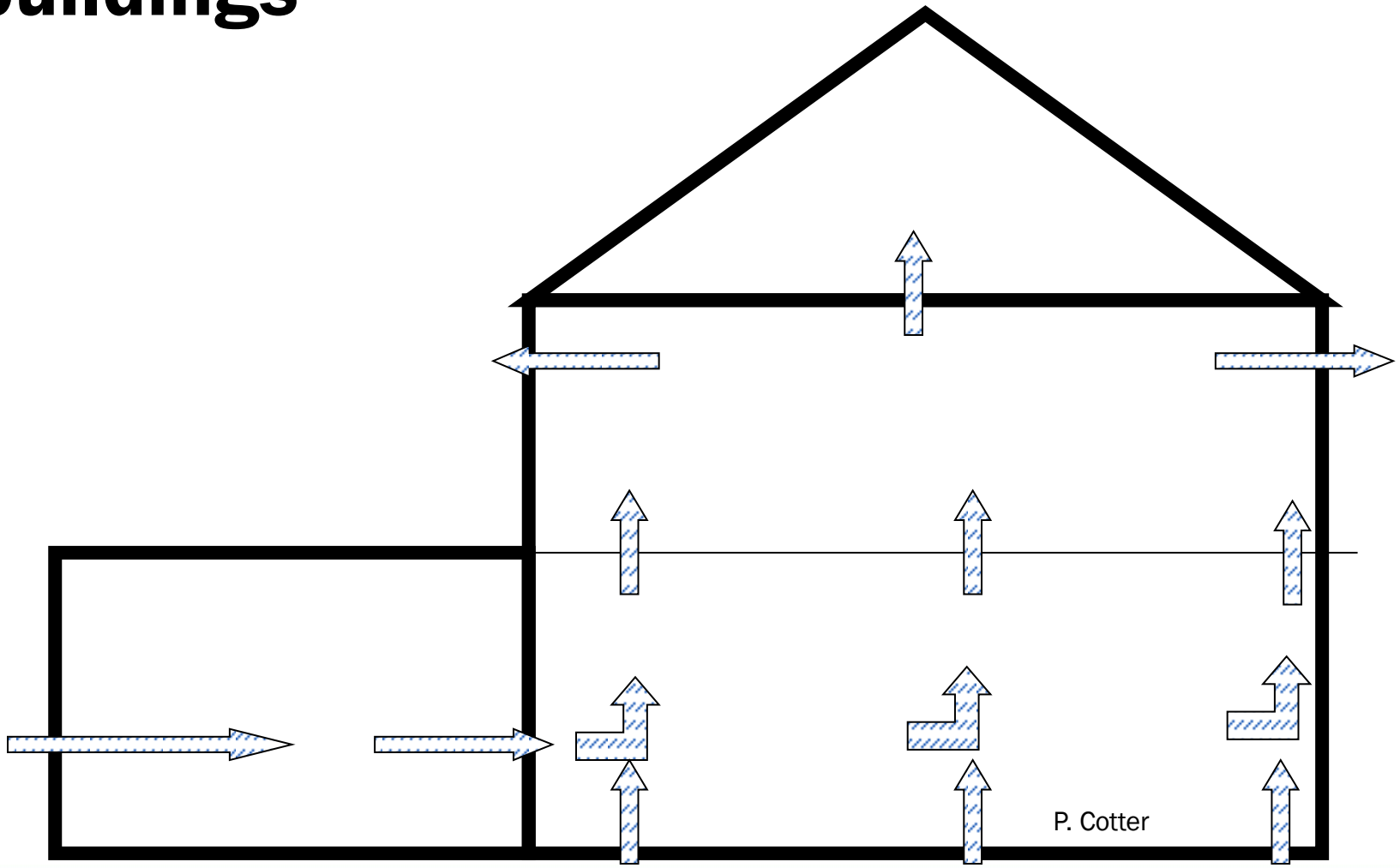
Leaves High

THE STACK EFFECT



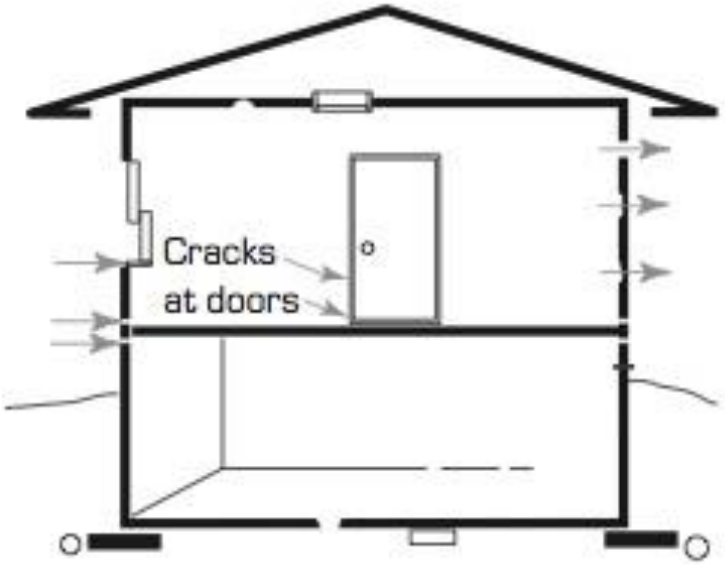
Enters Low

General airflow pattern in cold climate buildings

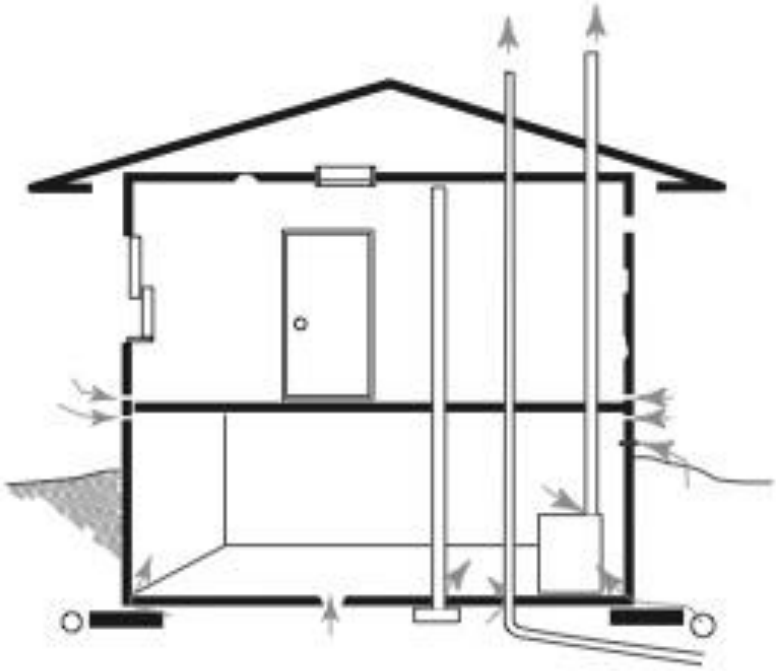


Air Leakage – new chimney

Other influences on airflow



wind effect



flue and vent effect

Tools of the trade

- Foam gun (much better than disposable cans)
- 2-part polyurethane systems
- Caulking gun (good one) and caulk
- Backer rod
- Rigid foam, batt, cellulose
- Protective equipment - resp, tyvek, etc
- Red tape, aluminum duct tape, mastic
- Poly

Spray foams

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Spray foams

Caulk and Caulking Gun

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Do not use painters caulk for air sealing

Lots of caulks out there

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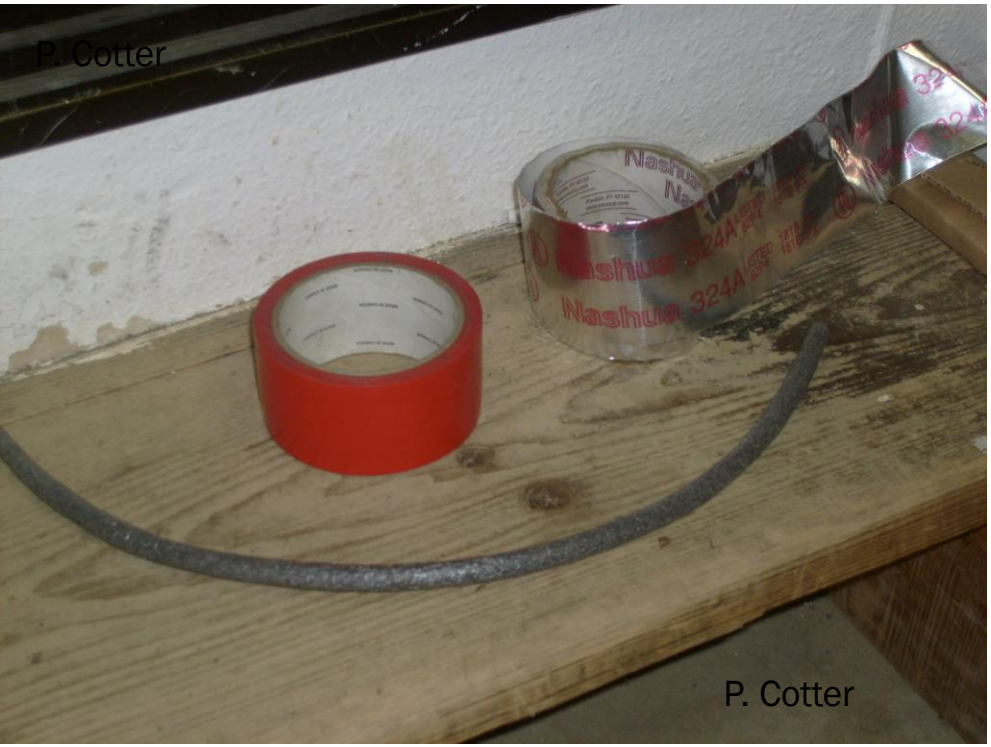
High quality caulks preferred (Ex. silaconized acrylic, elastiomeric, etc.)

In rural Alaska, these caulks ~ $8 - $12/tube

Caulks

- Newer polymer caulks
- Siliconized acrylic latex
- Polyurethane
  - Chemcaulk 900 excellent low temperature characteristics

Backer rods, tapes, mastic…



...and more

Rigid foam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And safety gear…


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Airsealing priorities

DON’T SEAL COMBUSTION AIR SOURCES!

Keep this open

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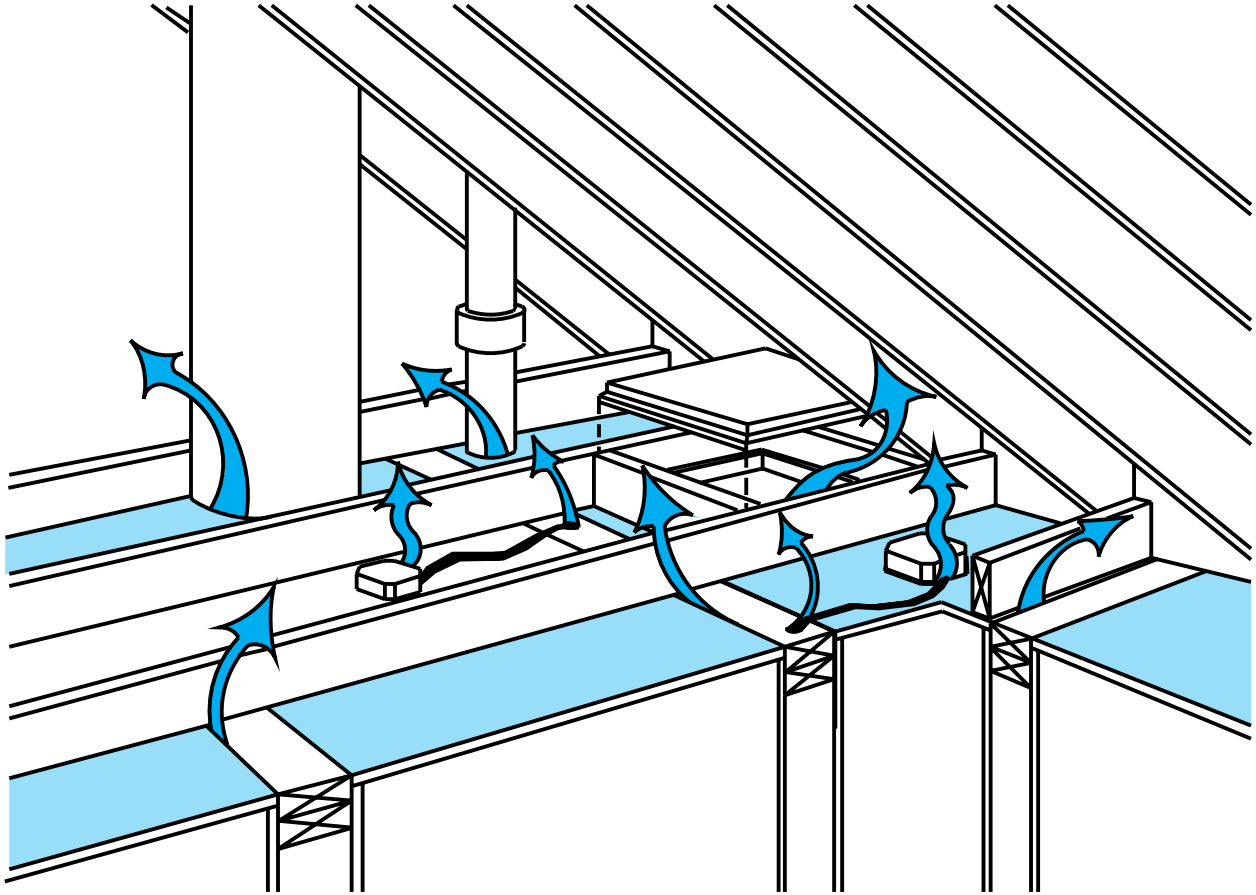
The order of airsealing (usually)

1) Attic

2) Foundation/crawlspace/basement

3) Everything else

Attic First! Why?



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Attic First!

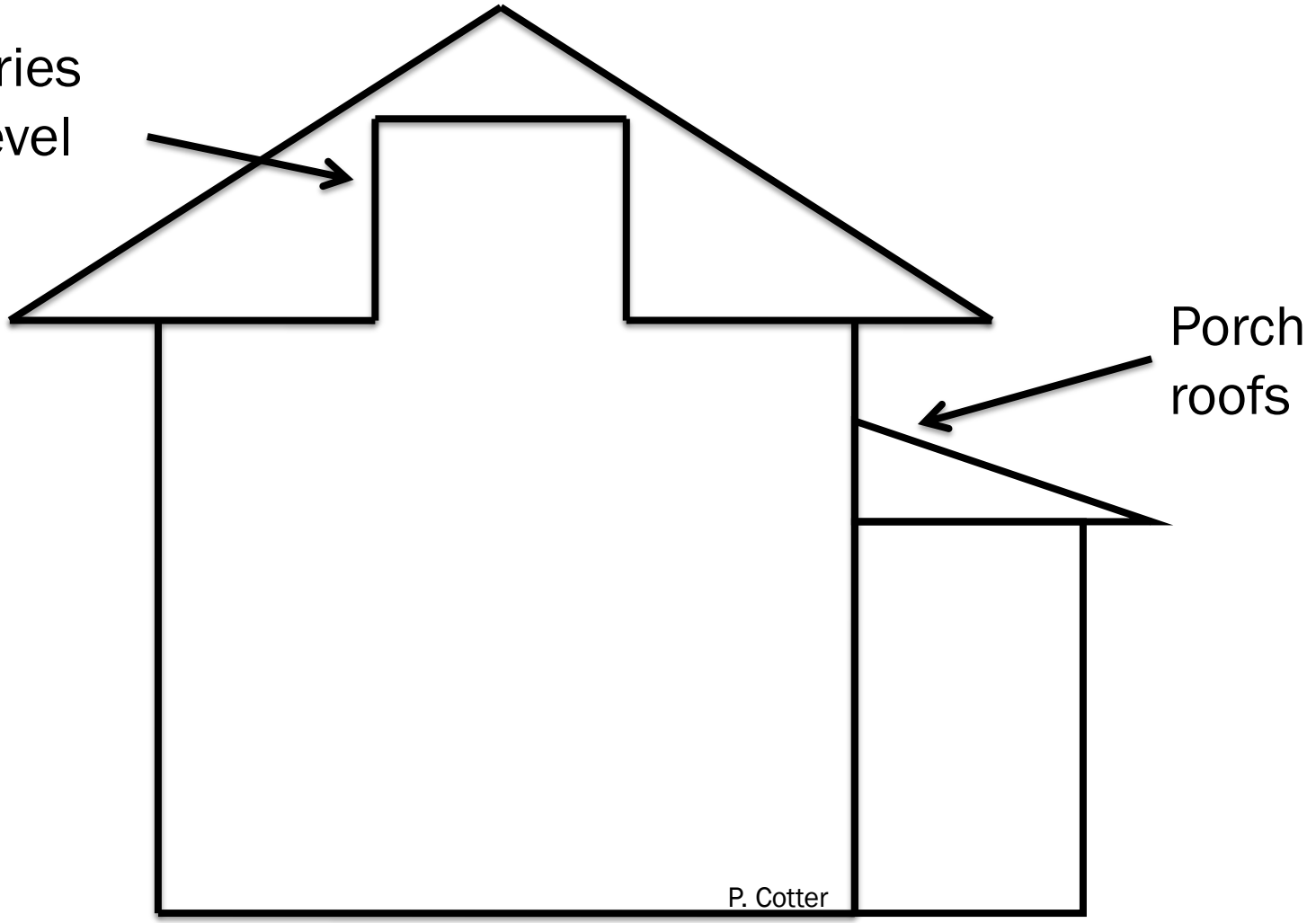
- What does it take?
  - Small body and long arms, preferably
  - Protective equipment
  - Foam (gun/kit/rigid)
  - Caulking
  - Tape?
  - Batt for backing?

Attic airsealing made easy(er)

- Before going into attic, locate and map
  - Penetrations
    - Electrical (lighting, outlets, etc)
    - Plumbing
    - HVAC
  - Partition walls (rooms, halls, closets, etc.)
  - Ceiling height changes
  - Stairwells

Look for Transitions

Half stories and 2-level attics



Air sealing organization

- Clear out work areas
- Follow your map
- Convenient starting point
  - Work in organized fashion
  - Clear existing insulation to find leak points
- Check for black/brown discolorization in batt insulation
- Special attention to wet rooms (bath, kitchen)

Suggests air leakage

Top plates

Caulked and foamed

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Top plates

Caulked and foamed

Sealing the top plates from exterior

Top plates from outside

Top plates from outside

Top plates from outside

Wire through top plate

Foam or caulk here – may be difficult to reach

Transitions

Open Framing

Open framing around closets

Additions

Air and thermal Communication

This is really an open framing problem

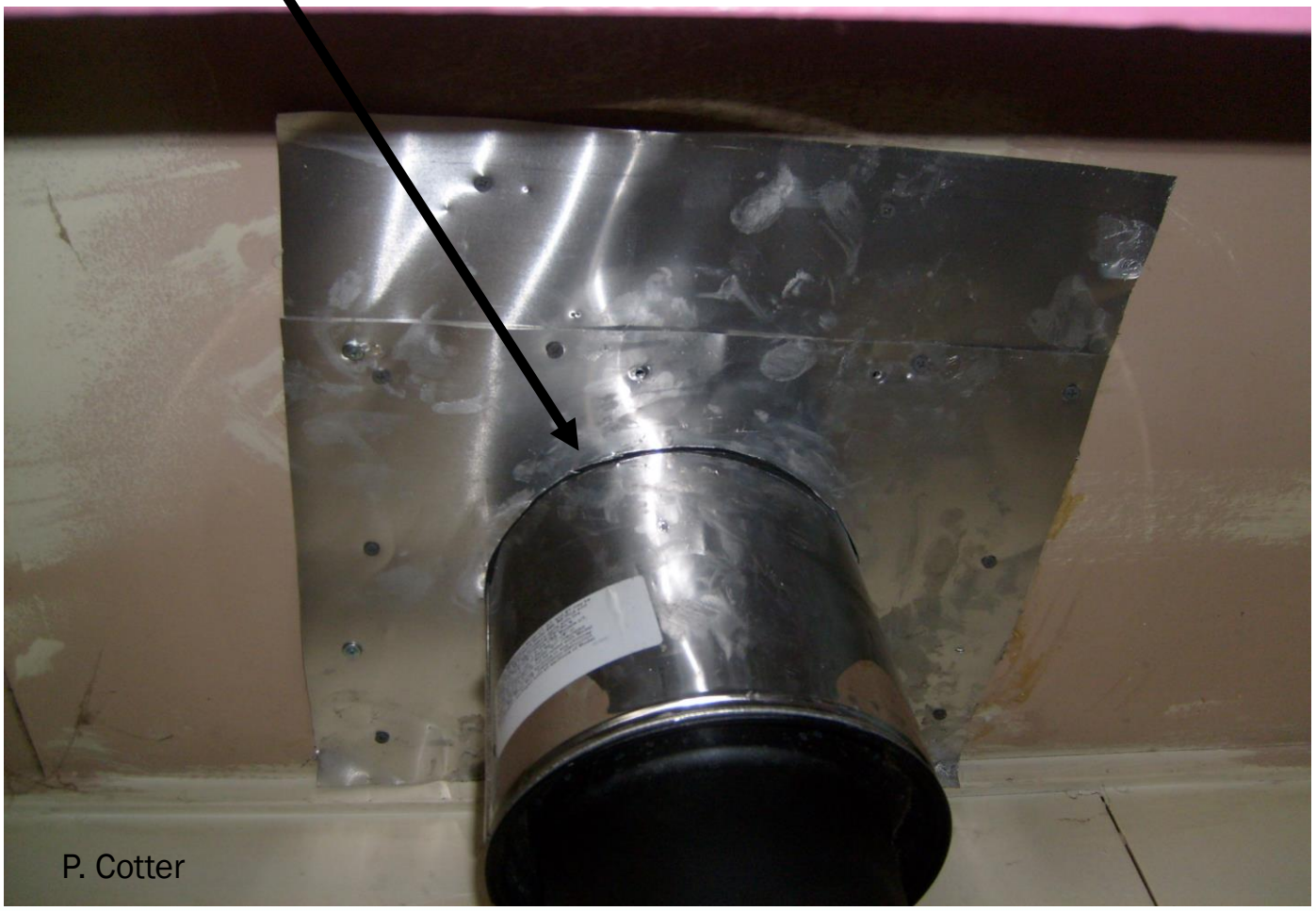
Serious Attic Bypasses

2’ X 4’ unsealed penetration in ceiling

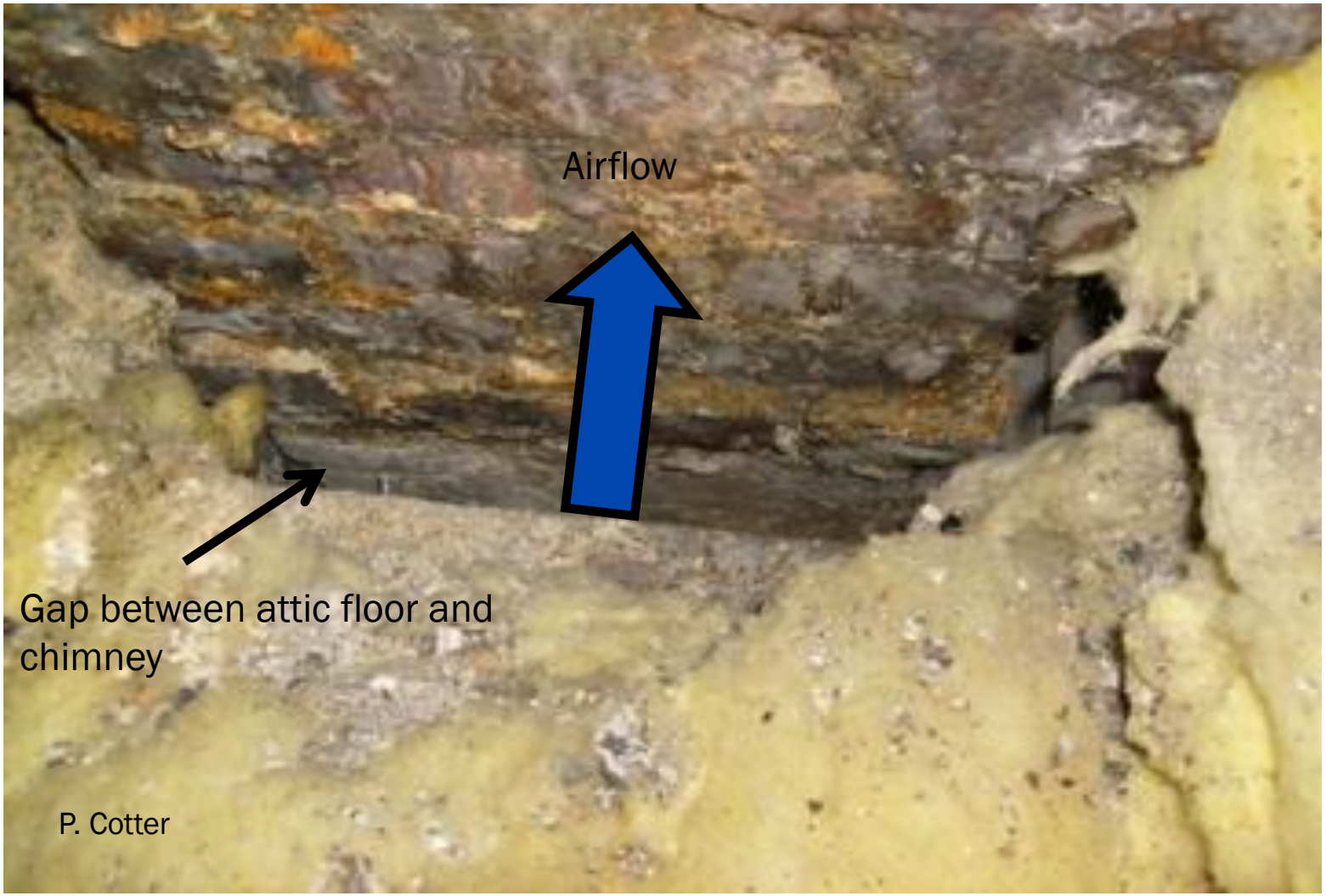
Remedy with, framing, sheet metal and fire-safe sealant

Flue penetrations sealed with sheet metal

Carefull selection of caulk here



Masonry Chimneys



Seal around exhaust fans

Seal these with duct mastic or aluminum duct tape

Plumbing Vent penetration

Sealed wiring and plumbing penetrations

Some prefer flexible air seal around plumbing penetrations to allow for movement (especially for ABS)

Extreme Air sealing

Electrical boxes, lighting

Partition walls

- Often leak to attic
- Seal
  - In attic or
  - Interior

Seal walls and wires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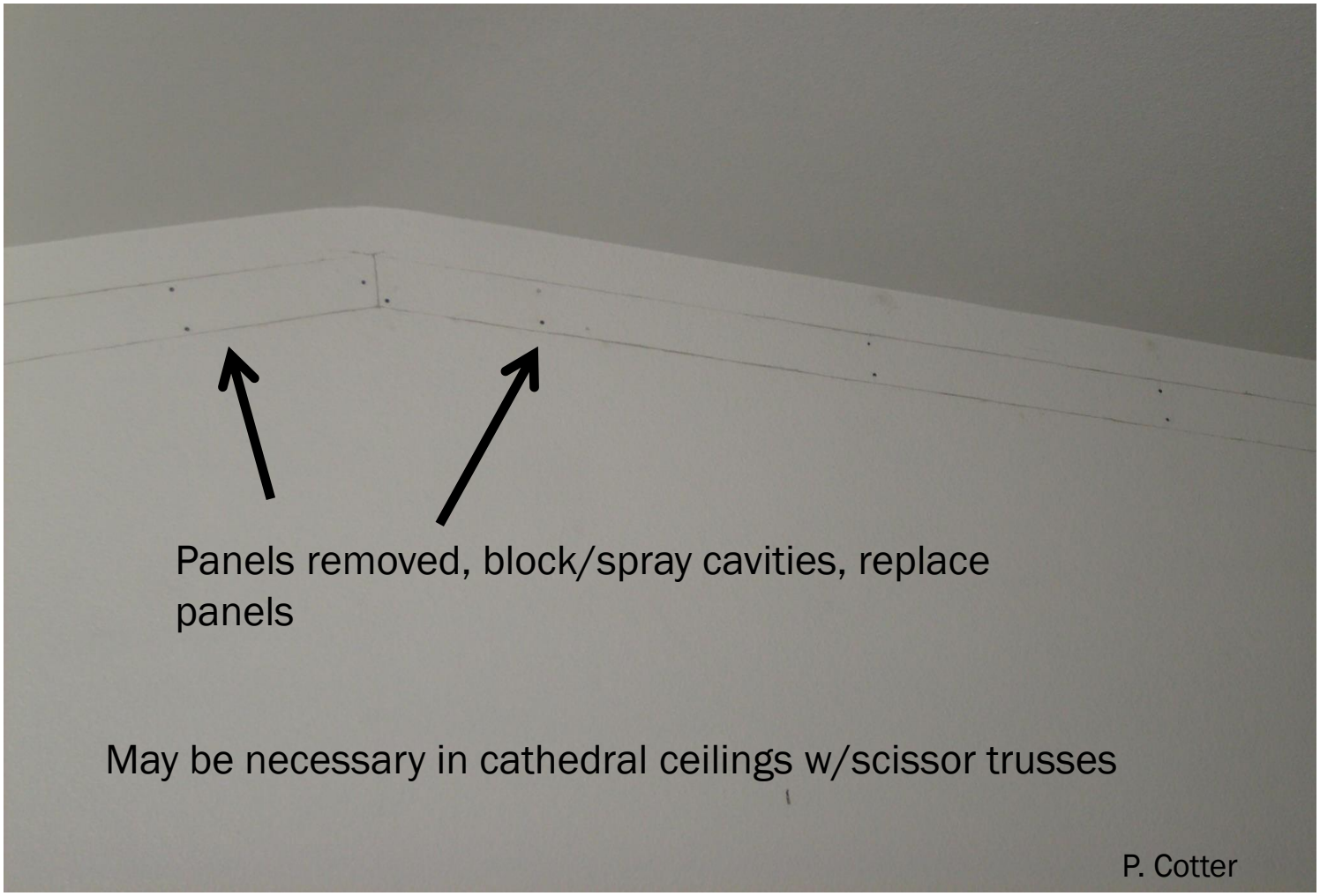
Random holes

Air sealed from interior



Attic Hatches

- Best Practice = Remove and place on gable end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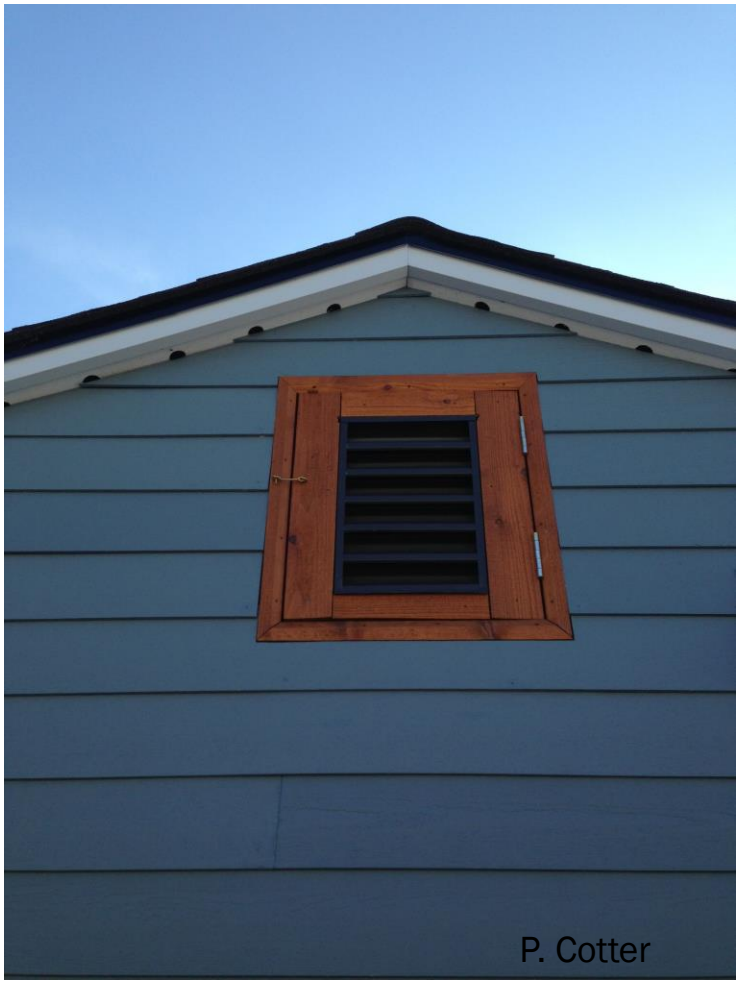
- Good Practice
  - Gasket
  - Positive latching mechanism

Bad Hatch

Gable end hatch



Gable end attic access – eliminate louvers in high wind areas

Gasketed Hatch

Recessed lights

- Best Practice = Remove them!

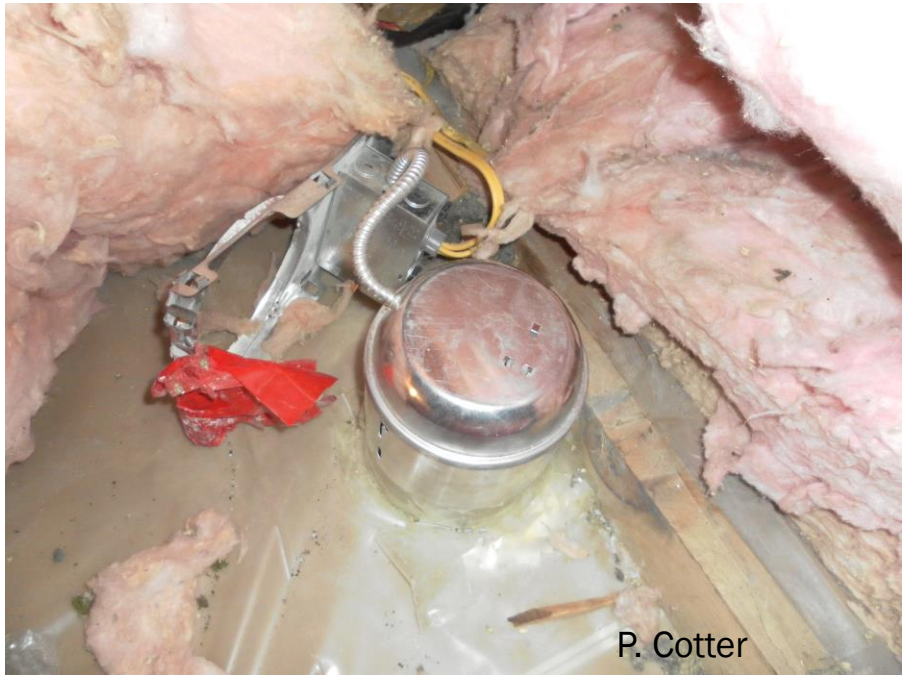
- Look for IC-rated fixtures
  - Model Energy Code (MEC)
  - Washington State Energy Code
  - ASTM E 283-91

Recessed lights - Existing

- Air tight retrofit
  - Sealed cans
- Attic box - MUST MEET FIRE CODE
  - Sheet steel or aluminum
  - Duct board/rigid fiberglass OK
  - Tape, caulk, foam to framing
- If fixture is not IC-rated…

  …box walls must be at least 3” from light

Most recessed lights leak



This box still leaked

Foundation/Crawl/Basement

- Second priority after attic
- Often easier than attic
- Access can be difficult
- Minimize infiltration

Foundation/crawlspace/basement

- Why seal?
  - Reduce amount of air leaking IN
  - Protect against contaminants
  - Minimize pipe freezing issues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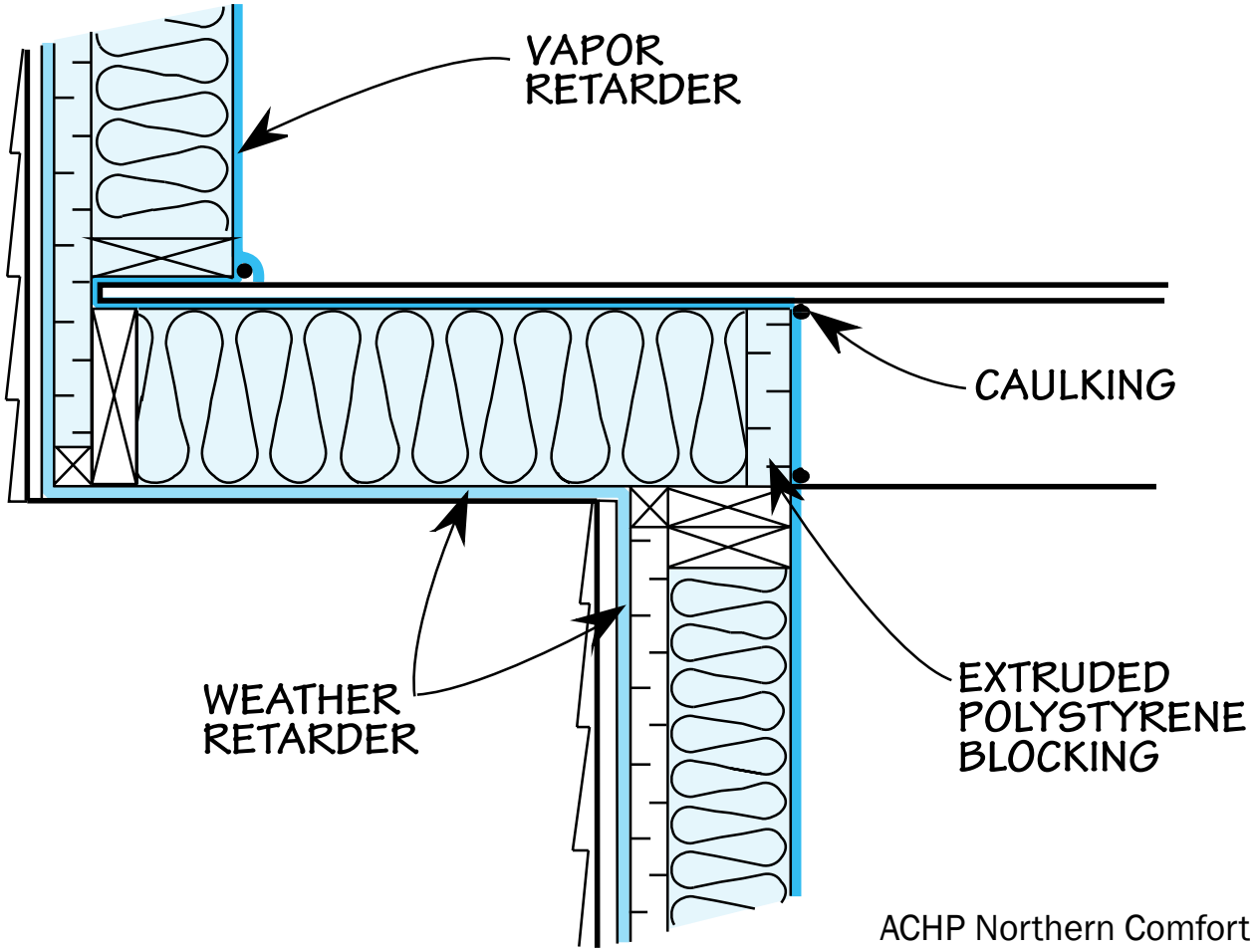
Friction fit and caulk…

Rigid and spray foam - insulate and air seal

Spray foam only option

Cantilevers?



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Attached Garages

- Seal penetrations between living space and garage
  - Electrical
  - Plumbing
  - Mechanical
  - Doors
    - Weatherstripping
    - Door sweeps

Windows and Doors

Options

- Remove interior trim and caulk/foam
  - May need backer rod/batt for substrate
  - Use low expansion foam
- If using foam, it is best to apply in 2+ layers if you will be trimming foam prior to replacing window trim
- Replace worn weather stripping, gaskets
- Window replacement may be warranted

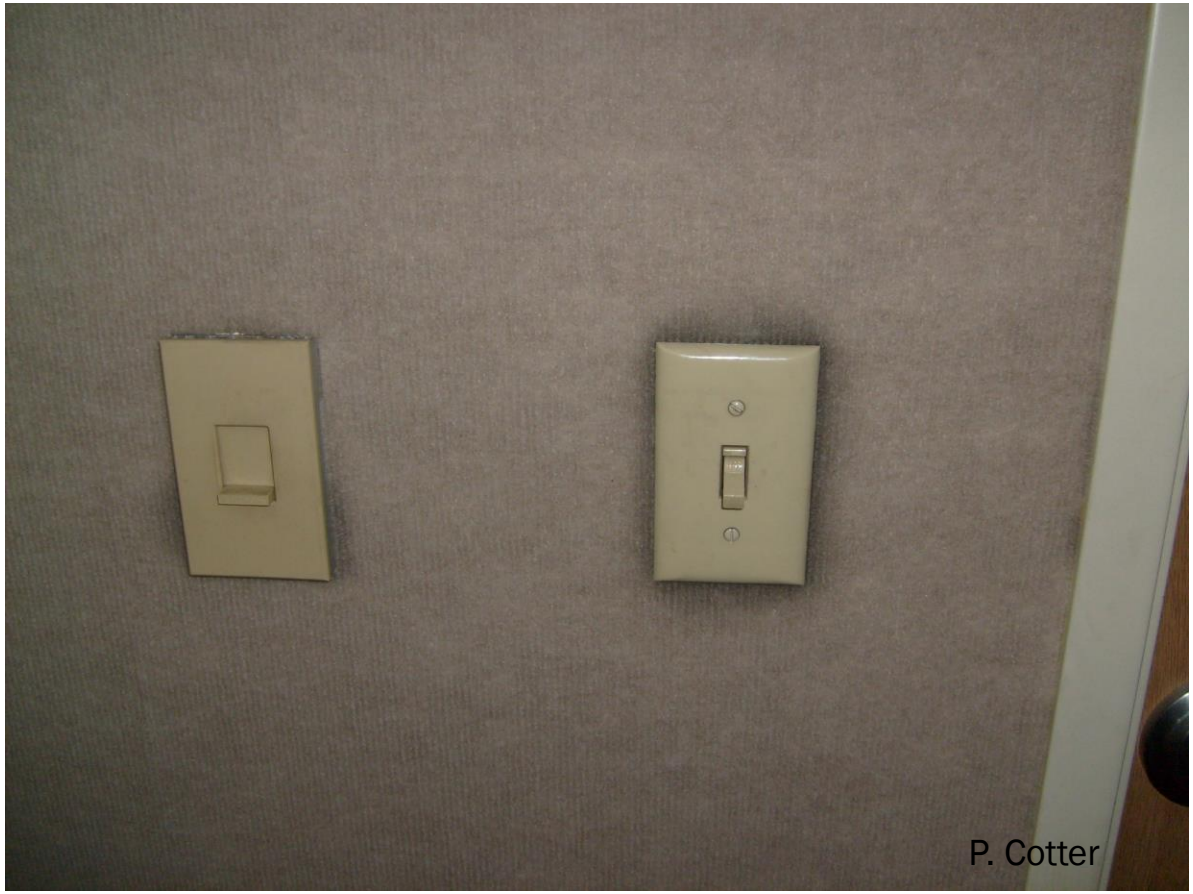
Trim removed – sealed with 2 layers of spray foam

Leaky doors

Weatherstripping

Electrical outlets/Switch plates

- Gaskets
- Caulk



The kitchen soffit

Often a problem…and an expensive fix

Air sealing Principles

- Avoid excessive depressurization scenarios
- Do not seal combustion air sources
- Seal the attic floor first
- Use “house as a system” approach

Resources

- AHFC - Research Information Center
- Alaska Residential Building Manual
  www.ahfc.us
- Cold Climate Housing Research Center
  www.cchrc.org
- One stop shop for AK Energy Efficiency information
  www.akenergyefficiency.org