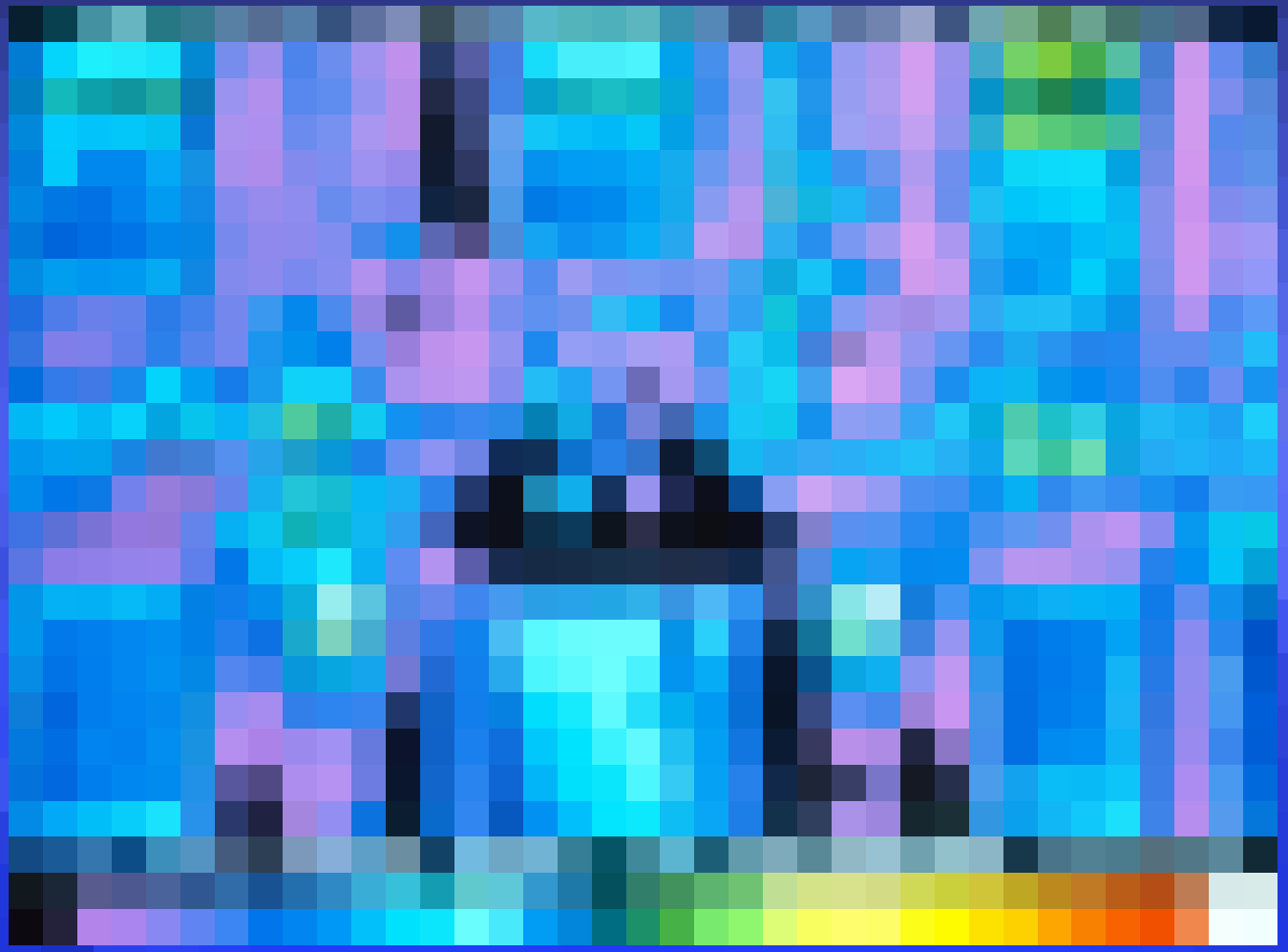
Impacts of Thermal By-Passes and Cost Effective Methods for Sealing Building Enclosures

Steve Easley



steve@steveeasley.com

Video Resources on Building Science

- www.steveeasley.com
- www.codecollegenetwork.com

What Should a Home Provide?

- Safe to live in
- Good indoor air quality
- Energy efficient
- Durable
- Comfortable

Typical “Issues” with Today’s Homes

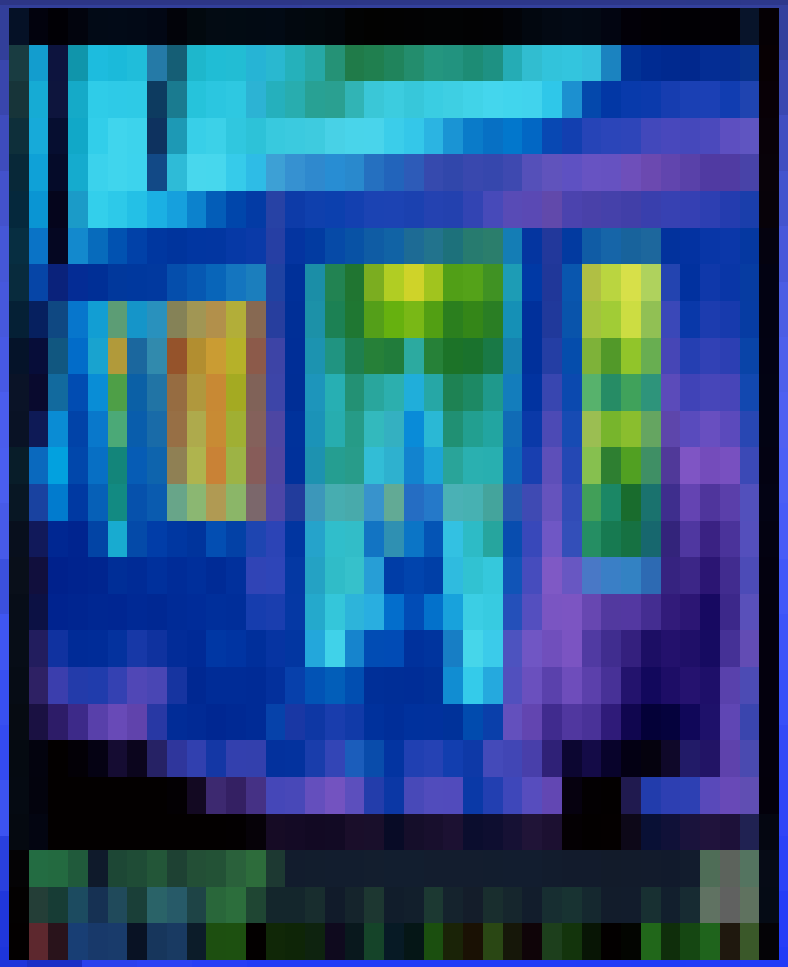
- Perform great on “paper”
- Costly to heat and cool
- Leaky and drafty
- Poorly ventilated
- Questionable indoor air quality
- Uncomfortable
- Durability issues

Thermal By-Passes

- **Convective** (solved by proper air sealing and a good air barrier system)
- **Conductive** (solved by proper insulation)

Thermal by-passes often lead to major construction defects.

Basics of Heat Movement



- Heat always flows from warm to cold
- The greater the temperature difference the faster heat flows
- Temperature gradients cause air movement
- Pressure differences cause air movement

Thermal By-Passes

- What is an Air Barrier?

Thermal By-Passes

- An air barrier is not any one product. It is a systems approach to reducing the heat scavenging effects of air infiltration and exfiltration.

An Air Barrier is a Systems Approach to Reducing Convective Thermal By-Passes

Thermal By-Passes are caused by

- Poor Design
- Poor Construction
- Clueless Homeowners

Thermal By-Passes are caused by

- Poor Design

Thermal By-Passes are caused by

- Poor Design, Living spaces over garages

Thermal By-Pass challenges, porches

Thermal By-Pass solutions

Insulation Challenge: Cantilevered Floors

Insulation Challenge: Soffits

Not compensating for new materials

Poor Construction

Thermal By-Passes

- **Convective** (solved by proper air sealing and a good air barrier system)

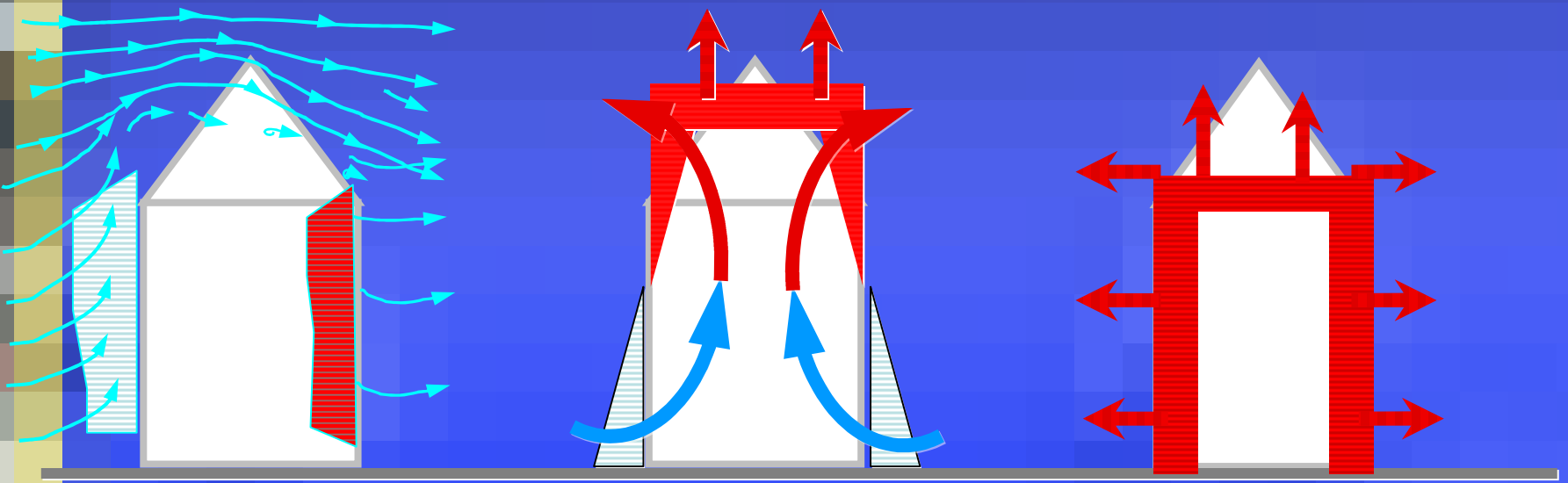
Convective By-Passes

Controlling Air Infiltration

Air Infiltration & Exfiltration

- **Costs Home owners $13 billion per year**
- **Attic by-passes**
- **Crawlspace/slab by-passes**
- **Penetrations in walls**
- **Ductwork**
- **Exhaust fans**

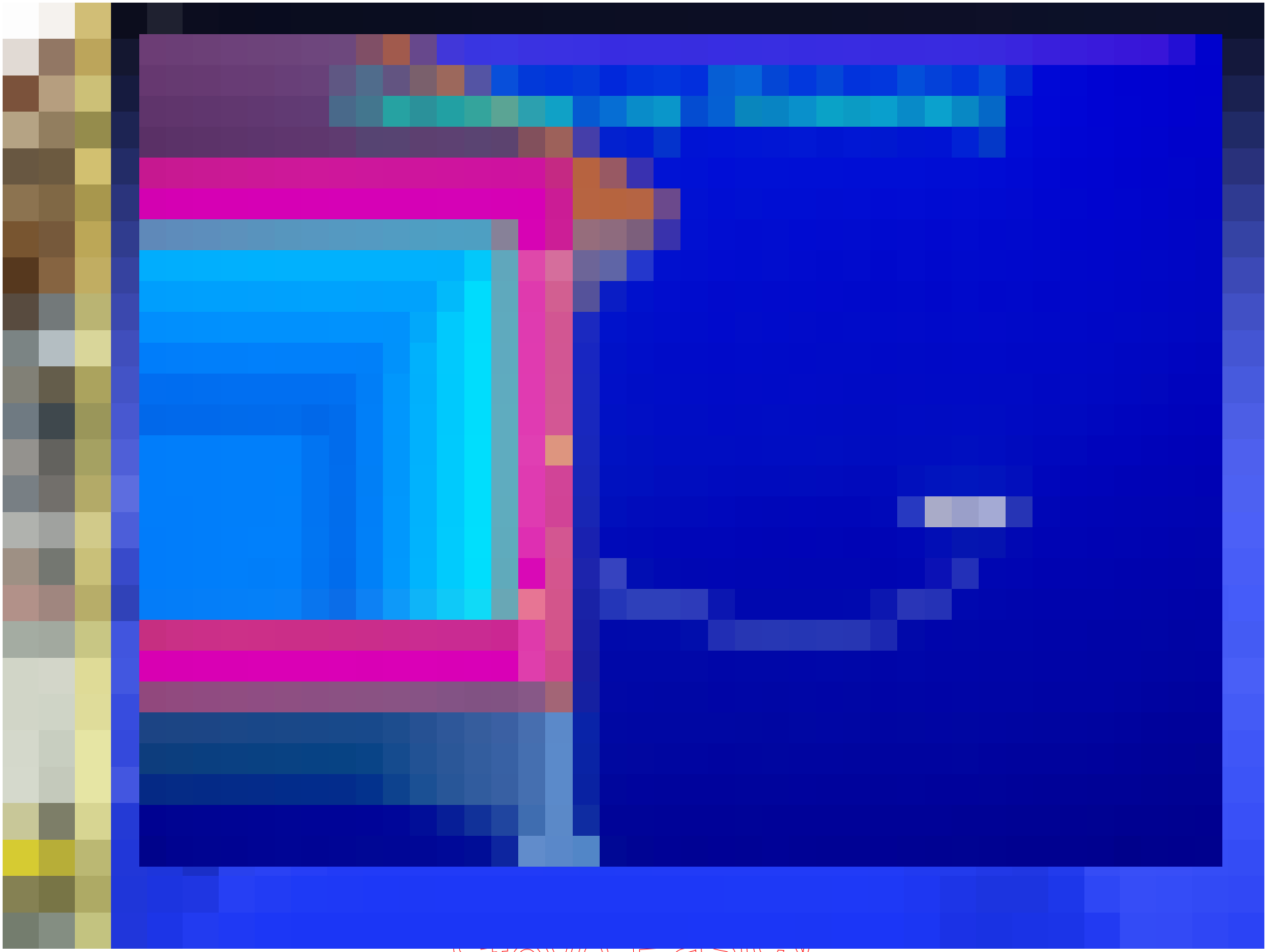
Cause of Air Infiltration in Houses



Wind Pressure

Stack Pressure

Mechanical Pressure (HVAC)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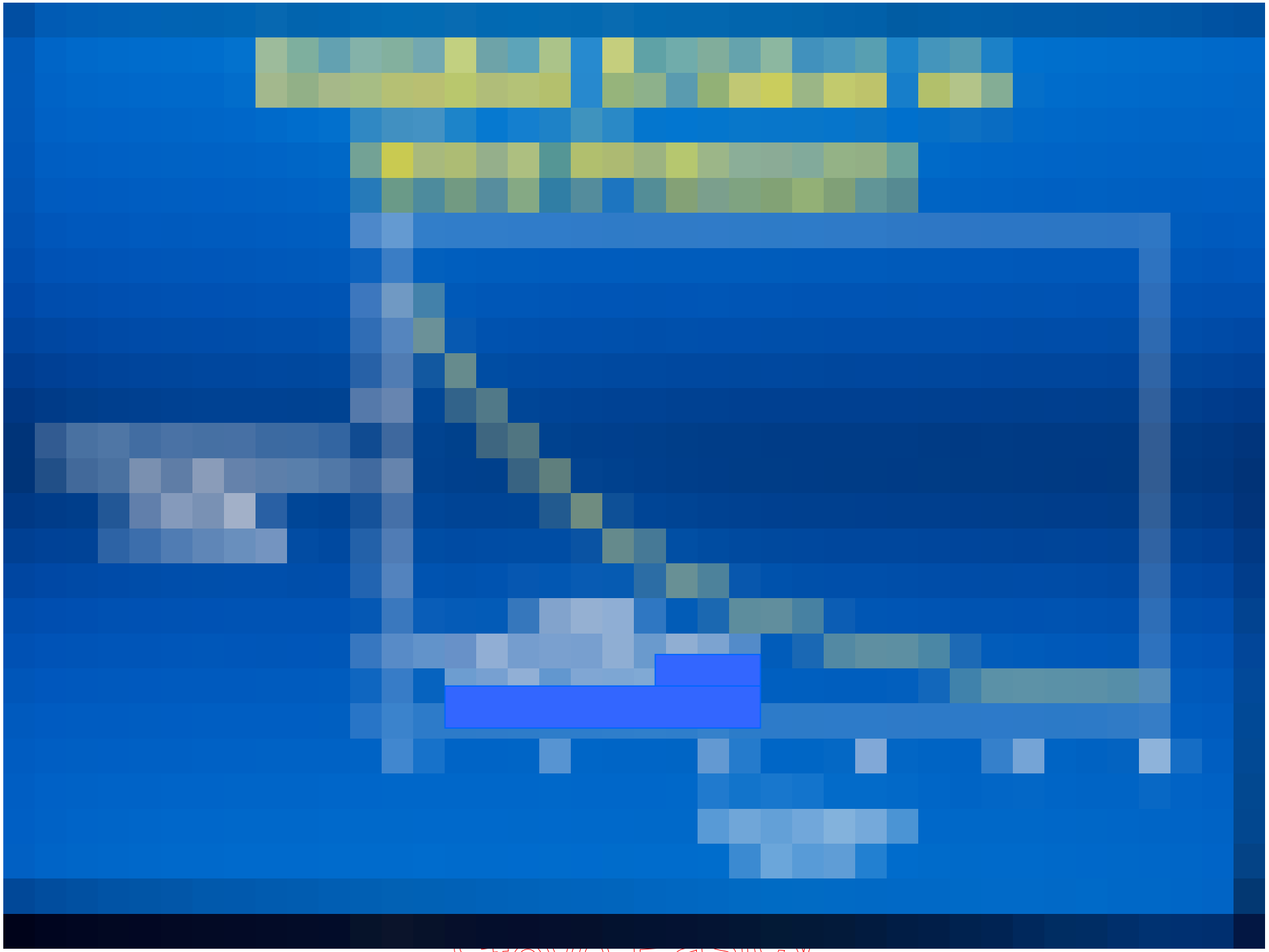
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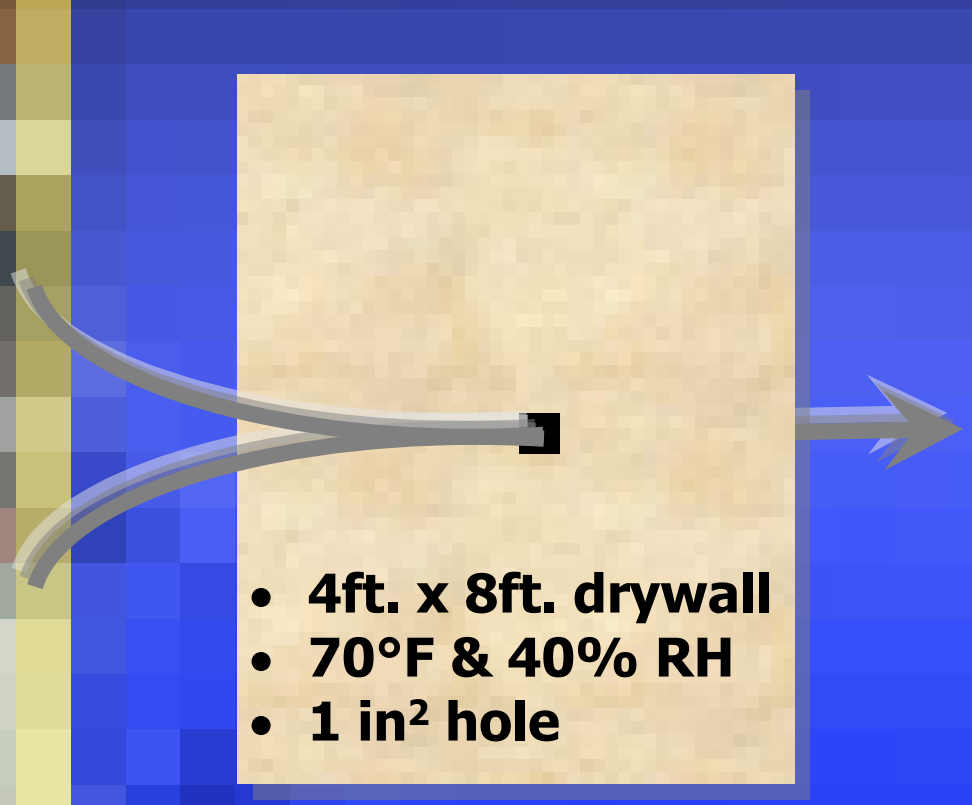
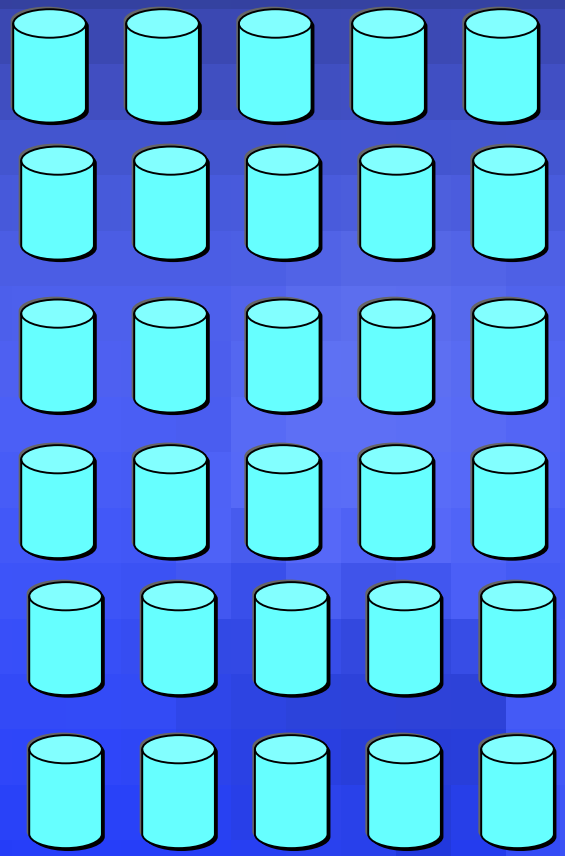
Vapor Retarder: Typical

Transport through Air Currents

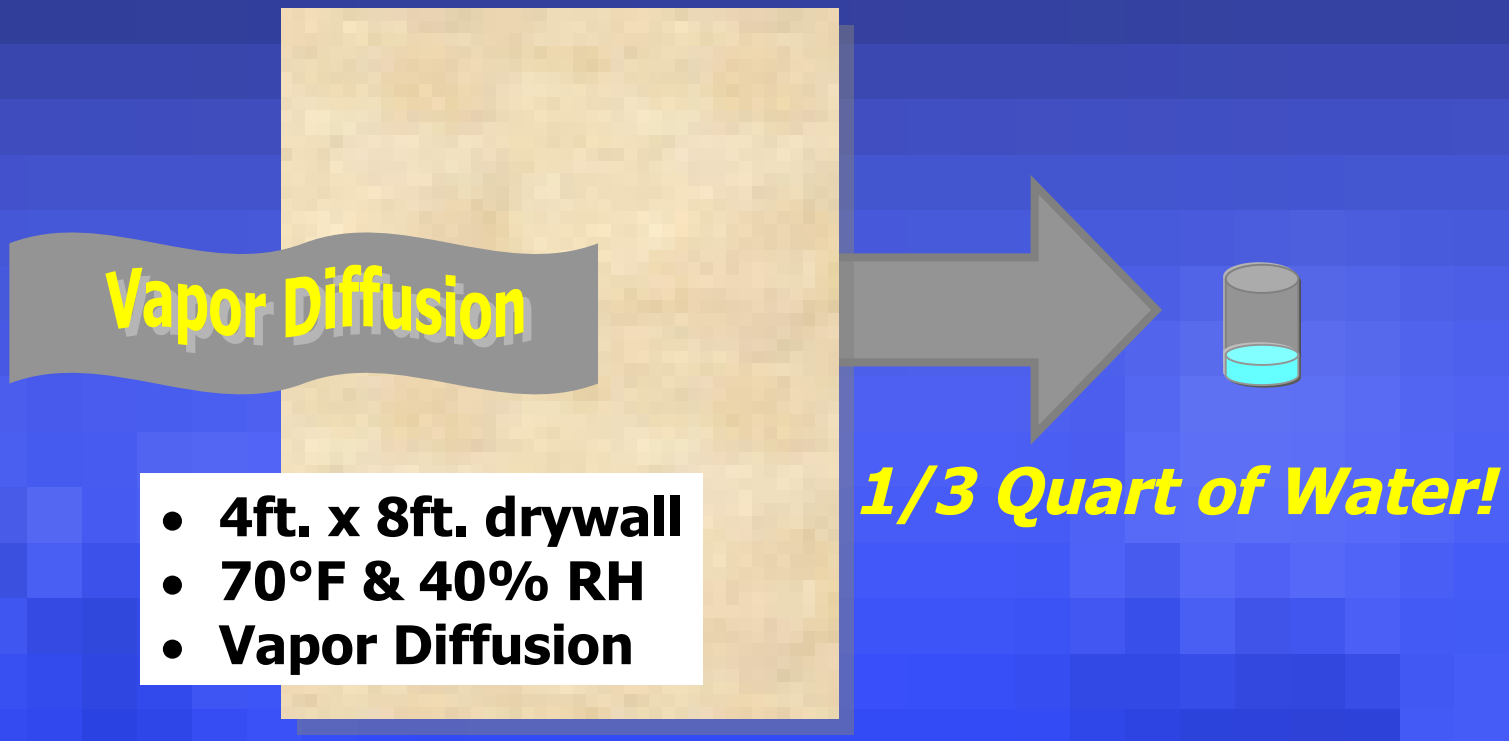


- 4ft. x 8ft. drywall
- 70°F & 40% RH
- 1 in^2 hole



30 Quarts of Water!

Diffusion of Water Vapor



- 4ft. x 8ft. drywall
- 70°F & 40% RH
- Vapor Diffusion

1/3 Quart of Water!

Water will find a way into the wall.

It's always a question of quantities and rates of wetting and drying

Keys to a high performance wall system

- Stops air flow
- Not affected by moisture
- Stable R value
- Protects structure

Attic Bypasses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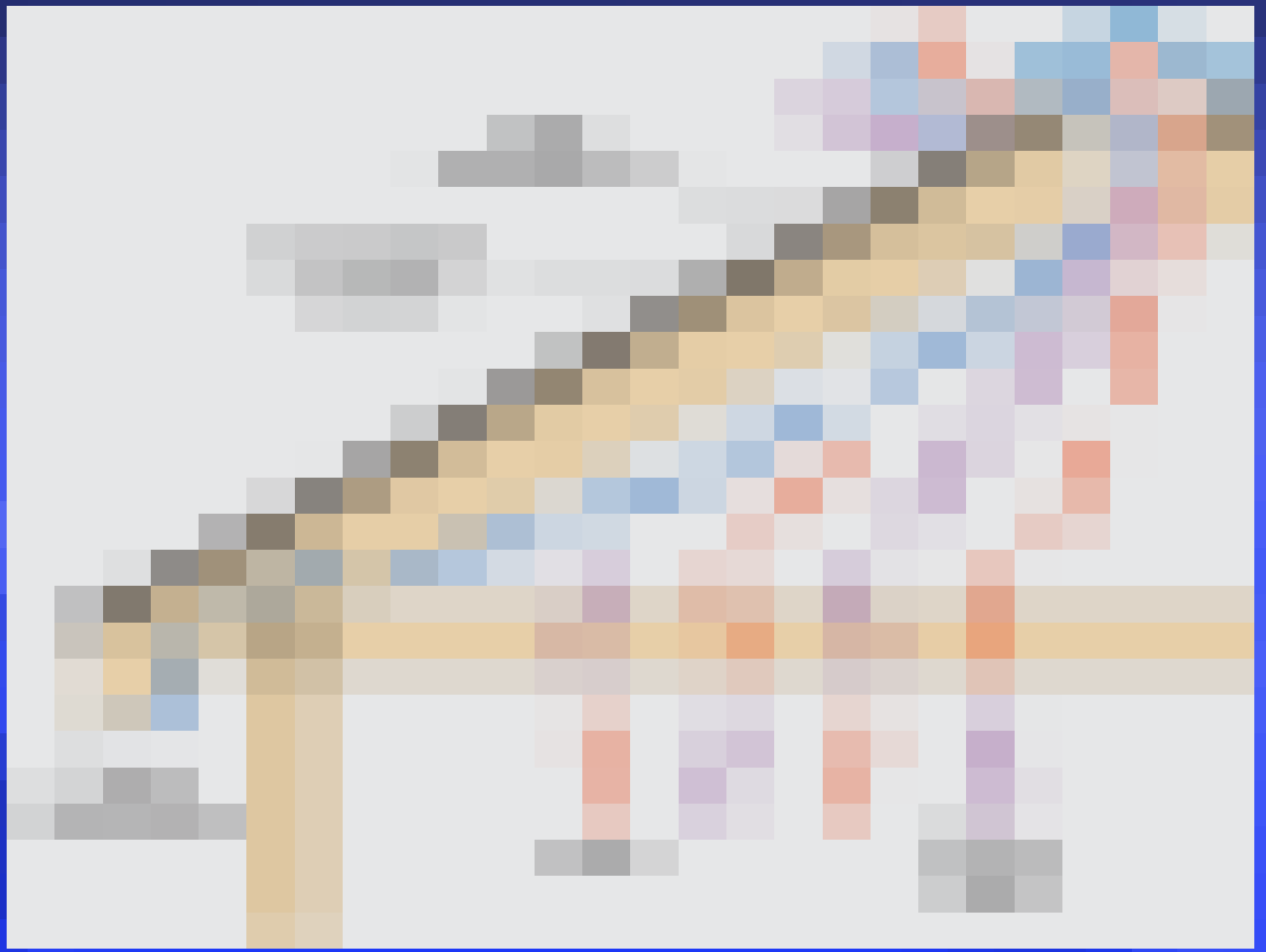
Traditional Attic Ventilation



Sealing Bypasses

Sealed Cans

Air Sealing Challenges: Ductwork

The Problems with Can Lights

Thermal By-Passes

- **Conductive** (solved by proper insulation)

Factors Affecting Insulation Performance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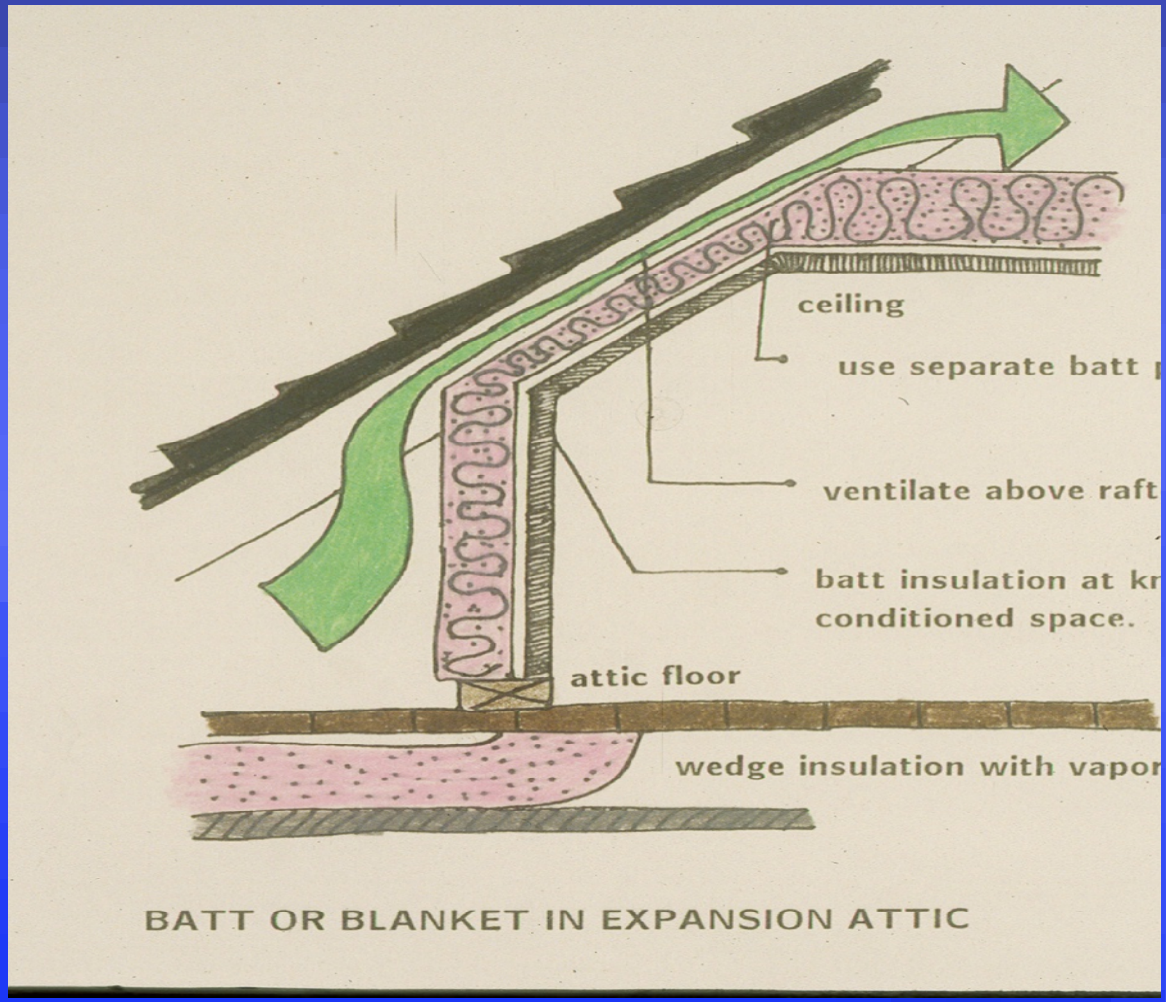
Prime Areas for Spray Foam

- Band Joist areas
- Living spaces over garages
- Knee walls
- Behind tubs & showers
- Hard to insulate ceiling areas
- Below grade spaces
- Plumbing on exterior walls
- Crawl space by passes

Air Barrier Locations

- Knee walls

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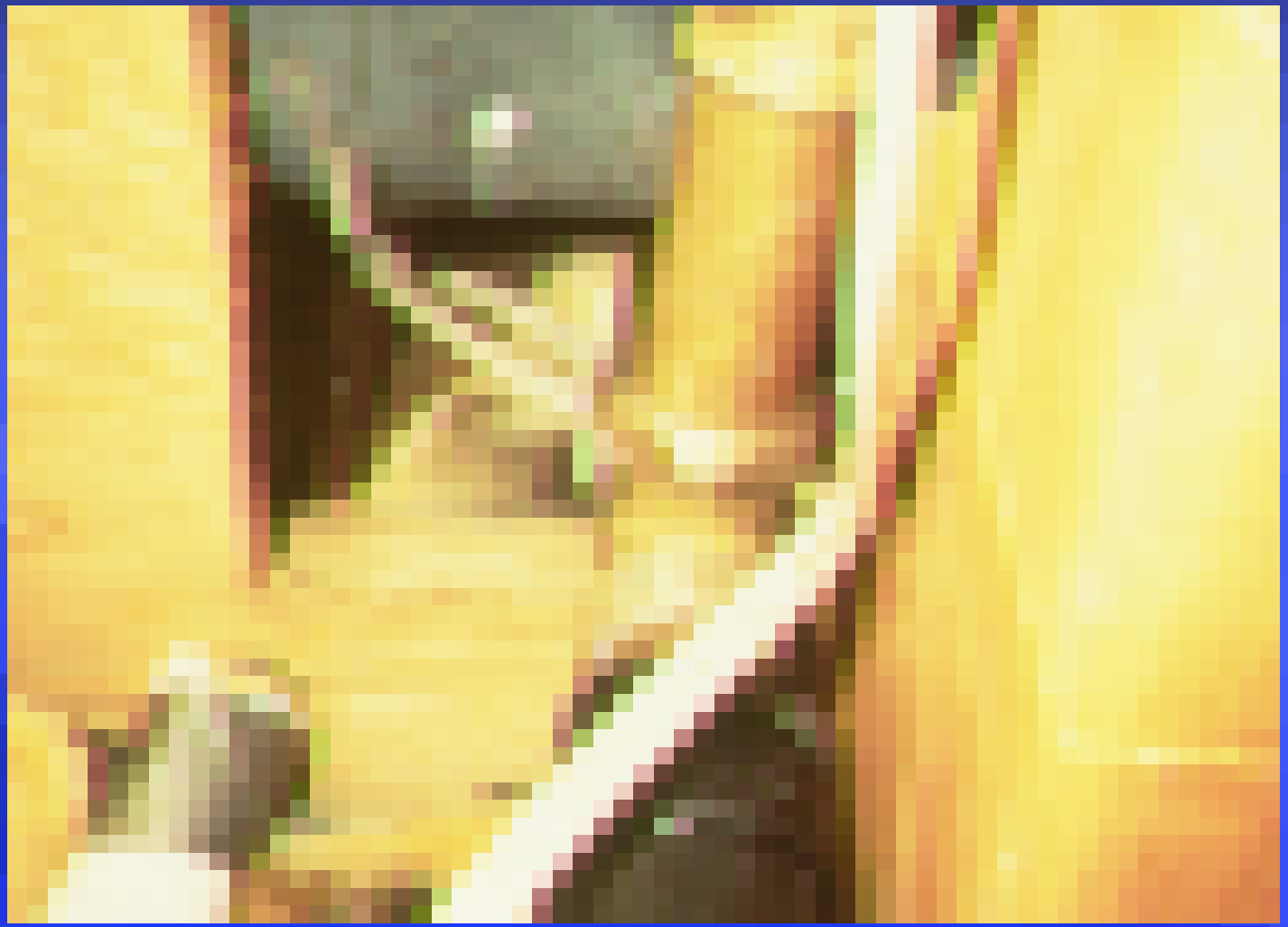
Insulation Challenge: Tub Surround

Crawl Space By Passes



A House is a System

- The building structure, safety, curb appeal
- Building shell or thermal envelope
- Heating and cooling systems
- Mechanical ventilation and moisture control
- Daylighting
- Plumbing/electrical
- Communication

Advanced Framing

Vapor Retarders: Code Definition

Must have a perm rating of ≤ 1.0 perm, as defined by ASTM E96-80

Perm Ratings of Different Materials:

Insulation facing, Kraft	1.0
Insulation facing, foil Kraft laminate	0.5
#15 asphalt felt	1.0
Vapor retarder latex paint (0.0031" thick)	0.6 – 0.9
½-inch Drywall (unpainted)	50
Concrete block	2.4
Drywall (painted with conventional latex)	2-3
2-mil polyethylene sheet	0.16
4-mil polyethylene sheet	0.080
6-mil polyethylene sheet	0.06
1-mil Aluminum Foil	0.0