Overview Of Residential Code Changes: What's New In 2009 And 2012 IECC For Climate Zones In The Region

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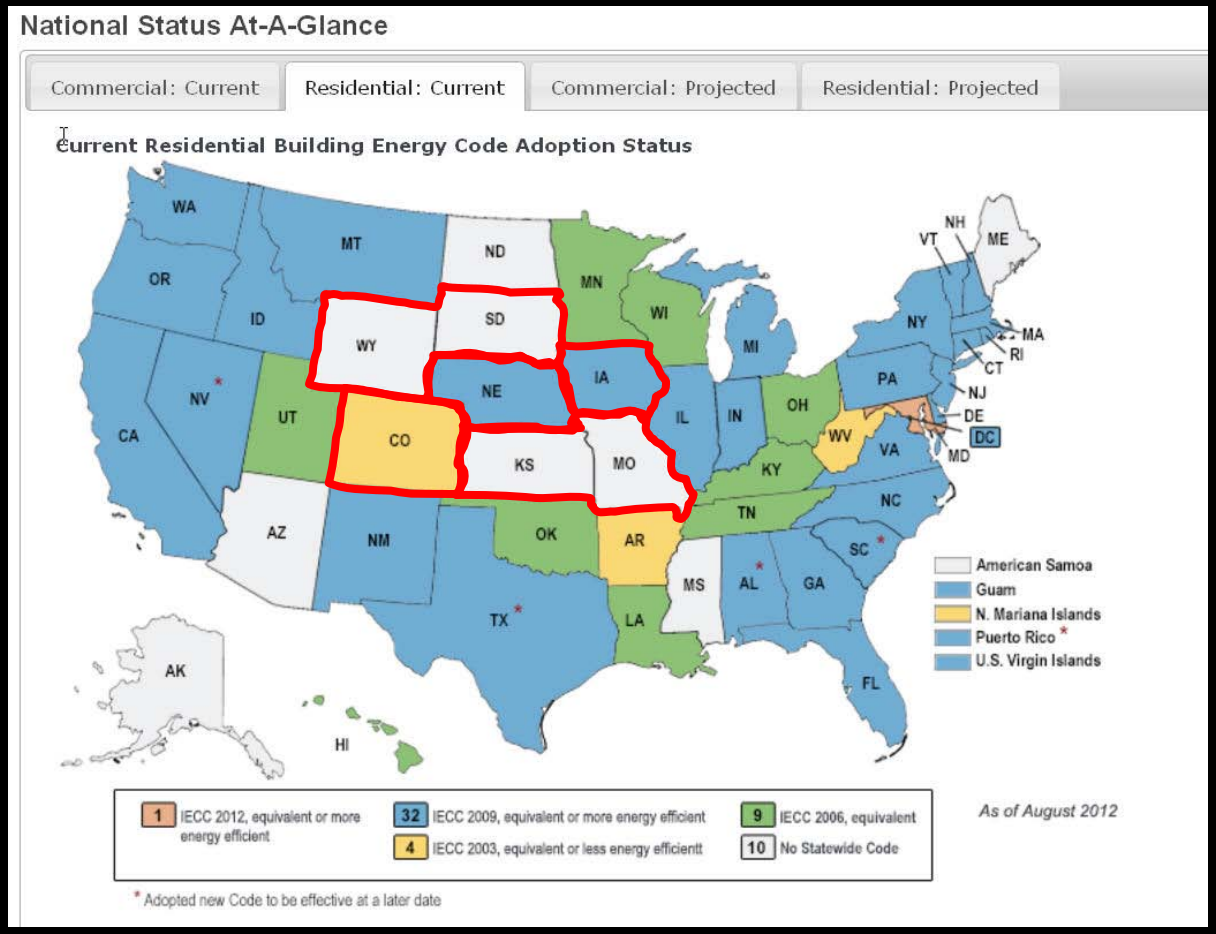
Change - Painful, But Worthwhile.

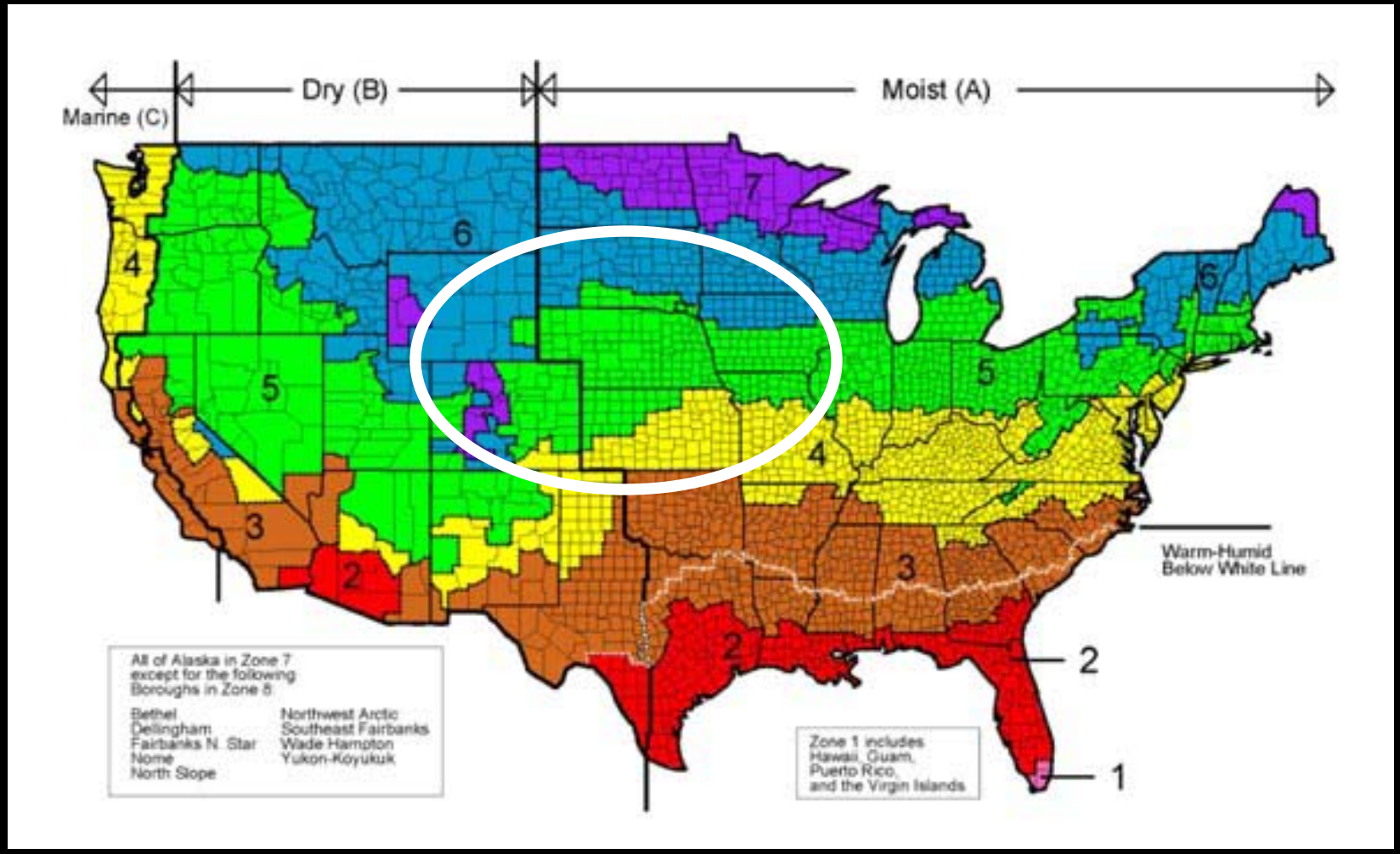


- Nebraska
  - Pre-2004: 1983 MEC
  - 2004: 2000/2003 IECC
  - 2011: 2009 IECC + amendments
  - based on demonstrated economic benefits
- IA – 2009 IECC
- CO – 2003 IECC
- MO, KS, WY, SD: NO STATEWIDE CODE!

Major Changes In IECC 2009 / 2012

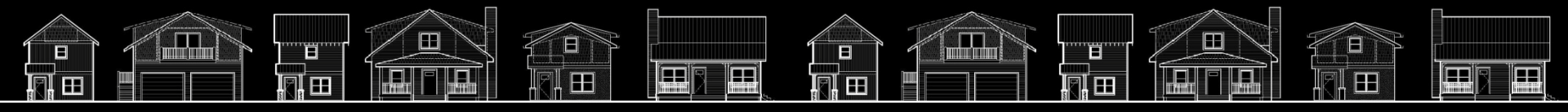
- Envelope insulation
  - most changes occurred pre-2006
- Glazing (windows)
- Trade-off rules for HVAC vs. envelope
- Duct leakage / testing
- Air sealing / testing
- High-efficacy lighting

Climate Zones: IECC 2006 And Later



Envelope Insulation

- What's been happening in Nebraska?
  - 2006:
    - Climate zone consolidation – some areas needed less insulation
    - Northern Nebraska: R21-25 walls and R49 ceilings in 2003
    - R19 walls and R38 ceilings in 2006
    - Less insulation allowed in floors and some ceilings if it fills the cavity
      - Recognizes the increased functionality of insulation that may be more likely to have a 2-sided air barrier
      - Increases build-ability
    - Increased wall insulation no longer required for high window to wall ratio
  - 2009: Trade-offs for efficient HVAC no longer allowed



Envelope Insulation Compliance

Prescriptive

R-Values
Table 402.1.1

Tools: None

R-values from insulation manufacturers

U-Factor and UA alternatives

U-Factors:
Table 402.1.3
Total Bldg UA:
Table 402.1.4

Tools: REScheck

Thermal bridging considered

Simulated Performance

Software-based alternative
Section 405

Tools:
REM/Rate,
REM/Design,
EnergyGauge

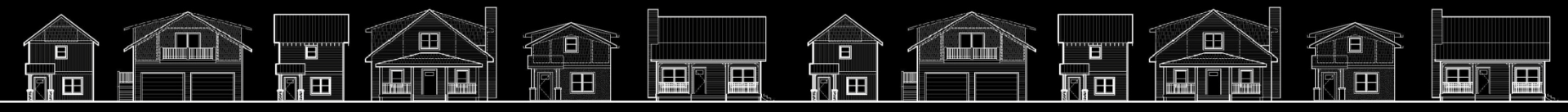
Envelope Insulation Changes

2009 IECC (for your regions):

- Walls
  - R-13 (CZ 4)
  - R-20 or R-13 cavity + R-5 cont. (CZ 5, 6)
    - 2x6 walls likely
- Ceilings
  - R-38 (CZ 4 and 5)
    - Can use R-30 in cathedral ceiling (500 SF or 20% limitation)
  - R-49 (CZ 6)
    - Likely to be blown insulation
- Basement walls
  - R-10 cont / R13 cavity (CZ 4 and 5)
  - R-15 cont. / R19 cavity (CZ 6)
- Floors
  - R-19 (CZ 4)
  - R-30 (CZ 5 and 6)
    - Can reduce to R19 if 6-sided air barrier

2012 IECC (for your regions):

- Walls
  - R-20 or R-13 cavity + R-5 continuous (CZ 4, 5, 6)
    - 2x6 walls likely
- Ceilings
  - R-49 (CZ 4, 5, 6) – likely to be blown insulation
    - Can use R-38 with a raised heel truss
    - Can use R-30 in cathedral ceiling (500 SF or 20% limitation)
- Basement walls
  - R15 cont. or R19 cavity (CZ 4, 5, 6)
    - 2x6 basements probably new to builders
    - 0.5% overall energy impact in our study
- Floors
  - R-19 (CZ 4)
  - R-30 (CZ 5 and 6)
    - more likely than R19 to fill cavity, better install



Slab Edge Insulation

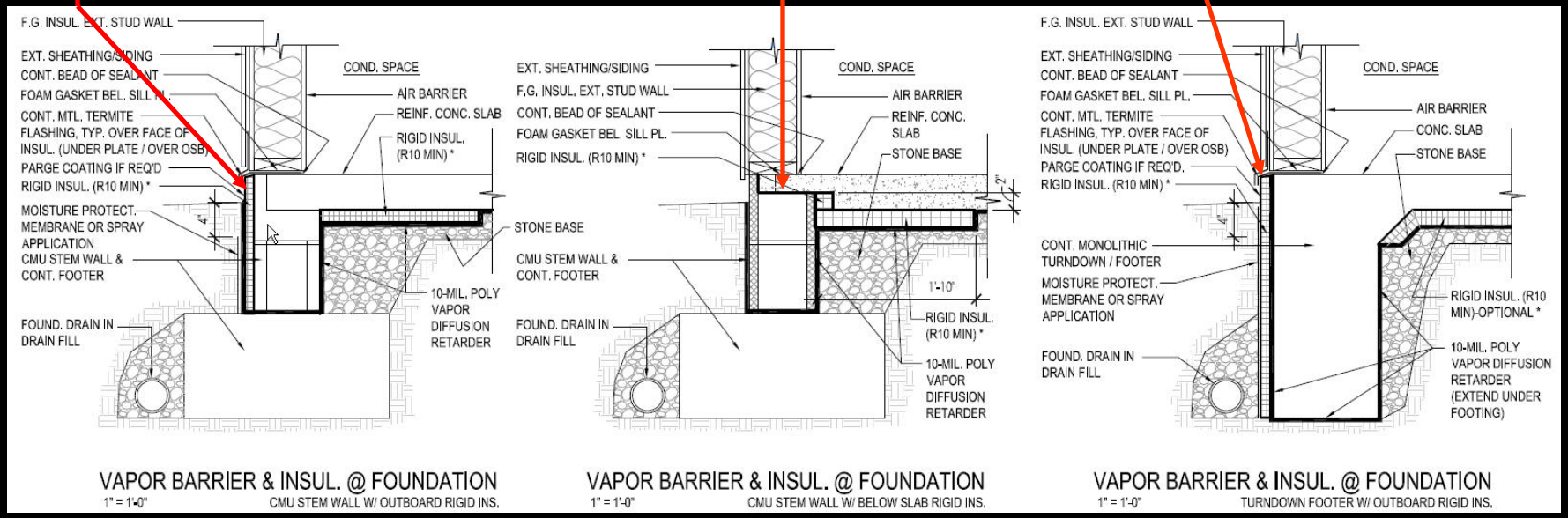
IECC 2012 (for your regions):

- Slabs with floor surface < 12” below grade
  - R10 installed to cover vertical edge
  - difficult to detail, conflicts with termite requirements

termite gap required?

small insulation gap

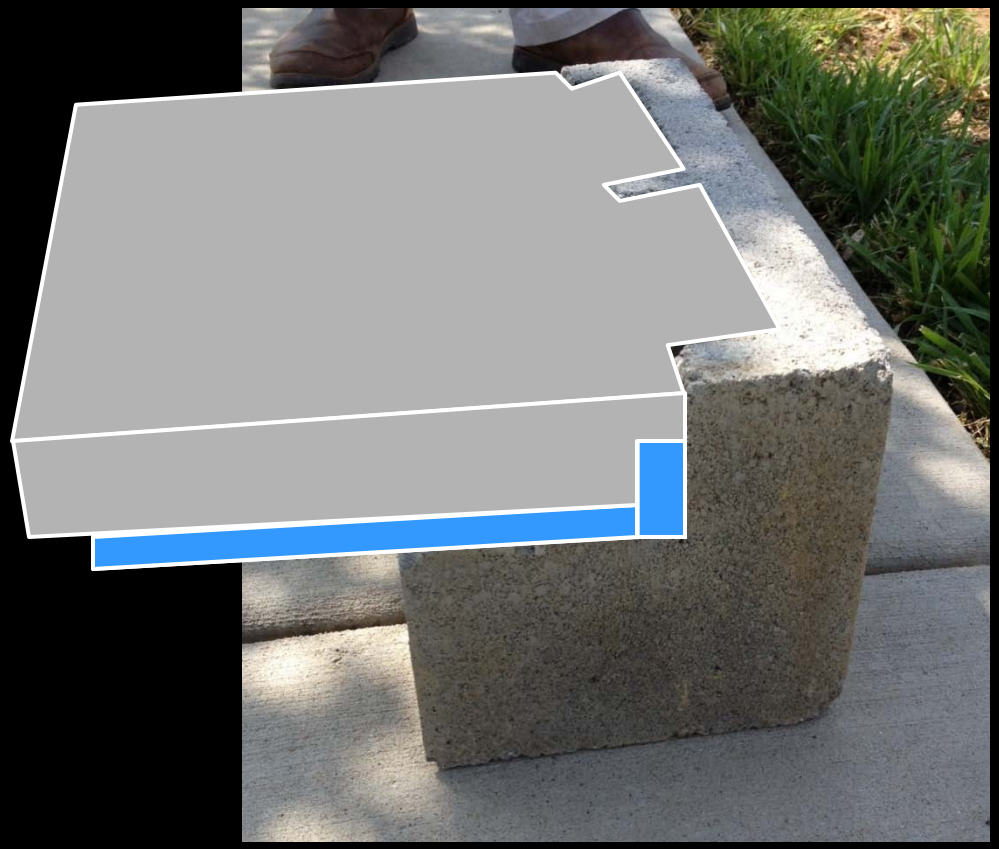
option to add flashing?



Example: Slab Edge Insulation

Header block (slab on grade)

- Interior webs create challenges
- Hold vertical insulation down 2” to allow for continuous slab
- No worse than 2” gap at exterior for termite inspection

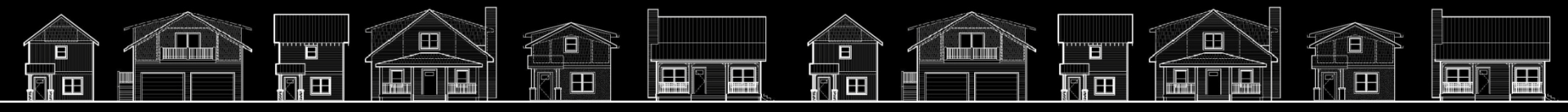


Envelope Insulation Enforcement

- Relatively easy to enforce
  - Methods are already in place.
  - Prescriptive table has been in code for many years.
  - Consolidation of climate zones brings more uniformity across state.
  - Removal of window limitation eliminates a check that many likely weren't doing anyway.
- Challenges
  - Spray foam
    - varies in R-value and thickness
    - tradeoffs (REScheck) more often used
  - REScheck can be "cheated" by adding window area.
    - Always reality-check the window area.

Fenestration (Windows)

- IECC 2006: Penalties for high window to wall ratio removed
- IECC 2009 prescriptive requirements:
  - CZ 4, 5, 6: U≤0.35, SHGC has no limit
- IECC 2012 prescriptive requirements:
  - CZ 4: U≤0.35, SHGC ≤ 0.40
  - CZ 5 and up: U ≤ 0.32, SHGC has no limit
  - Exemptions
    - one opaque door (wood)
    - 15 SF of decorative glazing (frosted or stained glass window)

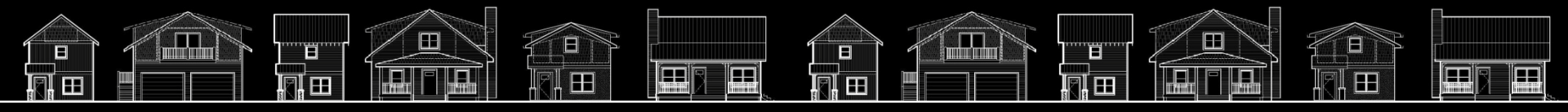


Fenestration - Enforcement

- Relatively easy to enforce
  - Most windows ship with NFRC labels.
  - These values are widely available.
- Challenges
  - Custom windows/doors with no NFRC labels
    - Default values in IECC will not meet prescriptive requirements
    - Too many likely will not meet simulated performance path
  - Keeping labels on windows until inspection.
  - Doors not always installed when windows are.
  - Passive solar glass in CZ 4 (high SHGC)
    - REScheck will not calculate tradeoffs for high SHGC glass, simulated performance alternative required.

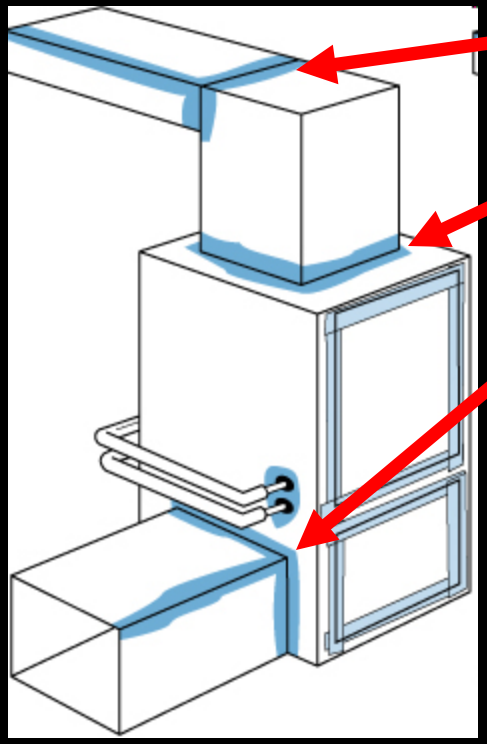
Duct Leakage Test

- Ducts or air handler outside conditioned space:
  - 2009 IECC:
    - Post-construction
      - 8% leakage to outdoors OR
      - 12% total duct leakage
    - At rough-in
      - 6% total duct leakage with air handler OR
      - 4% total duct leakage without air handler
  - 2012 IECC:
    - a) 4% total duct leakage at completion
    - b) 4% total duct leakage at rough-in with air handler
    - c) 3% total duct leakage at rough-in without air handler
- This is not difficult to achieve if you address the major sources of leakage

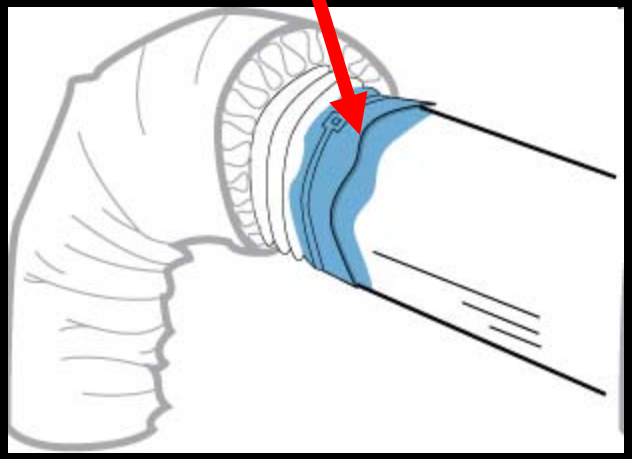


Duct Sealing – Areas To Seal

MASTIC!!!



Air handler

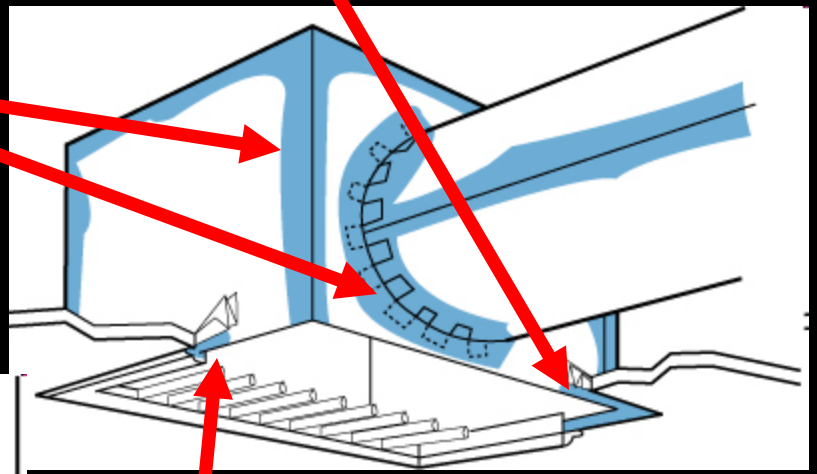


Flex connections

Duct Sealing – Areas To Seal

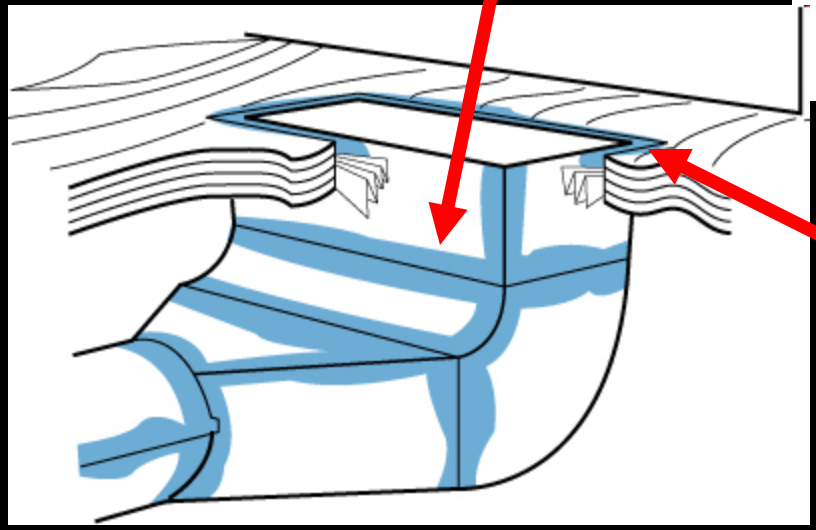
CAULK

MASTIC!!!



ceiling boots

Floor boots



Area where duct boot penetrates floor / ceiling

Duct Blaster Testing Challenges

- Troubleshooting
  - Relatively easy to do with theatrical smoke
    - $50-$100 machine at party stores
- Some areas still hard to detect
  - Leaky ducts in wall / floor cavities
    - 2009 IECC: use of building cavity for supply air not permitted, but allowed for return air.
    - 2012 IECC: use of building cavity for supply/return no longer permitted.
  - Leaks under insulation (smoke is filtered out)
  - Sometimes have to fix big leaks before you see small ones
  - Cabinet kick plates are a <u>huge</u> problem
    - impossible to tape off unless ducted to face of kick plate
    - usually not done well
  - Caulking / sealing duct boot to subfloor / drywall / paneling is essential to passing.

Duct Blaster Testing Challenges

- Who performs the test? 2009 and 2012 IECC leave it to the code official to decide…
  - HVAC Installer
    - May be able to find and correct leaks more quickly / cheaply
  - HERS rater
    - HERS raters are widely available in metro areas
    - already have equipment and training
    - Independent, third-party – no conflicts of interest
  - Code official / building inspector
    - May be the only viable option in rural areas
- Equipment is required (~$1,800)
  - availability poses a problem for rural areas
  - the “leakage to outdoors” test also requires a blower door setup.
  - annual equipment calibration required (can self-calibrate)
- Some training (~1 day) is needed
  - This teaches you how to use the equipment… diagnosing takes experience

2009 IECC - Table 1102.4.2

TABLE N1102.4.2
AIR BARRIER AND INSULATION INSPECTION

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material.
Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of floor.
Crawlspace walls	Insulation is permanently attached to walls. Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are airtight, IC rated and sealed to drywall. Exception—fixtures in conditioned space.
Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior wall	Air barrier extends behind boxes or air sealed type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

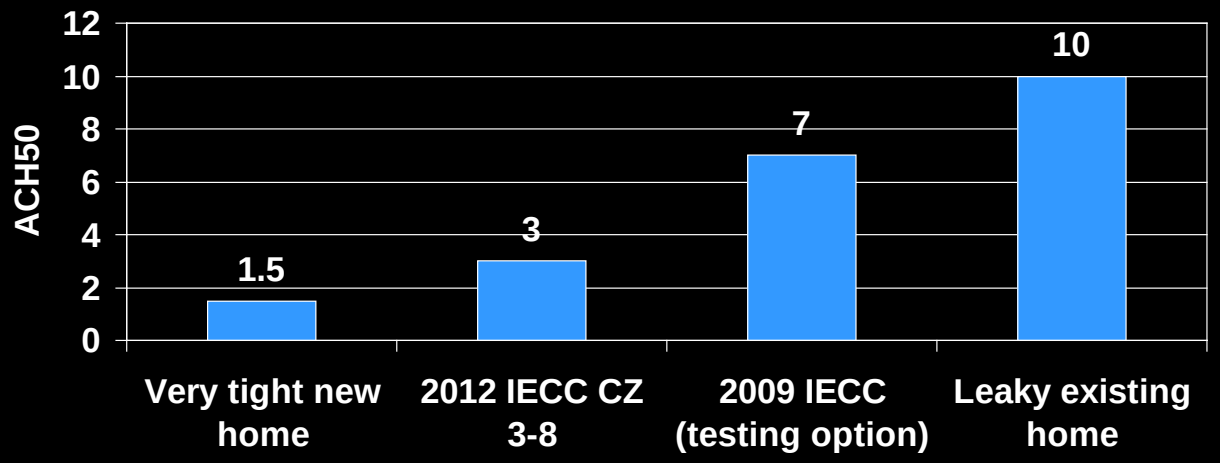
Air Sealing / Infiltration

Requirements:

- 2009 IECC
  - air sealing checklist (N1102.4.2), OR
    - checklist option is unlikely to result in tighter homes
  - blower door test ≤ 7 ACH50
    - 7 ACH50 is not a very difficult target
- 2012 IECC
  - blower door test ≤ 3 ACH50
    - ***3 ACH50 is very aggressive, but possible.***
  - NE study – about 30% savings on heating
  - transitioning from a checklist option to 3 ACH50 is likely to be ***very*** difficult.

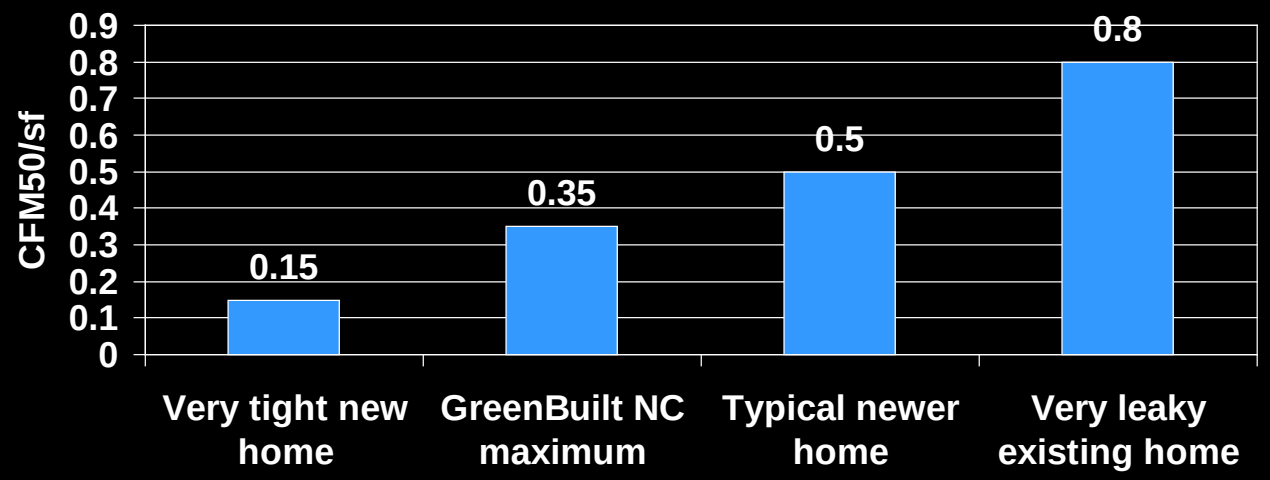
Blower Door Test Results

- What the results mean – ACH50
  - “air changes per hour” at 50 Pa depressurization
  - Based on volume of house
    - Easier to estimate without energy model, but also easier to increase to get model to pass
  - Can be more difficult goal for homes with a lot of surface area



Blower Door Test Results

- What the results mean – CFM50 / sf
  - “Cubic feet per minute” at 50 Pa depressurization
  - Based on surface area of house
    - Easy to obtain from energy model



Air Sealing / Infiltration Challenges

Checklist approach:

- Descriptions are pretty vague
  - Unlikely to get desired result without a lot of education and inspection.
- The code states that the items on this list should, “where required by the code official”, be “field verified” by “an approved party independent from the installer of the insulation.”
  - Does this allow a builder to self-certify?
  - Will the person signing truly understand what they’re verifying?
- Conclusion in the Nebraska study – unlikely to see substantial improvement in airtightness using checklists

Air Sealing / Infiltration Challenges

- Who can perform the test?
  - HERS raters (or BPI Analyst)
    - Widely available in metro areas
    - Already have equipment and training
    - Cost of a 3rd party blower door test estimated at $75-100
    - Travel to remote areas could be cost prohibitive
  - Builders
    - Only larger builders are likely to buy equipment
    - 2012 IECC refers to “an approved third party”
  - Code official
    - Unlikely, although this may be a good answer in very rural areas
    - Air sealing Inspections could be difficult to coordinate

Air Sealing / Infiltration Challenges

- Equipment is required
  - Approximately $2500 new
  - Availability problem in rural areas
  - Annual equipment calibration required (can self-calibrate)
    - Who is checking this, other than HERS providers?
- Some training (~1 day) is needed
  - This would be bare bones training… essentially how to run the equipment.
  - Ability to diagnose problems takes experience

Airtightness Testing Challenges

Challenges

- Test performed at final when certain “fixes” are difficult and a CO is needed quickly.
- Air sealing checklist is not likely to get someone who has never tested before down to 3 ACH50
- A target of 3 ACH50 is very aggressive for home designs with a lot of surface area.
- Going from no test to 3 ACH50 without a phase-in period is likely to be very unpleasant… for everyone.

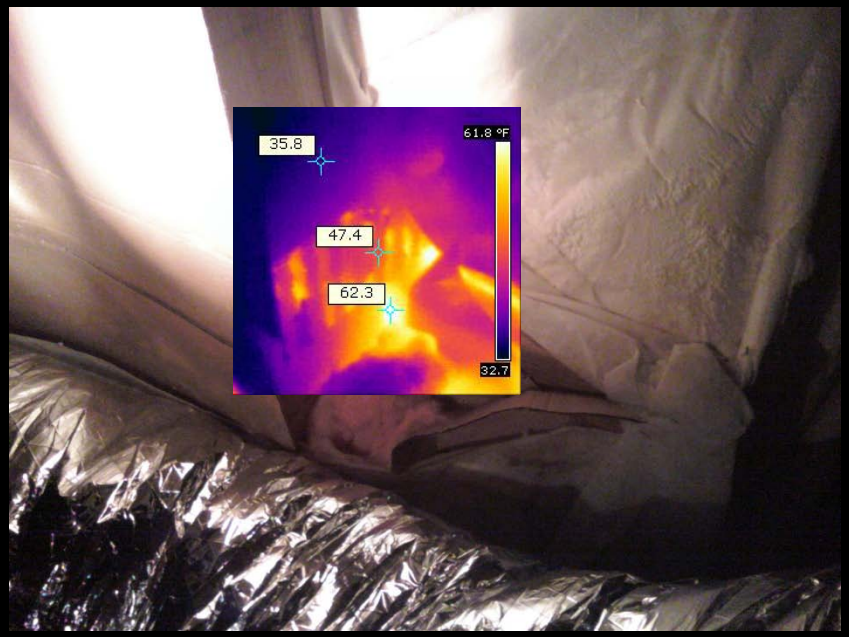
Possible solutions

- Allow a temporary CO to be issued until a passing blower door test occurs.
- Provide enhanced air-sealing guidelines for builders and designers
- Amend the code to allow an alternative CFM50/surface area alternative.
- Adopt a phase in period during which all homes are tested, but the 3 ACH50 goal is reached gradually.

Airtightness Testing Challenges

Challenges

- Not always easy to see where leaks are



Possible solutions

- Smoke pencils are minimally helpful
- Can feel leakage with hand
- Look for cobwebs
  - Spiders like moving air
- Look for discolored / dark insulation
  - It's acting as an air filter!
- Pay special attention to areas related to air quality – garages, crawlspaces, etc.
- IR camera is very helpful

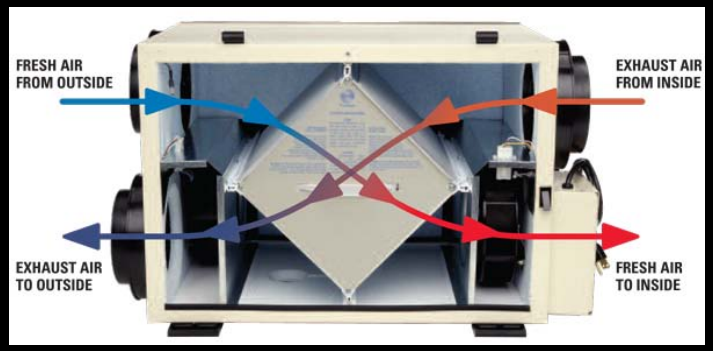
Are Airtightness Targets Too Tight?

"Built it tight, ventilate it right"

- Air leakage accounts for 25%-40% of the heating and cooling energy in a typical American home
- A house can't be "too tight", but homes under 3 ACH50 can have new (preventable) problems.
- A 3 ACH50 target ***needs*** (but is not currently required) to be accompanied by a fresh air ventilation requirement

Tight House Challenges

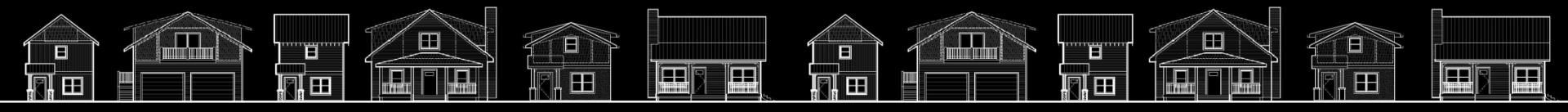
- Problem #1: winter humidity
  - Homes retain more moisture
  - window condensation in winter
- Problem #2: IAQ
  - More occupant-related contaminants
    - Moisture - breathing, showers, cooking
    - Particulates - candles
- Problem #3: combustion safety
  - Kitchen range hoods >300 cfm
  - Open fireplaces
  - Atmospherically vented gas appliances
- Solutions (whole house mechanical ventilation):
  - Constant exhaust ventilation
  - HRV/ maybe ERV
  - Dedicated supply air



High Efficacy Lighting

- Generally fluorescent, CFL, or LED
  - 2009 IECC: 50% of fixtures required
  - 2012 IECC: 75% of fixtures required
    - 40 lumens/watt if 15 watts or less
    - 50 lumens/watt if between 15 and 40 watts
    - 60 lumens/watt if over 40 watts
- It matters.
  - 50% of fixtures reduced AC by ~5% in Nebraska.
  - Heating is increased, effect interacts with heating fuel/efficiency.
- LED is getting cheaper every year…

Lighting Challenges

- Design / Installation
  - Fact: Dimmers are possible
    - dimmable lamps cost more
    - color shift with dimmable fluorescents at low settings
  - Flexible in terms of fixture selection
    - replacement-type CFL bulbs can be used
  - Change of perspective for installers
    - Installers may currently look at incandescent bulbs as “throw-aways” – cheap and the homeowner can change them
    - Neither CFL or LED can be treated this way due to cost and disposal issues.
  - Public opinion of these light sources
    - largely based on misunderstanding and low-quality lamps

Questions?