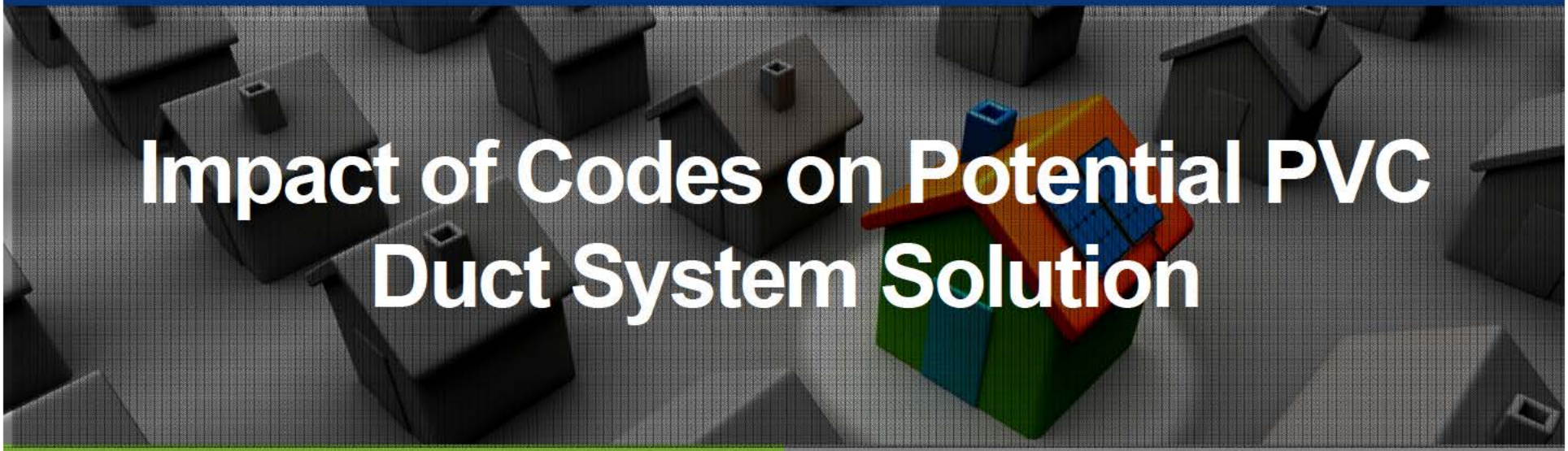
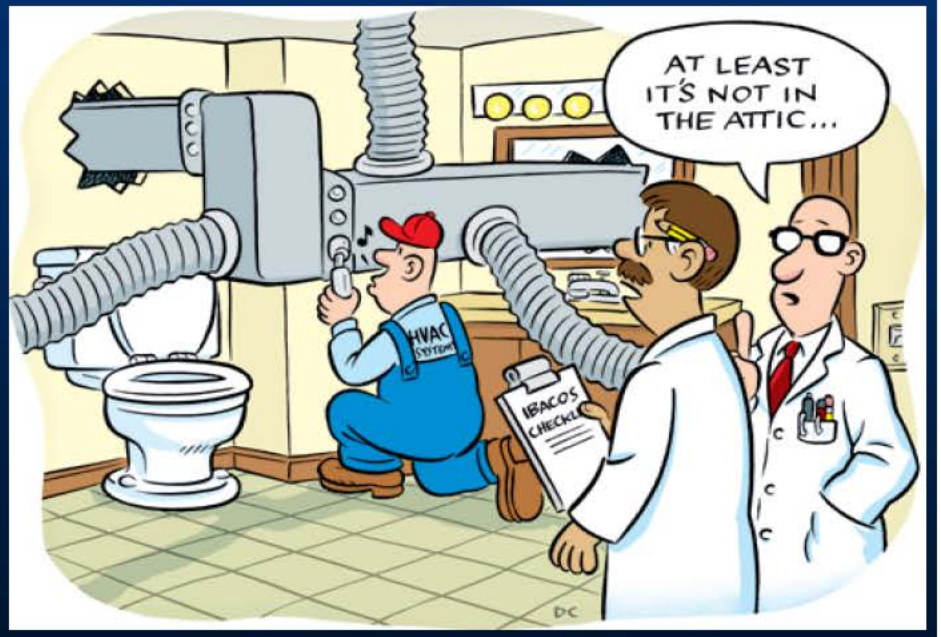


# Impact of Codes on Potential PVC Duct System Solution

IBACOS, Inc., Duncan Prahl

# Context

- Codes and retrofits lead to low load (Btuh/sf) and correspondingly low cfm per room
- Place ducts in conditioned space
- Make ducts a “no brainer” (tight, size)
- High sidewall solutions have been shown to work
- Plastic ducts seem to fit the bill



# Technical Approach

- I-Codes limit duct materials.
- What is historical basis of duct requirements?

- Perform a literature search.
- Do some simplified duct designs.
- Do some simple calculations.

# Literature Search

- Codes = Fire prevention
- Duct fires – Predominantly linings in early 1900s
  - "Sparky" and hot things in ducts (e.g., motors, fuel, heat exchangers, electric resistance heaters)
  - Hard to fight a fire in a metal duct with a burning lining
  - Fan blows smoke from burning duct lining around building
- Long story short: Ducts have most restrictive flame-spread and smoke-developed requirements

# Literature Search

- New Materials in Building Code = Fear + Vested Interests
- Primary Fear = Fire
- Vested Interest = Plastics
- 1950s - First building code section for plastics
  - Code written by plastics industry
  - Addressed fear regarding flame spread and smoke (sort of)

| **Code section (IRC 2012)** | **Flame Spread (ASTM E84)** | **Smoke Developed (ASTM E84)** |
|---|---|---|
| R302.9 (Interior Finishes) | **200** | **450** |
| R302.9.4, R316.5.10 (Foam interior Finish) | 200 or pass NFPA 286 | 450 or pass NFPA 286 |
| M1601.1.1.6 (Duct Systems) | 200 | Not specified |
| R316.3 (Foam Plastic) | 75 | 450 |
| R316.5.9 Plastic Trim (<10% Wall + Ceiling Area) | **75** | **Unlimited** |
| R302.10 (Insulation) | 25 | 450 |
| M1601.1.2 (Underground Ducts, Max. 150°F SAT) | 25 | 50 |
| M1601.3.1 & 2 (Duct lining/covering) | **25** | **50** |
| M1601.1.1.2 (Factory-Made Ducts, Class 0/1) | 0/25 | 0/50 |
| **Material** | **Flame Spread (ASTM E84)** | **Smoke Developed (ASTM E84)** |
| Gypsum Board | 10 - 15 | 0 |
| Red Oak | 100 | 100 |
| PVC | 10 - 15 | >300 |

# Code Sense

- Limit the spread of fire and smoke (sort of).
- Use safe equipment and appliances.
- Use automatic systems to alert occupants and suppress fires.
- What's missing?

# Recommended Guidance

- Turn off the HVAC fan when smoke alarm system is activated.
  - This was recommended in the early 1900s
- If you do that, who cares how flammable the ducts are (relatively)?

# Recommended Guidance (concpetually)

M1601.1.1.2 **Exception:** When the fans, equipment and appliances are disabled upon:

1. Activation of the smoke alarm system installed per section R314
2. Activation of a smoke alarm listed and labeled in accordance with UL 268A installed in the *duct system*

Factory made ducts in *duct systems* shall have a flame spread index and smoke developed ratings not greater than those listed in section R302.9, as tested in accordance with ASTM E84 or UL 723.

Other code sections will need review / revisions

Further concessions that could be made:

- Supply air temperature shall not exceed a maximum of 150°F
- A limit on the maximum number of rooms or square footage the duct system can serve, or a maximum system Btuh output

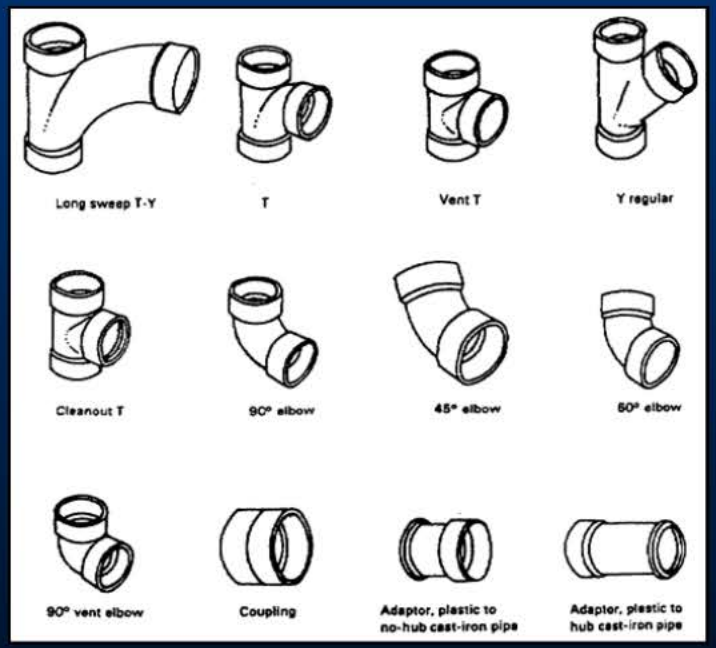
# Value

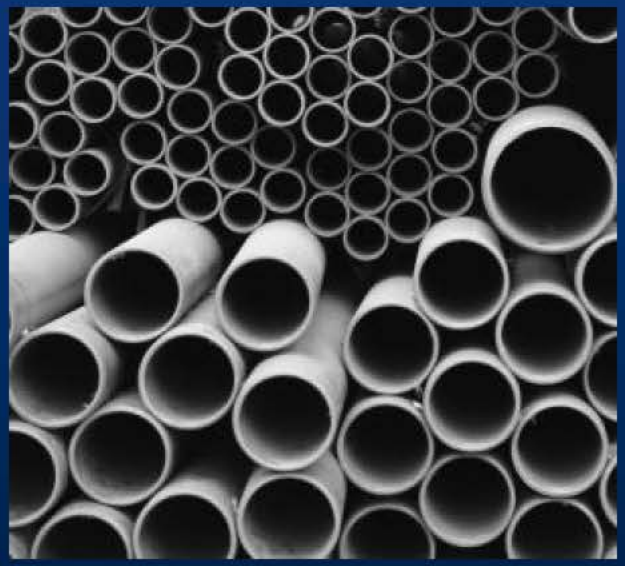
- Simplify duct design.
- Locate airtight systems inside conditioned space.
- Simplify duct installation.
- Easily match flow and diameter

| Duct Diameter | cfm @ 500 fpm | cfm @ 700 fpm |
|---|---|---|
| 1.5” | 6 | 9 |
| 2” | 11 | 15 |
| 3” | 25 | 34 |
| 4” | 44 | 61 |
| 5” | 68 | 95 |
| 6” | 98 | 137 |

# Market Readiness

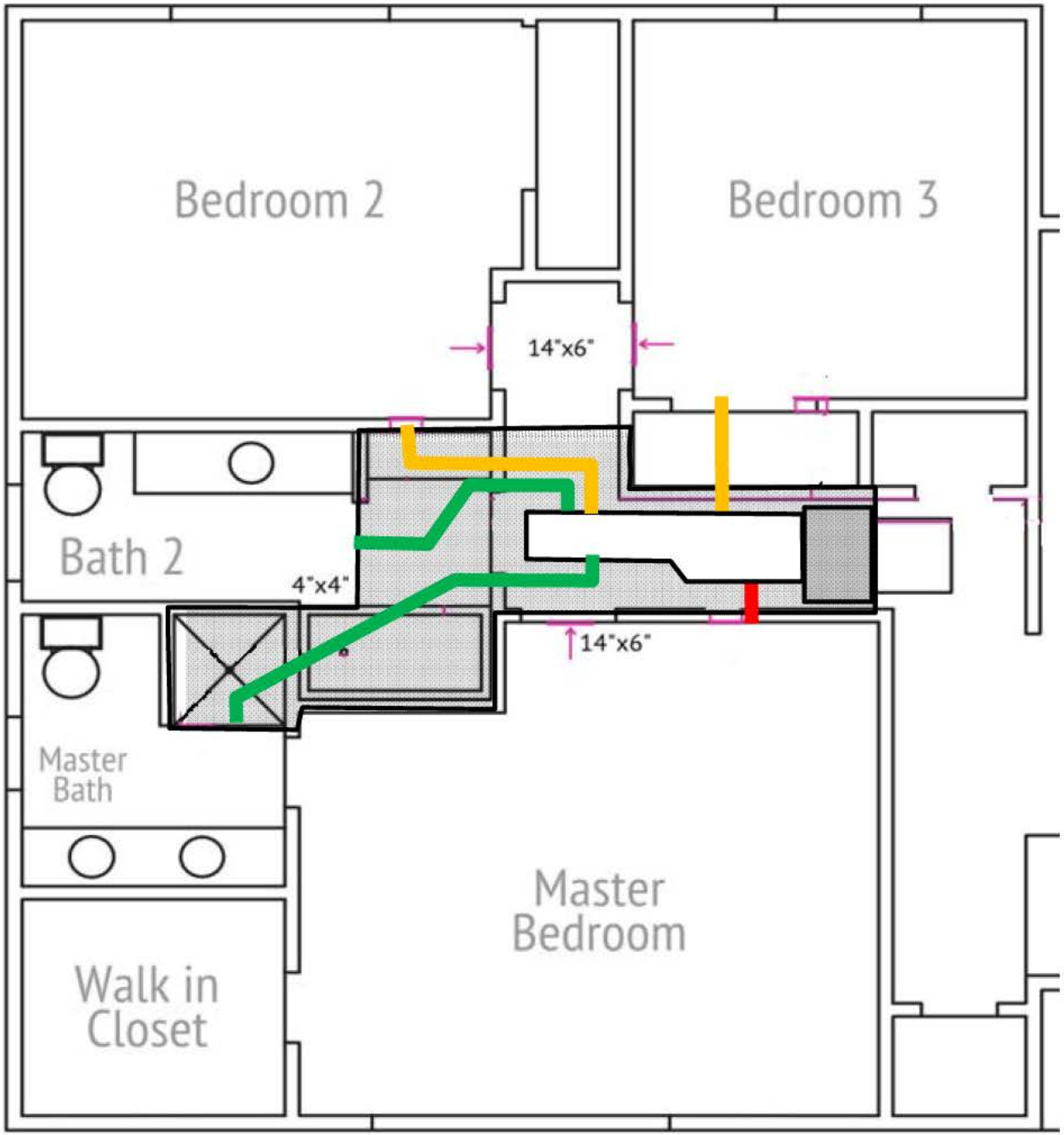
- Almost everything exists…



# Market Readiness

- Need small diameter long throw supply outlets
- May need testing for room air engagement?


| Room | Heating cfm | Cooling cfm |
|---|---|---|
| Bath 2 | 21 | 16 |
| Master Bath | 28 | 15 |
| Bedroom 3 | 62 | 71 |
| Bedroom 2 | 95 | 94 |
| Master Bedroom & WIC | 100 | 104 |
| TOTAL | 307 | 302 |

| Duct Diameter | cfm @ 500 fpm | cfm @ 700 fpm |
|---|---|---|
| 1.5” | 6 | 9 |
| 2” | 11 | 15 |
| 3” | 25 | 34 |
| 4” | 44 | 61 |
| 5” | 68 | 95 |
| 6” | 98 | 137 |

# Pros and Cons

- Pros:
  - Simple systems
  - Ducts inside, plastic duct joints are inherently airtight (solvent welded), modular
  - Easy zoning
- Cons
  - Code doesn't allow it
  - Not what Grandpa did
  - Need to educate stakeholders (code officials)
  - Requires HVAC/fire alarm/plastic industry collaboration
  - Expect a fight from someone

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