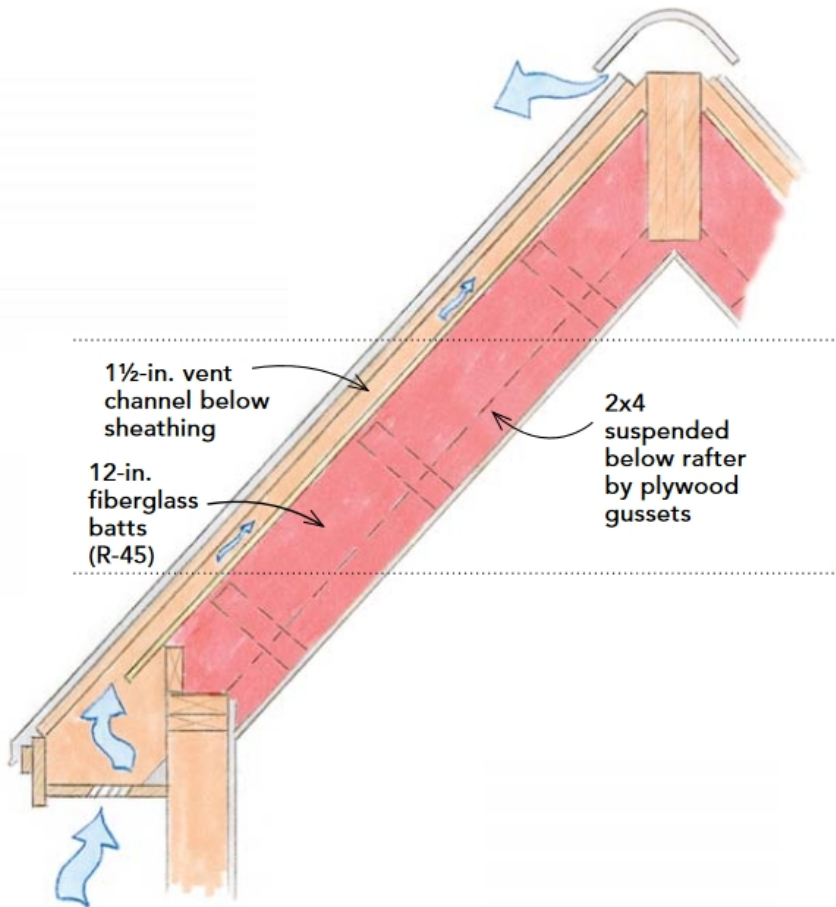


Still Fighting the Same Battles, 20 Years Later

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20 years or 40 years?

When I began working at the *Journal of Light Construction* in 1999, I was assigned to edit the magazine's Q&A column.

My original title for this presentation was "Still Fighting the Same Battles, 20 Years Later."



Vinyl Siding Without Paper?

Q. *Is it a good idea to install vinyl siding over OSB sheathing without putting up any housewrap or felt? I see this more and more often, and wonder whether the OSB should be protected since vinyl is fairly leaky. Apparently there is nothing in the codes against this practice.*

But Joe changed the title of my
presentation.

20 years? I've been
answering questions
for 40 years.

(Sometimes, Joe can be
competitive.)



The same three questions:

1. How do I insulate a cathedral ceiling?
2. How do I insulate a basement wall?
3. Why is my HVAC contractor specifying oversized equipment?

Groundhog Day – the alarm clock goes off, again



What *is it* about these questions?

1. Why are these questions so thorny?
2. What do builders continue to get wrong, and why?
3. What's changed in 20 years? Code requirements? Research findings? Have these changes added to builders' understanding, or just muddied the waters?
4. How can we do a better job of answering these questions? Should our advice change?
5. Can we envision code changes (or changes in our advice) that might help builders?

A discussion without conclusions

After 20 (or 40) years,
builders remain confused.

I don't have any simple
answers – but I want to get
everybody thinking about
these issues.



Remember: **There are victims!**

These are not victimless mistakes.

Every week of the year, we hear from homeowners facing \$20,000 and \$30,000 repairs for avoidable problems.



We need a paradigm shift

- In the face of a huge number of damp basements and failed cathedral ceilings, the building community now shrugs.
- We need to start seeing these defects as unacceptable.
- The auto industry would never accept this level of defects.

We aren't building good houses.

Issue 1: Cathedral ceilings

Problems:

- Heat loss and heat gain (= high energy bills and comfort complaints)
- Sheathing rot
- Ice dam disasters

Manufacturers are partly to blame

One problem: Bad recommendations from product manufacturers.

Bad advice from manufacturers compounds all three problems under discussion.

Manufacturers deserve blame on these issues.

Owens Corning Raft-R-Mate

Manufacturers are still selling flimsy polystyrene vents.



... (and Owens Corning isn't the only guilty manufacturer)

Owens Corning: “Attic ventilation lowers cooling costs”

raft-R-mate® Attic Rafter Vent
with optional air stop/insulation block

**YEAR ROUND PERFORMANCE AND DURABILITY
IN A QUALITY ATTIC RAFTER VENT.**

raft-R-mate® attic vents assist in the constant flow of fresh air from the soffit to your home's attic... all year round.

Why is that important? Without effective ventilation, summertime attic heat buildup can result in a wasteful and costly strain on your home's cooling system...and your family's comfort.

<http://www.owenscorning.com/NetworkShare/Residential%20Insulation/20314-raft-R-mate-Attic-Rafter-Vent-Brochure.pdf>

Bad installation instructions

Owens Corning
installation
instructions don't
mention the
importance of
sealing air leaks in
the ceiling.

[Photo shows a smoke pencil
revealing air leaks during a
blower door test.]



How many ways can you screw up a cathedral ceiling?

Let's consider an example:

- A homeowner (or builder) understands the basic principles behind vented cathedral roofs.
- The homeowner (or builder) understands the need for soffit vents, ventilation baffles under the roof sheathing, and a ridge vent.

OK!

Except the roof looks like this.



Convoluted roofs

Convoluted roofs with cathedral ceilings **can't** use the vented approach.

The vented approach only works on simple gable roofs or shed roofs, without valleys, hips, dormers, or skylights.



Maybe we'll try an unvented approach?

Spray foam solves all problems!



Except that open-cell spray foam is associated with damp roof sheathing...

- Sometimes.
- This damp sheathing is usually in attics, not cathedral ceilings. But the problem can occur in cathedral ceilings.
- There are solutions. But some of the solutions violate the building code.

So closed-cell spray foam
is better than open-cell — right?

Ouch!



Which is why the spray foam contractor says...

“You don’t need R-38. If you install R-20, you’ll stop 99% of the heat loss!”



So the homeowner decides that a vented approach is better after all...

... but “we have to put in a few recessed can lights.”



Maybe the homeowner reads an article on Green Building Advisor

GBA: “Pay attention to air leakage.”

Builder: “Don’t worry.”

The homeowner asks the code enforcement official: “Isn’t an air barrier mandatory?”

Code official: “**What’s an air barrier?** You must mean ‘vapor barrier.’”



No one understands air barriers!

Bad advice from Tyvek:

Q. “Can [wall] sheathing boards be taped?”

A. “Taping sheathing board or fan-fold seams creates a continuous vapor barrier, so moisture vapor would have nowhere to escape.”

<https://www.dupont.com/products-and-services/construction-materials/building-envelope-systems/faqs/wb-faq.html#Question6>

Can sheathing board seams be taped?

Taping sheathing board or fan-fold seams creates a continuous vapor barrier, so moisture vapor would have nowhere to escape. Adhesion of tape to foam and wood would also be temporary, due to thermal expansion and contraction of the wall assembly. A more effective and efficient means of providing air infiltration resistance and bulk water holdout is to properly install Tyvek® weather barrier, using our best practice guidelines. Since Tyvek® tape is flexible, it will continue to provide protection to the sheathing when undergoing thermal expansion and contraction.

Now the homeowner sees the light!

The solution is a continuous layer of exterior rigid foam.

(GreenBuildingAdvisor recommends this approach.)



The homeowner talks to seven
roofers...

Roofers: “No. We can’t do that.”



How about flash-and-batt?

- Well, maybe.
- But builders and installers need to understand that the minimum thickness of the spray foam layer (a) varies by climate, and (b) differs from requirements for walls.



Important fact: Our ceilings have air leaks

My analysis and advice:

- Builders need to be wary of online advice.
- Most cathedral ceiling failures are due to air leaks through ceilings.
- Airtightness *must* be verified with a blower door.



Can we find a way to make airtight ceilings mandatory?

Having an airtight ceiling avoids most problems.



Issue 2: Basement insulation

Recommendations from Building Science Corporation

(www.buildingscience.com/documents/reports/rr-0202-basement-insulation-systems):

"All Building America homes constructed by the Building Science Consortium were initially constructed with interior basement insulation. The approaches used early in the program were interior stud wall framing insulated with **fiberglass batts and 'blanket' insulation**. ... The experience by the Building Science Consortium with these two approaches has been bad. The Building Science Consortium has concluded that **these two approaches are unsuitable for use** by the home building industry due to serious problems associated with mold, decay and odors."

BSC: “Don’t use fiberglass batts or blanket insulation”

“These approaches are unsuitable.”



My advice

If you want to insulate a basement wall on the interior side, use either:

- closed-cell spray foam
- or
- rigid foam installed with attention to airtightness.



Owens Corning EcoTouch

Insulating Conditioned Crawlspace

In a heated crawlspace, or one with uninsulated ducts or water pipes, the walls should be insulated to keep the space warm. This will cut back on energy loss through pipes and ducts. Our EcoTouch® PINK® FIBERGLAS™ insulation batts are a good choice for crawlspace walls.



Owens Corning EcoTouch

Manufacturer's advice: "Unframed exterior basement walls should be insulated with blanket insulation..."

INSULATING A BASEMENT

Proper basement insulation is very important because an uninsulated basement can account for as much as 25 percent of a home's total heat loss.

Unframed exterior basement walls should be insulated with blanket insulation, which can be installed horizontally or vertically. Typically, the blanket is held against the sill plate at the top of the basement wall with furring strips.

CertainTeed basement insulation



BASEMENT WALL INSULATION

[WATCH VIDEO](#)

[VIEW BROCHURE](#)

[GET AN ESTIMATE](#)

Basement insulation

So:

One problem is manufacturers' recommendations.

Also, the code allows it

Building codes allow builders to install fiberglass batts on the interior of basement walls.

“R-13” and “R-19” values refer to fiberglass batts.

BASEMENT^C WALL R-VALUE
0
0
5/13 ^f
10 /13
15/19
15/19
15/19

What measures are needed to address this problem?

1. Code changes forbidding the installation of fiberglass batts, mineral wool batts, or cellulose on the interior side of basement walls.
2. Changes in manufacturers' recommendations, so that these recommendations align with best practice recommendations.

Issue 3: Why is my HVAC contractor specifying oversized equipment?

Study after study shows that residential HVAC equipment is typically oversized by 70% or 100%.



Image credit: Allison Bailes, Energy Vanguard

Let's consider a typical house

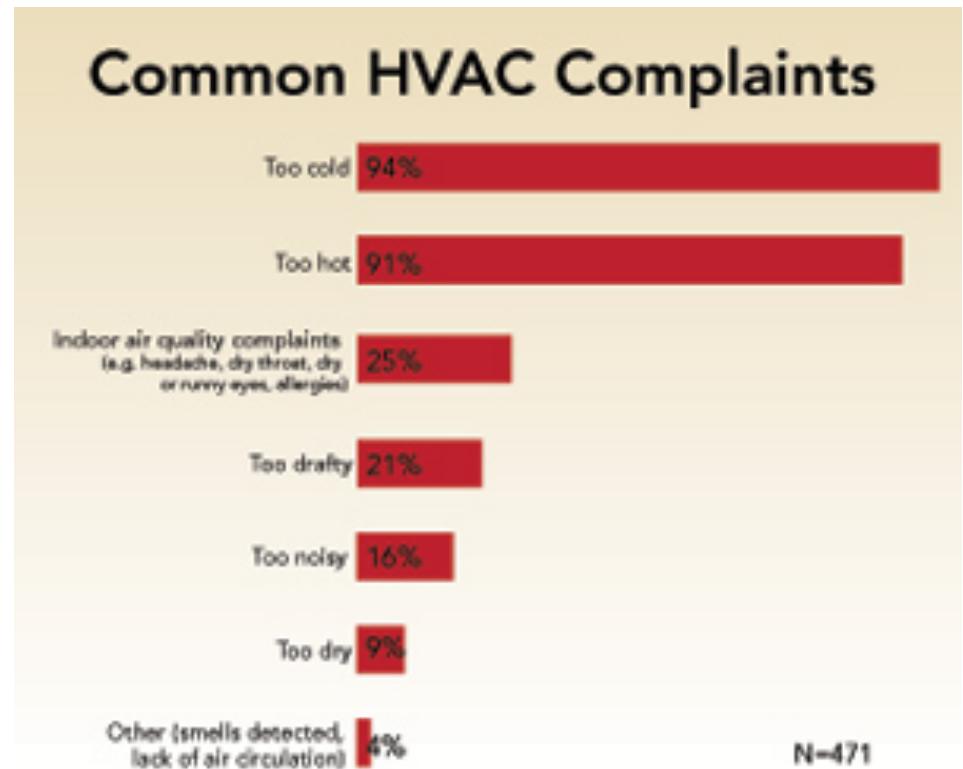
A typical new house might have a design heating load of 24,000 BTU/h.

It's extremely common for a heating contractor to insist on installing a 60,000 or 80,000 BTU/h furnace.

This happens all the time.

Results of oversizing

- Higher than necessary installation costs
- Comfort complaints
- Noise complaints
- Short cycling
- In some cases, higher energy bills



Why does this happen?

- Contractors are worried about callbacks.
- Contractors don't understand, or don't trust, above-code levels of airtightness, insulation R-value, or window performance specs.



Contractors size equipment using rules of thumb



Why buy Manual J software?

- HVAC contractors already know what size equipment they intend to install.
- An HVAC contractor buys Manual J software to produce a piece of paper to satisfy the code inspector.
- The contractor has no interest in learning how to use the software accurately.

Mitsubishi doesn't understand heating and cooling loads

A seven-room house with seven minisplit heads!



Solution: Change the code!

- Building codes require the use of Manual J (or some other “approved heating and cooling calculation methodology”) for load calculation before sizing equipment.
- **Problem solved!**

Why code changes don't solve the problem

- Most code officials don't enforce this code provision.
- Even code officials who enforce this code provision can't distinguish between an accurate Manual J calculation and a totally bogus Manual J calculation. (Bad inputs result in meaningless results.)

A textbook example

This is a textbook example of why code changes are insufficient to affect change in the construction industry.

Textbook Example 12.1 (cont'd)

in the bottom row of the table. All values are given in three significant figures to match the original flows. The mean is calculated from Equation 12.1 with $N = 39$:

$$m = \frac{1}{N} \sum_{i=1}^N Q_i = (3.83 \times 10^5)/39 = 9,820 \text{ cfs}$$

Next, the standard deviation is computed from Equation 12.2:

$$s = \left[\frac{1}{N-1} \sum_{i=1}^N (Q_i - m)^2 \right]^{1/2} = [(8.24 \times 10^8)/38]^{1/2} = 4,660 \text{ cfs}$$

Finally, the skew coefficient is calculated using Equation 12.3:

$$G = \frac{N \sum_{i=1}^N (Q_i - m)^3}{(N-1)(N-2)s^3} = (39)(3.45 \times 10^{12}) / [(38)(37)(4,660)^3] = 0.946$$

What is it about HVAC contractors?

- Most trades do a good job.
- Electrical contractors do a good job of electrical system design and installation.
- Plumbers do a good job of plumbing system design and installation (although hot water lines should be shorter).
- HVAC contractors stand out. They do a bad job. The industry is in crisis, and manufacturers should care.

The HVAC industry is in crisis

- Most HVAC contractors can't perform an accurate Manual J calculation, even though it is code-mandated.
- Most equipment is grossly oversized.
- Many duct systems are unacceptably leaky.
- Many (perhaps most) ventilation systems don't work.

Ventilation system field studies

- 2014 Washington study of ASHRAE 62.2-compliant systems found multiple problems.
- 2014 Florida study found that only 14% of studied systems had adequate air flows.
- 2018 California study found controls without required labels. Most homeowners didn't understand their systems.

What can manufacturers do?

- Develop furnaces, boilers, and ductless minisplit units that (a) have lower capacities and (b) modulate. Dettson is one furnace manufacturer that has accepted this challenge.
- Stop advising contractors to use methods that fall short of best practices.
- Provide better installation instructions and contractor training.

Dettson furnace

Rated at 15,000 BTU/h, this furnace modulates down to 6,000 BTU/h in low-load conditions.



My recommendations for addressing these three issues

1. Codes changes are necessary but insufficient.



My recommendations

2. Everyone involved in educating architects and builders has their work cut out for them.



My recommendations

3. In the U.S, it might be time for national legislation mandating contractor education and licensing, on the German model.

The German government lists 342 trades that require apprenticeship and licensing before a tradesperson can work independently.

My recommendations

4. *Manufacturers need to step up to the plate by:*
- *Providing recommendations that align with best practices.*
 - *Developing and promoting new products that better meet builders' needs.*

The status quo is unacceptable.

What information is trustworthy?

I saw an article in *The Atlantic*, September 2018, about a 32-year-old blogger named Shaye Elliot.

Her blog is about homesteading: she writes about raising chickens, growing vegetables, preserving food, and cutting firewood.

I'm thinking, "Hey — I could write a blog like that."

Reading further, I learned that Elliot has partnered with a manufacturer of essential oils — products like "geranium oil" — to promote their products in her blogs. She now makes \$500,000 a year.

What information is trustworthy?

Every week, as GBA editor, I received emails from manufacturers and small companies asking whether we will accept a “guest blog” provided by this company. These emails offer to pay for the privilege of promoting their products on our site — in hidden ads that look like a guest blog.

Fake news is everywhere.

Lots of published advice is bad.

An example of “sponsored content”


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What can manufacturers do?

- Support responsible journalists.
- Stop the practice of tempting journalists with bribes to plant fake news articles.

Thanks!

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