4 Ways Moisture Enters a Vented Crawl Space
Posted by Allison Bailes on October 5, 2017
https://www.energyvanguard.com/blog/4-ways-moisture-enters-vented-crawl-space

Here in the southeastern US, we have a lot of crawl spaces. Most are vented. Even most new ones are vented. It's not because it's the best way to keep them dry. That's certainly not true.

We have enough research on crawl spaces to know better. No, they're vented because foundation vents got into the code decades ago and, once there, something like that is difficult to dislodge.

So if you have a vented crawl space, especially in a humid climate, it most likely has moisture problems. And where does that moisture come from? Let's take a look.

1. Plumbing leaks

The first thing you might think of when we talk about water getting into a space that's part of your house is a leak of some kind. A lot of plumbing pipes, both supply lines and drain lines, run through crawl spaces, and they do leak occasionally. Because crawl spaces are visited infrequently, those leaks can go on for a long time before being discovered. One time, we discovered a plumbing leak in a crawl space after we encapsulated it. How many years was it there before we came along? Who knows!

The photo above shows another source of leaks in a crawl space: the air conditioner condensate line. Those pipes often aren't installed to the same level of quality as regular plumbing pipes. They also pass lower through the space, making them more susceptible to damage.

2. Soil

Another big source of crawl space moisture is uncovered soil. The photo below shows our Georgia red clay soil in a crawl space. The lighter area was uncovered and looked dry. You might think it's not putting much moisture into the crawl space air because it looks so dry. But you'd be wrong.

The darker patch of soil shown above had been covered by the plastic vapor barrier (6 mil polyethylene) before I pulled it back for the photo. It's darker because it's wet. The reason the uncovered soil seemed dry is because it was constantly evaporating water into the crawl space air.
The good news is that most new homes do get vapor barriers put down on the ground, eliminating a lot of the moisture that comes from the soil.

3. Foundation walls

Moisture can also come from the ground outside the house by migrating through the foundation walls. Vented crawl spaces rarely get any kind of damp-proofing or perimeter drains on the exterior. As a result, wet soil outside the crawl space can come right through, as you see below.

The crawl space in the photo below had a lot of this moisture. The backyard sloped down toward the house, putting a lot of hydrostatic pressure against the bare concrete block wall. You can see how well that worked. The whole crawl space had an inch or two of standing water. And it hadn't even rained in a while when I visited.

Another way water gets up against the foundation walls is from a roof without gutters, downspouts that don't move the water away from the house, or rainwater in a yard that slopes toward the house. I had an interesting water mystery to solve in one crawl space I encapsulated, and the source turned out to be one of those three.

4. Foundation vents in crawl space walls

Finally, we have the vents in the crawl space walls as a source of moisture. Yes, it's true. The idea behind those vents was to dry out the crawl space, but they actually do the opposite, at least in the summer. Here in the Southeast, we have this stuff in the air called water vapor.

When outdoor air comes through those crawl space vents, it actually raises the relative humidity in the crawl space. It's true! If you don't believe my word, see what the psychometric chart has to say about crawl space vents.

How to have a dry crawl space

If you have a crawl space and want it to be nice and dry, encapsulation is the way to go. (I'm not a contractor anymore and Energy Vanguard doesn't do this, but a lot of home performance contractors do.) You cover the ground, the foundation walls, and the crawl space vents to stop those three sources from wetting your crawl space. Then you may need to do something about the crawl space air, too.

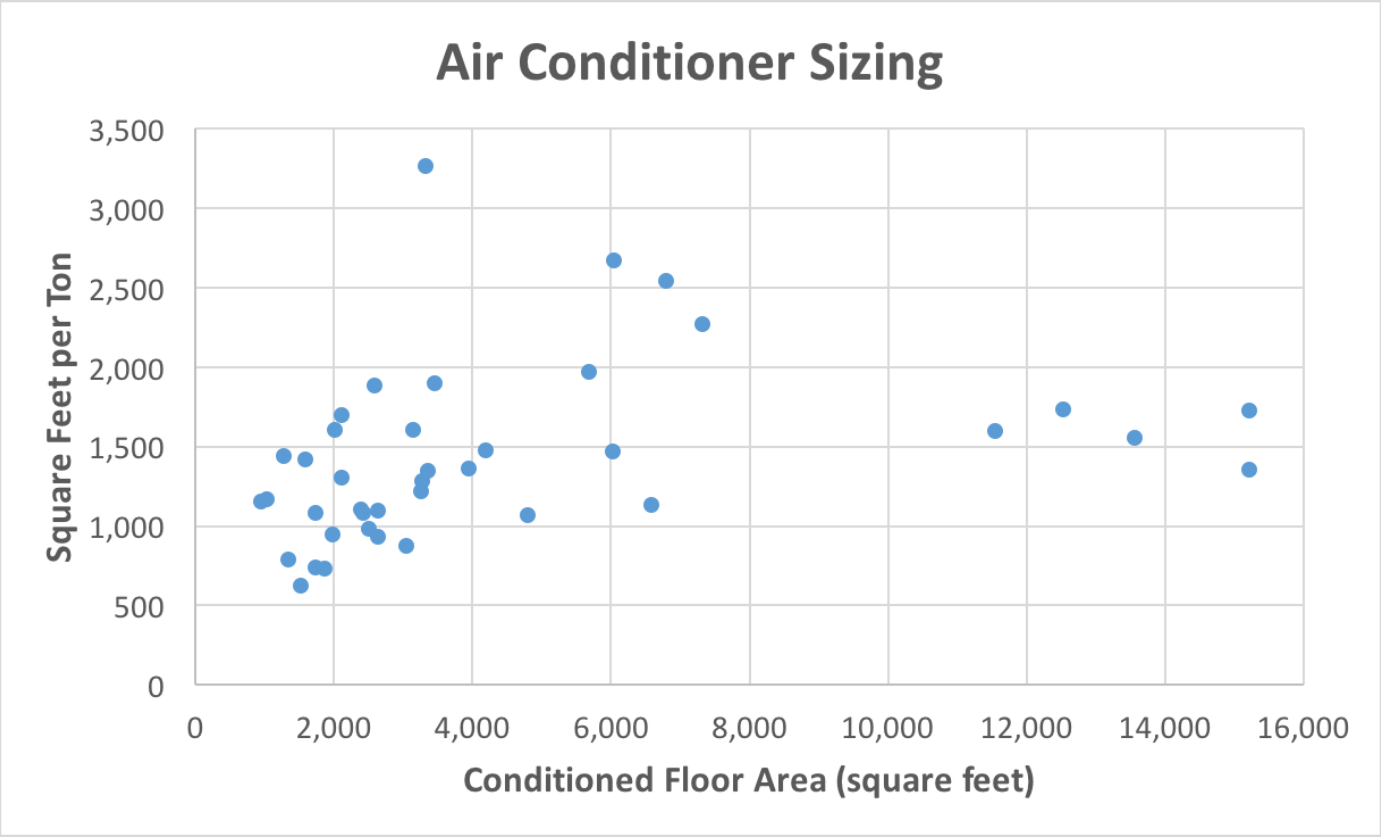
After getting it encapsulated, you have a crawl space that's beautiful, dry, and, if it's done right, your indoor air quality should improve.

Air Conditioner Sizing Rules of Thumb Must Die

Posted by Allison Bailes on August 26, 2016.
https://www.energyvanguard.com/blog/air-conditioner-sizing-rules-of-thumb-must-die

We design a lot of heating and air conditioning systems at Energy Vanguard. Alexander Bell, who goes by Andy, is our design wizard, and I've been getting involved with the process again lately. When I talk to potential clients, a lot of them tell me their contractor wants to size their air conditioner using a rule of thumb. The rule is usually something like this: Install one ton of air conditioning capacity for every 500 (or 600) square feet of conditioned floor area. How far off are they? Let's take a look.

As I said, we've done a lot of HVAC designs, which always start with a load calculation. So we can look at the data. The graph below shows data for just a few we've done recently. Forty of them, to be exact. On the horizontal axis, I plotted the conditioned floor area, in square feet. On the vertical axis, I plotted the cooling load divided by the floor area, or square feet per ton. Remember, when HVAC contractors use rules of thumb to size air conditioners, they usually pick a number between 400 and 600 square feet per ton.
Here's what our data show.



Note that not a single one of our load calculations was as low as the high end of their range. The low number on that graph is 624 square feet per ton. The majority of the cooling loads shown here are above 1,000 sf/ton. Only eight are below 1,000 sf/ton.

In case you're wondering, I threw out the data for cooling loads in cold climates when I plotted this graph. We had one in Maine that was nearly 4,000 sf/ton. Most of the homes in the sample set were in the Southeastern US, including Texas, but we had a couple in California and several in the Midwest as well. The average of the 40 shown above is 1,431 sf/ton. Yes, that's about a thousand sf/ton higher than the common rule of thumb in use.

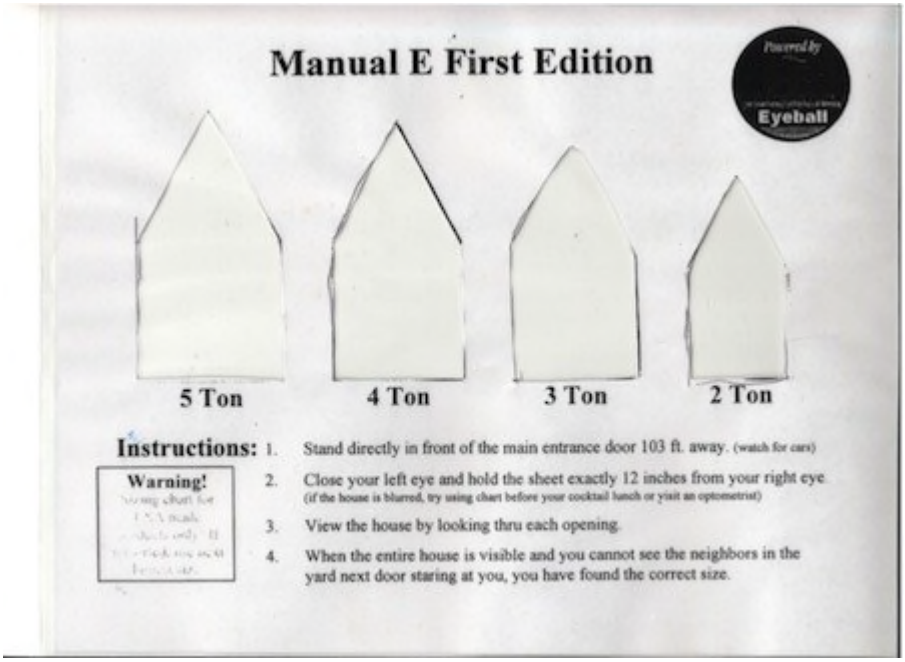
"But wait," you say, "cooling load isn't the same as air conditioner size. Didn't you tell us that you have to adjust the air conditioner size when you do Manual S?" Why, yes. Yes, I did. Most of the time, the air conditioner size will be larger than the cooling load.

But we're usually talking maybe 10%. So instead of 1,431 sf/ton based on the load, the actual AC size might give us 1,300 sf/ton.

That's till a lot different from the 500 sf/ton rule of thumb. Oh, and that 10% difference is usually offset by the oversizing inherent in Manual J.

Rules of thumb must die. Start with a real load calculation.

More on Air Conditioner Sizing Rules of Thumb
Posted by Allison Bailes on August 29, 2016
https://www.energyvanguard.com/blog/more-on-air-conditioner-sizing-rules-of-thumb



Air conditioner sizing rules of thumb must die. That's what I wrote in my last article. The most common rule of thumb is to use 500 square feet per ton to determine the size of air conditioner needed. Or 400 or 600 or some other number in that general vicinity. In my article, I showed a graph of air conditioner sizes, given in square feet per ton, for 40 homes that we did load calculations for. The average of the 40 was 1,431 sf/ton. Now, let me say a bit more about that.

Here are a few points that came up in the comments to the article and on LinkedIn and Facebook as well as some takeaways that I feel need to be emphasized.

1. No matter the number, you can't use square feet per ton to size air conditioners. I posted the square feet per ton results we got from 40 Manual J load calculations in hot and mixed climates. The average was 1,431, but you can't use that to size air conditioners. You have to do an actual load calculation. Those 40 results ranged from a low of 624 to a high of 3,325 sf/ton.

2. If you tell me your load calculations average 400-600 square feet per ton, I assume you're not doing them correctly. Is it possible that homes meeting current building and energy codes need that much air conditioning? Yes. If they have a lot of window area, they face west, and are in states with weak codes. My friend Mike McFarland of Energy Docs in California gets 1,500 sf/ton for retrofits and achieved 3,350 sf/ton for a new zero energy home. And their design temperature is 102° F so don't tell me this doesn't apply in Florida or Arizona.

3. You need room-by-room load calculations to get the airflow right. Contractors who use whole-house rules of thumb often don't get the right amount of conditioned air for individual rooms.

4. The square feet per ton you get from Manual J still gives you an oversized system, even when you do it correctly. Mike McFarland says he finds it 20-40% too much capacity. David Butler says 15%. In my

own condo, for which I've measured AC runtimes for the past two years, I'm seeing about 75%. (I'll write more about my condo soon.)

5. It's easy to get whatever load you want when you do a Manual J load calculation. I've written about this before. Putting in the wrong values for windows is an easy way to add load, as is putting in too many people, using exaggerated design temperatures, and the wrong orientation. If you want 500 sf/ton, it's not hard to produce a Manual J load calculation that gives you that number.

Designing an HVAC system starts with proper sizing. Look at the square feet per ton number you get to see if you're in the ballpark. If the number is less than 1,000 sf/ton, there's a good chance the number is wrong.

The Contractor's Fear of Third-Party HVAC Design

Posted by Allison Bailes on September 28, 2017

https://www.energyvanguard.com/blog/contractors-fear-third-party-hvac-design

What if a builder refused to build from plans drawn by an architect? What if a tile installer refused to implement designs handed to them and instead did their own thing? What if an HVAC contractor told a potential client they wouldn't install a system designed by a third party to ACCA protocols? One of those questions is more real than the others. Of course builders build from architects' plans and tile installers don't throw out designs they're asked to implement. But third-party HVAC design is a different animal.

The benefits of using a third party for HVAC design

We do third-party residential HVAC design here at Energy Vanguard. Andy Bell runs that part of the company and is a true master of the art and science of heating and cooling load calculations (ACCA Manual J), equipment selection (Manual S), register and grille selection (Manual T), and duct design (Manual D). That's pretty much all he does these days.
Our clients are architects, HVAC contractors, homebuilders, owner-builders, and homeowners having their dream home built. When they hire us, they do so for several reasons. They want:

- Their system sized using load calculations rather than rules of thumb

Help deciding among a broader set of options than most contractors offer (*e.g.*, conventional equipment, mini-split heat pumps, ductless, ducted...)
The design done by a company that doesn't make money off the sale of the equipment
We're one of a pretty small group of companies that do third-party design. Mostly what happens is that HVAC contractors make the decisions about what equipment to install, what size it will be, and how to get the heating and cooling distributed. Sometimes they do actual design, using the protocols of the Air Conditioning Contractors of America (ACCA). Mostly they use other methods, usually rules of thumb. The problem with rules of thumb is that they're unreliable. Using the industry standard ACCA protocols, when they're done accurately, doesn't mean you'll never have any problems, but it gives you the best shot of designing a system that will work. We've done hundreds and have had only a handful of former clients come back to us with problems. In those cases, we've been able to help them figure out what's going on and fix the problem.

The (occasional) difficulties of third-party HVAC design

Sometimes we have a different kind of problem. We usually work remotely and never see our clients. They hire us. We provide the HVAC design documents. They use those documents to hire a contractor (in the cases where they don't already have one). And that's where things can fall apart.
One thing that happens is the client provides our design documents to a contractor, who says, "I'm not going to install that. I didn't design it." Or worse, they take a look, see what size we've specified for the air conditioner, do a quick calculation in their head using a rule of thumb, and say, "This design is wrong. It won't cool your house. You wasted your money hiring them, and I'm not installing that."
Most of the time we're able to work with the client and the HVAC contractor to overcome those initial objections. Occasionally, though, every single contractor the client talks to is dead set against using our design. And because they meet with the client face-to-face and we're only a voice on the phone, the contractors have a little extra sway.
The contractor's fear

Going back to those initial questions I asked, builders don't have a problem building from an architect's plans and tile installers don't have a problem implementing the designs of others. But HVAC contractors aren't used to being told what size equipment to install and how to run the ducts. And they have legitimate fears.

If the equipment sizing and duct design are significantly different than what they're used to installing, they're afraid it won't work. When that job is finished and people are living in the house, who are they going to call if the system doesn't work? Well, the first call probably goes to the builder. Then the HVAC contractor. Then the third party HVAC designer, if the previous two calls didn't get the desired results. So the HVAC contractor is ahead of us in the accountability line. They look at a design that's different from what they're used to installing, and that extra accountability is what scares them.

How do we fix this?

I'm not writing this to throw HVAC contractors under the bus. Yeah, there's plenty of bad workmanship and uneducated contractors out there, but the HVAC industry needs a revolution. Contractors have three big areas of responsibility when they get a job:

Design

Equipment

Distribution

I'd say the only one they do OK on is equipment. Yes, there are contractors who do all three well, but they're in the minority. The majority of contractors skip over design and do a pretty bad job on the distribution side. I've written plenty about the distribution side in this blog. Today my focus is design.

Where I'd like to see us get to is to have a relationship between third-party HVAC designers and HVAC contractors like that between architects and builders. Architects and builders are both licensed professionals, so one part of the answer may be to require licensing for third-party designers. I'm not convinced that would solve the problems, though. If licensing were the answer, the contractors — who have to be licensed in most places — would already be doing everything properly. And my friend Kristof Irwin of Positive Energy in Austin, Texas is a licensed engineer who faces the same kinds of problems.

My crystal ball is a bit foggy right now, and I can't see where this ends up. Maybe the answer is time. As third-party HVAC design becomes more common, the difficulties should diminish. Maybe its educated homebuyers. I'm doing my part here to help with that. Maybe it's something structural, like licensing. I don't know.

Why Won't the HVAC Industry Do Things Right?

Posted by Allison Bailes on February 24, 2011

https://www.energyvanguard.com/blog/36319/Why-Won-t-the-HVAC-Industry-Do-Things-Right

My grandfather, the original Allison Arthur Bailes, was an electrician, plumber, HVAC contractor ('heating & air man'), and refrigerator repairman. In the '70s when I was a teenager, I used to spend a couple of months each summer working 'on the truck' with him and my uncle in Leesville, Louisiana. My job was mostly to schlep tools and materials between the truck and the job (though, being in Louisiana, I didn't know the word 'schlep' at the time).

On HVAC jobs, what I recall us doing mostly was checking and adjusting the refrigerant charge in cooling systems. Occasionally we'd replace blower motors or diagnose other mechanical failure problems with the equipment, but I don't recall ever spending a single minute troubleshooting a duct system. If someone called with a comfort complaint, the problem always had to be with the equipment.

Of course, this was the 1970s, and the whole building science thing had barely gotten started. Few people really knew how much duct system problems hurt performance. (We were also discharging the old, bad Freon directly into the air then, but that's another story.)

Now we know how much poor duct system design and installation can reduce performance. We know that oversized systems under perform and fail sooner. We know that not every carbon monoxide problem is cracked heat exchanger.

Yet, the HVAC industry, made up largely of professionals with high integrity like my grandfather, hasn't grown and adapted. Yes, there are some who know how to do it right, and some of those even put what they know into practice. But overall, the HVAC industry needs an overhaul.

Yesterday I read a great article by John Barba on doing load calculations to size HVAC systems. He'd recently taught a class of 35 HVAC pros, and almost none of them said they do load calc's. When asked what size heating system they would put in a particular house, given all the parameters necessary to do a heat loss calculation, they came up with numbers ranging from almost double to more than triple the actual load. You really should go read the article because it gives you a great look at how a lot of HVAC pros think.

Unfortunately, this problem is widespread. I wrote last year about some of the problems I've found in collecting the Manual J load calculation reports required for ENERGY STAR homes.
Speaking of ENERGY STAR homes, Version 3 of the program is in the pipeline now and set to become mandatory next January. I've written several times about the HVAC checklists for the contractor and the rater and how difficult it will be to get them done correctly. It shouldn't be this way. Everyone who understands how HVAC should be done says that the items on those checklists are things that HVAC contractors should be doing anyway, whether a home is going for the ENERGY STAR label or not.
Yet the reality is that the HVAC industry isn't ready to do things the right way, and that's a sad statement. Part of the reason for this is education. I've taught a number of HVAC

Contractors in HERS rater classes over the past few years, and they're almost always surprised at how much they learn - about HVAC! One told me, "Allison, you've taught me stuff about my business that no one's ever taught me in any of the classes I've taken before."
Another reason is money. In the HVAC industry, you've got to get in and get out quickly because in most cases you can't price jobs to include time and materials necessary to do things the right way. One HVAC contractor told me that they know static pressure in duct systems is important, but they don't make that simple measurement on each install they do because it takes extra time.
On the latter point, I wrote last year that HVAC contractors should charge by the square foot rather than by the ton of air conditioning capacity. That helps solve the problem of oversizing, but the going rates for HVAC installs in new construction still don't allow for quality duct design and installation.
Another problem with new home construction is that most of the best HVAC people work on existing homes, where they can make more money. They still don't do much with duct systems, but they often do a better job with the equipment.
Pretty much everyone I know who works as a home energy rater or building analyst and has to deal with HVAC contractors has lots of frustration around this. The industry is being pushed in the right direction, with everything from more stringent energy codes to programs like ENERGY STAR, but it's a struggle.
I wish I could wave a magic wand and make everything right. Sometimes it feels like that's the only thing that can work.