

BY NATE ADAMS

Called in to address an attic mold problem, the author was confronted with more mold than just what was growing on the roof sheathing. The owners liked to keep indoor temps high (around 78° F) and ran six humidifiers all night, creating a jungle-like environment rampant with interior mold.



Petri Dish House

The good thing about science is that it is true whether or not you believe in it. —Neil deGrasse Tyson

Several months ago, I was called in to look at a house I had worked on as an insulation contractor earlier in my career. At the time we were not in the business of comprehensive home performance. These clients were used to living in a South Asian climate and wanted to transport that experience to Cleveland. To correct problems in the house created by these conditions, I was essentially asked to defy physics. This is a cautionary tale of what *not* to do in a home if you want healthy clients. Unfortunately, the tale does not have a happy ending, but it did make for a few interesting, albeit ugly, pictures.

On the day of my visit, it was 18°F out. Inside the house, it was 78°F with dew points above 70°F. The central humidifier was set all the way up to 7. (I would bet they'd like one that goes to 11, like a *Spinal Tap* amp.) To keep things moist, they ran three additional humidifiers during the day, and three more (a total of six) at night! It was a jungle inside. Within minutes, I was down to a T-shirt and sweating.

Previously, we had insulated the attic floor of this

home, and the clients had become very concerned when they discovered “fuzzy stuff” in their attic (1).

Mold needs three things to grow: a food source (such as dust), moisture, and a temperature in the range of about 40°F to 100°F. In homes, food is almost always present. Surface temperature and moisture are the only real control factors. On any surface in this house cooler than the 70°F+ dew point, moisture will condense. Some surfaces checked out fine (2), but with all those humidifiers running and 18°F air outside, there were plenty of opportunities for things to go wrong. I saw a number of things I probably will never see again.

The bay window in the dining room wasn't well insulated, which was easy to tell because of the mold. In fact, throughout the house, *every* poorly insulated surface was moldy. To combat this, the homeowners had posted a list of weekly chores for their kids that included wiping down many surfaces in the house with bleach. (In addition to walls being wiped down, the room curtains were bleached weekly, too. With all that bleach, there are likely VOC issues in the home.)

The entire interior of the house is repainted every few years with either Drylok or Kilz. The bay window had been freshly painted less than a month before our visit,

yet mold was already popping through (3).

Under that same bay window ran the main cold air return for the house. This area was actually used for storage, and when we looked in there, we found pressboard that was coming apart from being soaked (4). All the wood was well below the dew point and was moldy (5). This isn't exactly a nice, healthy place for the return air to pass through, is it?

I was pleased with the air-sealing job my guys had done on the rim joists (6). But note the mold, in the bottom left corner of the photo, growing on the concrete-block wall that is above grade. The homeowner repaints this annually with Drylok, and had only just done it a few months before this photo was taken.

It was easy to find the spots where the dense-pack wall insulation was missing or had settled (7)—no thermal camera needed. Mold ensued where the surface was below the dew point, and not where the temperature was above the dew point (8).

One spot we found was an omission from our previous work (9). My crew had to work around a ton of stuff in the attic, and the attic above this area of the ceiling didn't get insulated. There was so much moisture in the house that water condensed on the ceiling. Before we came, it apparently condensed across the entire ceiling and woke up the owner's three teenage boys quite frequently when they'd get a big drop of water in the face. The uninsulated ceiling area was about 60°F; the warm ceiling was 72°F.

Even though the windows were decent double-pane replacements, the homeowners had put plastic up on all of them in an attempt to reduce condensation. It didn't help. You could see the condensation on the plastic, and any leaks showed condensation on the glass itself (10).

What was most surprising to me was that with all this mold in the house, the owners had only called me in about the mold in the attic. When we had insulated the attic, we had dropped the attic temperature, so condensation now formed on the underside of the roof, followed quickly by mold (11). The first 6 to 8 feet of the roof was completely soaked by the frost on the nails poking through (12).



THE SAD TRUTH & CONSEQUENCES

The homeowners' three teenage boys all suffer from asthma. It was frustrating that these owners weren't willing to listen to my proposed solution:

1. Reduce humidity levels,
2. Insulate any surfaces that get cold.

I corresponded with them several times after my visit and told them that there could be severe health consequences, but my suspicion is that nothing will change until one of the boys lands in the hospital with a severe respiratory issue.

HUMIDITY—BELIEVE IN SCIENCE

This problem is fixable. But first, behavior must be modified. Short of building a pool house and living in it, humidity levels must come down. I don't care how well you try to insulate and air-seal everything, in an existing home, you're going to miss a spot, and bad things will happen there.

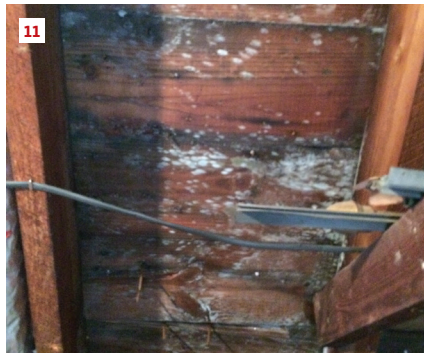
Sure, these clients like it warm. That's

OK, if they're willing to maintain 55% relative humidity (RH). This is the upper level of indoor humidity recommendations. At 77°F with 55% RH, the dew point is 60°F. There is a good chance that almost all of the surfaces in the house can be kept above this. Even at 82°F with 50% RH, it's possible; that's a 62°F dew point.

The critical piece is that the humidifiers need to be dialed back as the temperature outside drops. A higher-end humidifier usually has an outdoor-temperature sensor, but I would lean toward my favorite control, the Ecobee thermostat (see "Solving for Comfort With a 'Smart' Thermostat," Oct/14), because I could remotely monitor RH and alert the clients if they again were to forget that physics exists.

SURFACE TEMPERATURES ARE KEY

All exterior surfaces need to be insulated with a vapor- and moisture-impervious insulation, if possible. As long as the surfaces



all stay above dew point, there is a chance of success.

Closed-cell spray foam is probably the best bet for the attic, basement, and bay window in this house. The attic should be brought into the building enclosure, as it is used for storage and will be very difficult to air-seal to the level needed without foaming the roof deck. The basement walls should probably be sprayed to floor level. It may be a good idea to put foam board on the basement floor and pour concrete on top of it.

The missed spot in the closet needs a dose of dense-packed cellulose, and I would want to do an infrared scan of the house with the blower door running to catch any other missed areas. Cellulose may get wet, but at least the plaster and lath of the walls mostly protects it from a drenching.

All the window trim would need to be taken off and foam sealant applied underneath it to prevent condensation.

There are surely many more things that

should be considered, and that is what an energy audit, with lots of time to think through problems, is for.

Both clients have fairly high-paying jobs, yet live in a modest house, so heating costs are not their concern. The furnace is substantially oversized—an 80,000 Btu two-stage furnace—so it could keep the home at those high temps even when below zero outdoors. It's an 1,800-square-foot building with a 2,150 cfm50 blower door, so the load is likely under 40,000 Btu. But I would want to run an energy model, tried to actual energy bills.

THE IMPORTANCE OF CONSULTATION

I've written in *JLC* in the past about my sales process and how it's solutions-focused rather than product-focused. During my initial consultation, I ask a ton of questions to find out what homeowners are trying to solve. The clients here need a customized plan if they want to continue on this tem-

perature and humidity path. Unfortunately, they didn't move forward with an audit and plan, likely because it would call for them to change their behavior. I was told in no uncertain terms that was not going to happen. But without at least some behavior change, I can't pursue this project. There is way too much liability. These owners seem to be intentionally stepping in front of a bus here, and I don't want to be a scapegoat for problems caused by reckless behavior.

When I signed off with the clients, I warned them of potential nasty consequences. I am no longer in their employ, so as a consultant I can move on. I can't force someone to do something they don't want to do. Does it still bother me? Of course. Hopefully there will be a change of heart before anyone lands in the hospital.

Nate Adams runs Energy Smart Home Performance, a building-performance consulting company in Cleveland.