The Rest of the Story

Part 2

BY BRUCE BARKER

ONCE AGAIN THE WORD INVITES YOU TO TRAVEL into the dark realm of subjects that are sometimes misunderstood by home inspectors. The Word hopes you will find this trip informative and maybe a little entertaining.

This month we continue reporting on (as Paul Harvey used to say) **the rest of the story.** This is the story about what The Word and his wonderful wife learned while remodeling our 1980 ranch home in Cary, NC. As inspectors, we usually just do our thing, collect our fee and move on to the next inspection. Rarely do we get to see what happens after we leave. The rest of the story can be interesting and instructive in terms of what we might want to look for and report, or at least mention, to our clients.

Last time, we discussed some of the general deficiencies we found in our home. This time, we'll get into a couple of the big dollar issues: the crawlspace and the attic.

"Allergies"

It seems, sometimes, like The Word's wonderful wife is allergic to everything. She is definitely allergic to dust and is probably allergic to other common contents of attics and crawlspaces. Many clients suffer from these afflictions.

The Word is allergic to paying utility bills and to watching (and listening to) his wonderful wife suffer. Many clients also suffer from these afflictions.

Houses often have conditions that cause allergic reactions both physical and fiscal. Some of these conditions, like absent or minimal insulation, are reportable deficiencies. Other conditions are either concealed (but we know they're probably present) or are otherwise out of scope of a home inspection. Whether you mention these out-of-scope conditions is up to you, but you may want to consider doing so. Going that extra mile is a great way to get more referrals from clients (instead of relying on agents).

Holey House, Batman!

It's amazing how many holes exist between the interior of houses and unconditioned spaces. These holes can add up to a few square feet at least. Holes are everywhere. The space around holes for pipes and wires is usually small, but there are lots of them and they add up. The holes for tub drains can be huge, often a square foot or more. Holes

ILLUSTRATIONS: BATMAN MASK|Dreamstime and ALLERGEN|Fotolia.com

for HVAC ducts, vents and chimneys can be huge as well. Remember, too, that the chimneys and vents themselves can be huge holes. There are also lots of holes in the walls, especially around penetrations such as windows.

These holes provide a passageway for conditioned air to enter and leave the house's interior. Dust, pollen, mold and water vapor are some of the common passengers on this air stream, but other and much more dangerous passengers can also hitch a ride. Radon comes to mind. Vapors given off by chemicals that people often store in attics and crawlspaces might tag along. How about bacteria from animals in the crawlspace and attic (alive and dead), including their wastes? Uncontrolled air movement is not ideal for several reasons.

A Hole and a Force

Air movement needs a hole and a force to move it. Holes in most houses are plentiful. So are forces to move the air. It doesn't take much force to move air and when you consider that the holes are open 24/7, a lot of air can move between the house and unconditioned areas. So what are some of these forces?

Well, one force is our old friend the stack effect. The stack effect is a fancy way of saying that warm air wants to rise. If it were not for the stack effect, chimneys and vents wouldn't work. In the winter, the house becomes like a chimney. The air in the house is warmer, thus less dense, than the air outside the house. This warmer air wants to rise and will escape through any hole that it can find. That escaping warm air has to be replaced, and that air is probably colder outside air drawn in through other holes in the house.

News Flash: warm air doesn't always rise! Pressure differences in the house can cause warm air to move sideways or downwards given the right conditions.

Blowing in the Wind

Wind is an interesting force because the air movement between the house's interior and exterior will be different depending on wind speed and direction, and depending on where in the house a hole is located. Wind can increase the pressure inside the house on the windward side and decrease the pressure inside the house on the leeward (opposite) side. Thus, air can flow both from and to the house's interior at the same moment.

Of course, the wind effect is not that simple. Wind is also acting on the ventilated attic and crawlspace. Areas within the attic and crawlspace can become pressurized and depressurized depending on the amount and location of the ventilation openings. Pressure conditions in the attic and crawlspace can enhance or counteract the pressure differences inside the house and increase or decrease the amount of air movement through the holes.

We Do It to Ourselves

Just to make things interesting, let's throw in the mechanical systems and the fuel-burning appliances because they usually have an effect on air movement in the house. Kitchen and bathroom (and any other) exhaust fans will depressurize the house and draw outside air inside. So will fuel-burning appliances (including fireplaces) that draw combustion air from inside the house. The combustion air goes right up the flue or chimney with the combustion products. The air has to come from somewhere, so it comes through the holes in our holey house.

Powered attic ventilation fans will usually depressurize the attic and draw air from the house. These ventilation fans are usually installed without accounting for existing ventilation openings and are often installed in an attempt to improve perceived ventilation inadequacies. If the attic ventilation is indeed inadequate, power ventilation won't make more outside air magically appear. The power ventilation fan may, instead, pull air from the house through the many holes between the house's interior and the attic.

A forced-air HVAC system can pressurize or depressurize areas within the house. A leaky return air system can pressurize the house because more air is being supplied than is being withdrawn. Conversely, a leaky supply air system can depressurize the house because more air is being withdrawn than is being supplied.

A bedroom, or any room with a door, can be pressurized by the HVAC system if there is no return duct or relief opening to relieve the pressure from the supply duct. The pressure can force air through the holes into unconditioned spaces.

Tightening the Ship

So far, we have lots of holes in houses and lots of ways to move air and its contents through them. Losing conditioned air is an energy-efficiency bummer, but energy efficiency is only part of the story. Because the air probably contains moisture from occupant activity (cooking, bathing and just breathing) it can create moisture problems in the unconditioned areas. This moisture may condense on the cooler surfaces, damaging materials and providing the moisture that fungus needs to grow. If condensation occurs somewhere near the insulation, the insulation will get wet and will tend to retain the moisture against nearby materials for a longer time. Wet insulation is close to worthless as an insulating material so we have the potential for a triple whammy of energy inefficiency, damaged materials and fungal growth.

So do we agree that air movement between conditioned and unconditioned space is not good for many reasons? If so, what can be done to stop this air movement?

The first improvement is to find and seal as many holes between conditioned and unconditioned space as possible. Hole sealing can be quite cost effective and, since it requires little training, is something that many homeowners can do themselves. Hole sealing is something you may wish to suggest to help improve the house's energy efficiency and reduce air movement and the stuff that rides along with the air.

The second improvement is significantly more costly and complicated than hole sealing, but it can have a much greater impact on the house. Bringing the attic and crawlspace within the house's thermal envelope by sealing and insulating their perimeters can be a good choice for many clients, especially those buying houses on crawlspace foundations. The cost and difficulty of these retrofits should not be underestimated. Part of the cost, of course, is cleaning up the mess caused by years of air and moisture infiltration into these spaces.

Figure 1

The Word's Attic

The Word elected not to seal his attic. There are no appliances or ducts in the attic, thus the cost benefit of sealing the attic didn't seem favorable. The Word did, however, have the dirty, compressed, uneven, marginally effective loose-fill fiberglass insulation removed. In its place, a layer of open cell foam was sprayed to air-seal the attic from the house's interior. The remaining insulation requirement was achieved using loose fill cellulose. A baffle was installed around the attic access opening to keep the insulation in place, and the opening was insulated and weatherstripped.

This is about as good as it gets in terms of an energy-efficient attic. The Word could have added a radiant barrier in the rafters to reduce some radiant heat gain, but given the tree-cover on the lot, that seemed to be overkill.

Crawlspace Sealing 101

Sealing the crawlspace, however, was a no-brainer. In The Word's opinion, crawlspaces should be sealed unless there is some overwhelming reason not to. There are just too many problems that can occur in a ventilated crawlspace. So in case a client asks, or in case you want to seal your own crawlspace, here are the basic steps for doing so.

Before you start, do your homework. If there's a fuel-fired appliance in the crawlspace, that appliance may need to be changed to a direct-vent type that obtains its combustion air from outside the crawlspace. These types of problems can greatly change the cost of crawlspace sealing.

1. Get a permit if required by your jurisdiction.
2. Correct any exterior foundation grading and drainage deficiencies, including gutter problems. This is always a good idea and especially so when sealing a crawlspace. You don't need water problems after spending all that money to seal a crawlspace.
3. Correct any water infiltration or drainage issues in the crawlspace. Crawlspace dirt floors should slope toward one or more points where water can drain out. If the points are to sump pumps, so be it. Make sure the sump pump is accessible after the crawlspace is sealed.
4. Wait for a while, if necessary, to let a wet crawlspace dry some before proceeding. You'll be sealing in whatever moisture is on the ground and in the crawlspace walls so, ideally, things should be as dry as practical.
5. Remove any old insulation. It won't be useful in the new system and having everything visible helps you find and correct any problems that may exist.
6. Clean up the crawlspace floor. Sharp objects can punch holes in your vapor retarder.
7. Seal all the holes you can find between the crawlspace and the house's interior. Even though the crawlspace will become semi-conditioned space, you still want to control if and where air flows between the crawlspace and the house's interior.
8. Clean up any fungal growth in the crawlspace. You don't want any fungus, alive or dead, entering the house.
9. Seal existing crawlspace ventilation openings.
10. Cover the crawlspace floor with a thick, reinforced vapor retarder. You can get by with 6 mil poly, but it's better to use a much thicker, reinforced material. Ten mil is what The Word used. Even thicker is better but more expensive. Run the vapor retarder at least 6 inches up all crawlspace walls and columns and seal the vapor retarder to the walls and columns. If you're using spray foam insulation, that will handle the sealing. Overlap and seal all seams in the vapor retarder.
11. Insulate the crawlspace walls including the band. The Word used closed cell foam. It's both an air and water barrier and does a good job of getting into areas that are hard to reach and completely seal by other methods. The amount of insulation depends on your climate zone. Figure 1 shows the foam being applied. Remember to leave a gap in the wall so you can see the wood-eating critter tubes.

Here are a couple other nice-to-haves. Put an extra layer of vapor retarder on the path to any equipment in the crawlspace that requires service, such as an air handler or a water heater. The vapor retarder is most likely to tear on these paths. Have the contractor leave some extra vapor retarder and sealing tape for vapor retarder repairs. Repairs will be needed at some point.

12. Apply an ignition barrier on any foam insulation used, if required. Check the manufacturer's ignition barrier requirements carefully. Ignition barriers aren't inexpensive and a big fight might ensue if a barrier is required and it's not in the insulation contractor's bid.
13. Provide ventilation to the crawlspace. The Word chose the conditioned air method which involves supplying conditioned air at 1 cubic foot per minute per 50 square feet of crawlspace area. The International Residential Code also specifies providing a return duct or transfer grill into the house, but this is not allowed in North Carolina.
14. Weatherstrip and insulate the crawlspace access door (assuming, of course, that it's an exterior access door). It's now an exterior door, so treat it as such.
15. If you're in a Radon-prone area, consider having the house tested before sealing the crawlspace. A Radon mitigation system is less expensive to install before sealing the crawlspace.

Here are a couple other nice-to-haves. Put an extra layer of vapor retarder on the path to any equipment in the crawlspace that requires service, such as an air handler or a water heater. The vapor retarder is most likely to tear on these paths. Have the contractor leave some extra vapor retarder and sealing tape for vapor retarder repairs. Repairs will be needed at some point.

Danger, Danger Will Robinson!

Air sealing houses is good, but air sealing can cause problems. People need some "fresh air" from the outside. If air sealing causes the air changes per hour, as measured by a standard blower door test, to fall below five, mechanical ventilation may need to be added.

The more serious problem can occur when air sealing is performed on houses where combustion air for fuel-burning systems is drawn from inside the house. This means fireplaces and fuel-burning stoves as well as fuel-burning furnaces, boilers and water heaters. Air sealing these houses can kill the occupants if inadequate combustion air creates a carbon monoxide problem or if the systems were malfunctioning and the effects were not apparent because the home was so leaky.

A qualified person (e. g., BPI certified) should perform a blower-door test on all houses that have been extensively air sealed and should perform a combustion safety test on houses containing fuel-burning systems. If the tests indicate problems, appropriate remediation should be performed. At a minimum, carbon monoxide alarms should be installed in all houses with combustion appliances or with an attached garage.

The Bottom Line

They don't build houses like they used to. That's true. In terms of air sealing and insulation, they build them better now. It's both possible and useful to consider upgrading attics and crawlspaces to modern standards. The Word is glad he did.

Memo to crawlspace monsters: The Word does not reside on Mt. Olympus (just at its base) and welcomes other viewpoints. Send your lightning bolts or emails to Bruce@DreamHomeConsultants.com. The thoughts contained herein are those of The Word. They are not ASHI standards or policies. ■

Bruce Barker operates Dream Home Consultants. He has been building and inspecting homes since 1987. He is the author of "Everybody's Building Code" and currently serves as chair of the ASHI Standards Committee. To read more of Barker's articles, go to ***www.dreamhomeconsultants.com****.*