BY JIM BRADLEY

Photo: Chris West

Fixing a Wet Roof

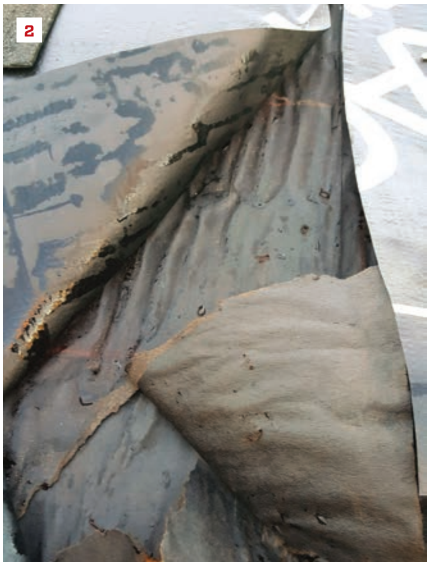
I'm a home performance contractor based near Burlington, Vt. I perform a lot of energy audits on older homes, often in consultation with my colleague, building science and Passive House consultant Chris West, of Eco Houses of Vermont. [Editor's note: See Chris West's article, "A Thermally Broken Steel Connection," *Energy*, on page 37.] Chris and I often collaborate on solutions to problems that we identify during our inspections.

The example in this article is a home built in the 1940s, with some later additions. The client called in late 2015 for a complete energy audit. After we submitted our report, he called back again because he wanted a high-performance energy upgrade for one room in the house, which would become a home office.

Our previous energy audit and inspection had revealed many issues with the house, including an exposed dirt crawlspace under the addition where the home office was planned. The fiberglass insulation between the joists under the floor was damp, and the crawlspace perimeter had not been air-sealed or insulated. That crawlspace is an obvious source of moisture coming into the building, and I proposed to the client that we fix the crawlspace as part of the office project. But he chose to put the crawlspace work on the list for later.

So we went ahead with upgrading the walls in the home office space. The plan was to reinsulate the walls with Roxul cavity insulation and some additional rigid Roxul on the inside face of the wall, apply Intello smart vapor retarder, install Passive House–rated windows, and re-drywall the walls. But when we opened up the walls and a section of ceiling during the job, we found another moisture problem: There was frost on the underside of the roof sheathing.

When we returned the next day, expecting the frost to be gone, we found instead a steady seeping of water



When the author's crew exposed the underside of the cathedral roof sheathing **(1)**, they saw what appeared to be a roof leak. However, when they removed the roof shingles to investigate, they found instead a condensation problem: Bulk water was collecting under the impermeable synthetic roof underlayment installed as part of a recent reroof job **(2, 3)**.

between the joints in the matched-board roof sheathing. At first glance, the roof appeared to have a leak.

The roof shingles were good-quality IKO shingles, installed only two years previously. As we inspected the roof from the outside, we found an unusual bulge in the shingles. We removed some roofing at that location to see what we could learn. But to our surprise, the nearly new Grace Tri-Flex synthetic underlayment under the shingles was bone-dry.

When we sliced open and peeled back the synthetic underlayment, we found a different situation. The asphalt felt paper under the Tri-Flex, left in place during the most recent reroof, was wet. And when we slit the asphalt felt and pulled it back, we found roof boards that were soaking wet.

Evidently, the source of the dripping water was not a roof leak, but condensation of interior moisture under the vapor-impermeable Tri-Flex underlayment.

DEVISING A REPAIR

My first idea for fixing this moisture issue was simply to tear off the shingles, install a more vapor-open roofing underlayment, and reshingle the roof. But on further consideration, Chris and I recommended a more robust solution: We would build a ventilated roof assembly above the vapor-open membrane, so that any moisture diffusing through the membrane out of the insulated cathedral roof would be carried out of the vent space by air transport.

After stripping away the almost-new existing roof shingles, we applied Siga Majvest membrane to the roof (see photo, page 34). With a perm rating of 68, this fabric would allow good drying.

Over the membrane, we attached 3/4-inch strapping, run vertically, to create an air space for convective drying. This 3/4-inch air space is about the least we like to use—a full inch or even 1 1/2 inches would be better. But a 3/4-inch space is enough to do the job, and using anything larger in this case would have introduced problems for trim and roof intersections. Even at 3/4 inch, we had to install a new fascia of Boral mineral-based trim to hide the raised roof plane.

Over the strapping, we applied another layer of sheathing, using plywood rather than OSB because of plywood's better resistance to moisture attack. We installed insect screens at the bottom of the roof and a regular ridge vent at the top.

After fixing the roof, we continued on with our upgrade to the home-office walls. Before drywalling that room again, we applied Intello smart vapor retarder to the walls and ceilings. That way, vapor diffusion into the insulated assemblies during winter will be limited, but the structure will have the opportunity to dry by diffusion to the inside during the summer.

LESSONS LEARNED

This house and its problems are a good example of why building trade contractors should learn to apply building-science principles to the jobs they take on. It's understandable that, when this house was reroofed recently, the roofer chose an impermeable synthetic roofing underlayment. It's a great material—light, strong, durable, and waterproof—and I would use it myself in a heartbeat, over a well-ventilated attic.

But the manufacturer instructions for Grace Tri-Flex, and also the instructions for fiberglass asphalt roofing shingles, specify that the material should be applied

Photos: 1, Jonah Vannamee; 2 and 3, Jim Bradley over a ventilated roof. This roof was a different case—an unventilated, insulated cathedral roof with no intact air barrier protecting its underside from moisture sources inside the building. In that situation, an impermeable roofing underlayment was not suitable.

It is true that fiberglass asphalt roofing shingles are themselves a vapor barrier. However, shingles do allow some amount of diffusion drying because of the cracks between the individual shingles. But in the roof as we found it, any moisture that was trying to get out and away from the organic material of the roof rafters and sheathing was being impeded by the newly installed impermeable synthetic underlayment. If that fabric were vapor open, like Majvest is, the moisture could diffuse through the membrane and away from the vulnerable wood. Even if water did condense under the roofing shingles, at least it wouldn't be soaking the wood—and it could drain out of the roof over the fabric.

Even so, we chose to provide for air-drying above the underlayment. As we see it, this roof may be in place for 50 years before anybody opens it up again. In the meantime, there's no telling what may happen to the rest of the house. This way, we can rest easy that our assembly will be durable even in the face of unusual moisture challenges.

INCREMENTAL PROGRESS

For a small house, this building has complicated moisture problems. We've reduced the moisture risk from the room we remodeled, but the roof above it is still exposed to moisture from the adjacent kitchen—and, of course, from the crawlspace. The homeowner, like most of my clients, doesn't have the budget to tackle all his house's problems at once. Going forward, the plan is to address the crawlspace moisture problems and the possible issues in other parts of the roof as funds become available. For now, however, we can be confident that the work we've already done will be durable and perform well.

Jim Bradley is a BPI-certified home-performance contractor, builder, and remodeler based in Vermont.

The author and his crew spread Majvest weather barrier membrane over the original board sheathing of the roof. With a perm rating of at least 34, Majvest is vapor open, but it resists driving rain.

The crew installs plywood roof sheathing over 3/4-inch wood strapping as a nailbase for asphalt shingles. This creates an air space that will allow moisture diffusing out of the cathedral roof to escape the assembly through convection.

Photos: Chris West (top), Jonah Vannamee (bottom)