Insight
Shakespeare Does Roofs

An edited version of this Insight first appeared in the ASHRAE Journal.

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To vent, or not to vent…that is the question:
Whether 'tis nobler in the mind to suffer
The slings and arrows of outrageous moisture,
Or to take arms against them
And by opposing end them. To rot – to rust,
To rust perchance to scream - ay, there's the rub.

With apologies to the Bard of Avon, after several decades of dealing with roofs I have come to the answer to the roof vent question: do not vent…except. Great answer, eh?

Vented roofs blow off more than unvented roofs. Vented roofs burn more than unvented roofs. Vented roofs are energy inefficient compared to unvented roofs. Vented roofs cause moisture problems south of the Mason-Dixon Line and east of Interstate 35 in Texas. Venting a roof in a hot-humid and mixed humid climate is a very, very bad idea.

The only time you should vent a roof is to control ice-damming. And when I do a vented roof to control ice-damming I install the vented roof over the top of an unvented under-roof.

The original reasons to vent roofs were pretty reasonable. In cold climates roofs were vented to control moisture accumulation and…yes…to control ice-damming. In hot climates roofs were vented to increase thermal comfort.

In cold climates roof venting controlled attic moisture accumulation only in poorly insulated attics. Let me repeat that to have it sink in. Roofs needed to be poorly insulated. In the winter the air outside is cold. Yup. Cold air is not capable of holding much moisture. So bringing cold air into your attic does not remove moisture unless there is heat loss from the building. The heat loss warms up the incoming cold air giving it the ability to pick up moisture and carry it to the outside. All of the attic ventilation ratio's – 1 to 300, 1 to 150 were based on little or no insulation. The code now calls for R-60 in attics. There is no effective heat loss from the building into the attic. It gets worse, the relative humidity of the outside air is very high – vapor pressure is low – hygroscopic materials like wood, plywood and OSB "see" relative humidity not vapor pressure. Venting highly insulated roofs in cold climates actually makes them wet. LOL.

You want to have some fun, ask a Canadian about how well the CHIP program worked in the 1980's. Oops…has to be an old Canadian. CHIP was the short form for "Canadian Home Insulation Program" that came out of the first energy crisis. Everyone got a couple of hundred dollars to insulate attics. Guess what? The attics got colder. Stopped the heat from getting into the attic, but not the moisture. Roofs rotted (**Photograph 1** and **Photograph 2**). More oops. To stop the moisture we needed to air seal the attic ceilings. Canadians did it first, and best (**Photograph 3**). Even more oops. Moved the moisture problem to the building underneath because air change in the building was reduced. It sometimes got real bad, caused spillage and backdrafting of combustion appliances and folks died from carbon monoxide poisoning. Had to install sealed combustion or power vented combustion appliances and provide controlled mechanical ventilation.

Photograph 1: Roof Rot – OSB does not come that color when it comes from the factory.

Photograph 2: More Roof Rot – Frost on nails and roof sheathing.

Photograph 3: A Young Guy – Yes, me in 1982 pointing out how to seal attic ceilings.

In hot climates, back in the day, you were not actually venting the roof, you were venting the building under the roof through the roof bringing in outside air to the occupied space and removing inside air up through the attic to the exterior. This worked before we had something called air-conditioning. With air conditioning venting roofs sucked air conditioned air out of the building. The only way to not suck air conditioned air out of the building when venting the roof is to air seal the attic ceiling. Yup, ended up with spillage and backdrafting in the U.S. Civilians had a better understanding than most experts. When they installed attic turbine vents (**Photograph 4**), they found that their air conditioning bill would go up. They had a simple fix (**Photograph 5**).

Photograph 4: Turbine Vents – Typically lead to increased air conditioning bills.

Photograph 5: Civilian Solution – Plastic garbage bag handles the turbine vent problem.

You want to have some fun, ask an American about how well the Weatherization program worked in the 1990's. Oops…has to be an old American. Pretty sure Canada exported the technology to the U.S. to get even for Canada-US Free Trade Agreement. Weatherization folks discovered controlled ventilation and combustion safety.

Even if you air seal the attic ceiling, and you handle combustion safety, and you provide controlled ventilation in the occupied space, venting a roof in a hot-humid and mixed humid climate causes moisture problems because the air outside is humid. Note the "humid" in "hot-humid" and "mixed humid" climate.

Something that should be obvious is not always obvious. Vented roofs blow off more than unvented roofs. Significant air pressure differences act across buildings due to the action of wind. In general building assemblies experience positive wind pressures on the windward side and negative wind pressures on the leeward side. This includes sloping roof assemblies. Attic spaces that are ventilated typically have soffit ventilation. Soffit assemblies are not able to withstand high wind events. When soffit assemblies collapse in high wind events, wind can enter the attic space on the windward side pressurizing the attic space. When this attic positive air pressure is coupled with the negative pressure on the exterior surfaces of the leeward side of the building the air pressure difference across roof sheathing and roof cladding elements such as shingles, tiles, and metal roofing significantly increases. This significant air pressure increase can lead to loss of the roof structure. Roof assemblies that are not vented resist high wind events more effectively than vented roof assemblies because there is less risk of soffit collapse.

As noted earlier, vented roofs burn more than unvented roofs. We were here before (BSI-129: Wildfire). With respect to wildfires the issue is burning embers. Roofs are particularly prone to burn ember exposure – both from the perspective of the roof covering and from the perspective of roof venting.

Entry of burning embers is a concern in urban regions with higher risk of wildfire occurrence. Homes built in regions designated as Urban Wildland Interface Zones are at a high risk for fire exposure. Wildfires burn with speed and intensity that often lead to a high percentage of homes lost in these communities. However, the ignition of homes is typically not caused directly by flames but rather by ignited embers becoming airborne and entering vented roof assemblies. Obviously, unvented roofs do not have this issue.

Also, as noted earlier, vented roofs are energy inefficient compared to unvented roofs. This is particularly the case where ductwork and mechanical systems are located in vented attics. Ductwork leaks and leads to negative air pressures, energy costs and part load moisture problems (**Figure 1**). An unvented conditioned roof solves this problem (**Figure 2**).

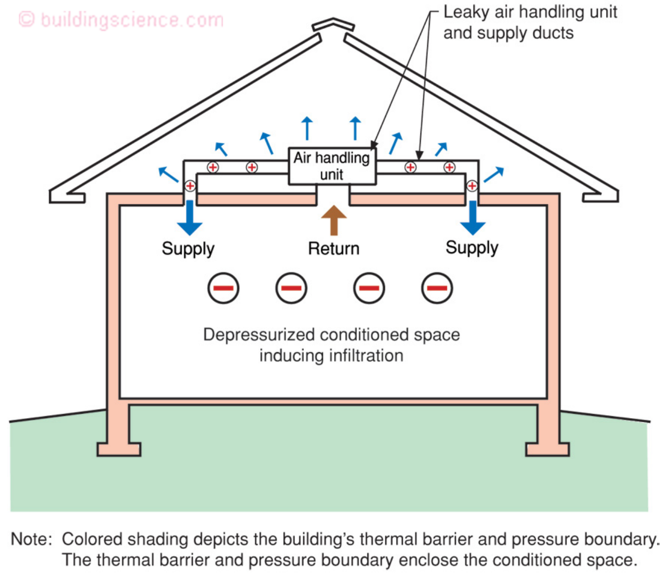

Figure 1: Vented Roofs - Vented roofs are energy inefficient compared to unvented roofs. This is particularly the case where ductwork and mechanical systems are located in vented attics. Ductwork leaks and leads to negative air pressures, energy costs and part load moisture problems.

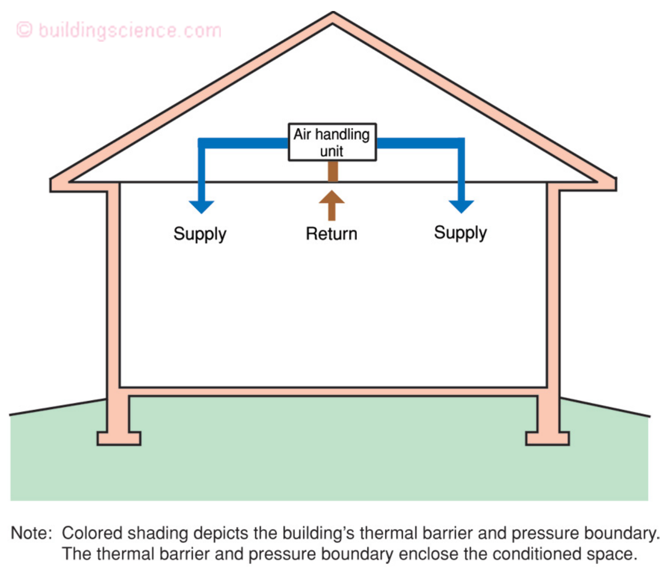

Figure 2: Unvented Roof - An unvented conditioned roof solves the problem of duct leakage and negative pressure.

For decades, one of the arguments for venting roof assemblies is to "prevent shingles from being cooked". This has been discounted in many papers. A good piece of work was done by Rudd in 2005 (Journal of Building Physics, October 2005). Rudd found that "the summertime average daily temperature of roofing materials is nearly unchanged whether vented or unvented, while short-term peak temperature increases are not more than 7 degrees F." It is also obvious that the color of the roofing layer is more significant regarding temperature than venting or not venting.

Now to the "except" part. The only time you should vent a roof is to control ice-damming (**Photograph 6**). We were here before (BSI-046: Dam Ice Dam). Ice dams happen when the outside temperature is below freezing, the roof deck temperature is above freezing and there is snow on the roof. The warm roof deck causes the snow on top of the roof deck to melt and the melt water runs down to the edge of the roof where the water freezes leading to a buildup of ice and a back-up of water – hence the term "dam".

Photograph 6: Classic Ice Dam – Can be prevented and controlled with ventilation.

The strategy to control ice dams is fundamentally straightforward – keep the roof deck below freezing when the outside temperature is below freezing. The best approach – the classic approach - to ice dam control is the vented roof. Keep heat from the interior from getting to the roof deck and then remove any heat that gets there using ventilation. So you want/need a vented roof to control ice-damming. Having said that, I installed the vented roof over the top of an unvented under-roof (**Figure 3**). What about the issue with the entry of burning embers? Operable vents that are closed when a wildfire event occurs.

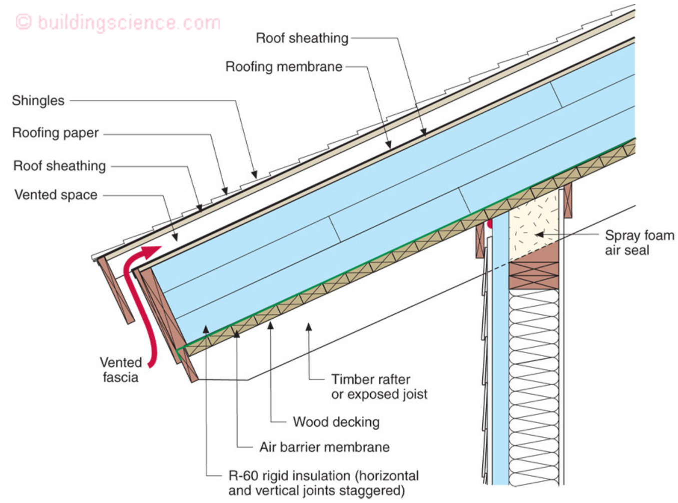

Figure 3: Vented Over Roof Over an Unvented Under Roof Roof - Note that the air intake for the vented "over-roof" is at the facia and that the overhang is insulated compensating for cladding thermal plumes due to incident solar radiation.

Whew! Had to get all of this off my chest. Venting therapy.

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