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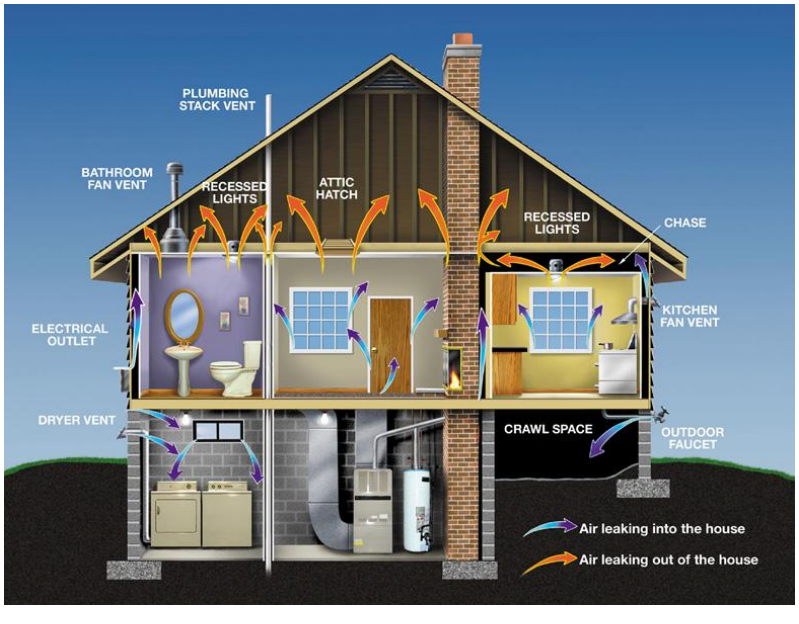
Why keeping air leaks in your home is not a good ventilation strategy

By David Keefe of Vermont Energy Investment Corporation

Why should we spend money to seal up air leaks in the house and then spend more money to install a fan to move air in and out? It seems counter-intuitive. Why not just leave the holes? Isn't it pretty much the same?

There are several reasons why a tight building with mechanical ventilation works better than a leaky building. Mostly it's about control – having the air come and go when and where you want it, rather than when and where it happens to.

With mechanical ventilation, you can choose how much air goes in and out of the building. Random uncontrolled holes don't offer this choice. The air moves according to the weather. When it's windy, you get a lot. When it's really cold, you get a lot. When it's not windy or cold, you get little or none. Notice that this is just about the opposite of what you want. And Mother Nature doesn't know or care about what is going on in the house. We mostly need ventilation for human activity. Ideally, we would have little or none when the house is empty and lots when our activity warrants it. The only way you can do this is to have control of the flow.



Mechanical ventilation allows you to choose where the air comes and goes. We mostly need ventilation where we generate moisture and odors, but that's not where most of the random holes tend to be. One reason this is important is that it is difficult to get rid of moisture and odors once they have spread throughout the house. It's much more effective to remove them from the house when they are more concentrated. That

way you don't need to remove as much air in order to remove the pollutants. So we can get the desired effect without as much heat loss (or in the case of air conditioning, heat gain).

Fans move air in the desired direction. Air going through random uncontrolled holes is going the wrong direction about half of the time. To carry moisture, odors or other pollutants out, the air needs to be going out. To deliver fresh air, the air needs to be coming in. Overall, your chances of success are about 50/50.

With fans, you can turn the flow up. If you have just taken a shower and want to dry out the bathroom, or if there is an odor you wish were elsewhere, a fan can respond to your command. Random holes can't, they just leak according to the weather.

With fans, you can turn the flow down or off. If the weather is severe or you are going on vacation, you might not want as much outside air coming and going. Just turn the fan off. That's easy. You can't seal and unseal random holes whenever you want. That's hard. It's also worth noting that if you want options and flexibility then you want a tight house, because you can always easily make a house temporarily leakier. Just open the windows. You can never easily make a house temporarily tighter.

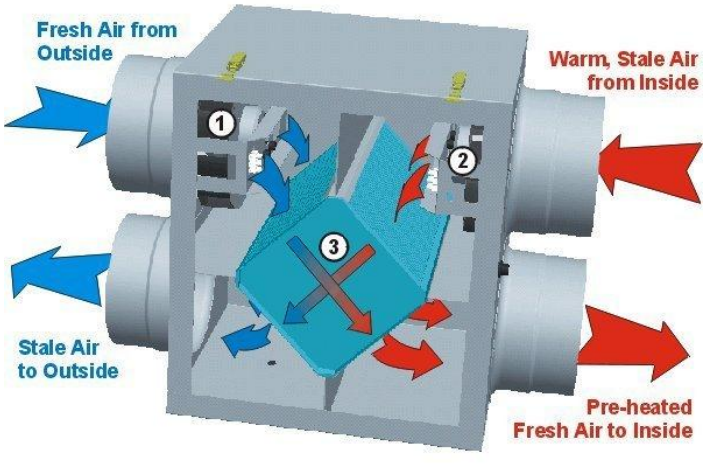
Wind and cold is not as much of a problem in tight houses. Tight houses don't care much about wind, but loose houses are uncomfortable and expensive to heat when it's windy outside. Tight houses don't leak much more when it's cold than they do when it's warm. But leaky houses leak a lot more when it's cold than they do when it's warm. That's because of the "stack" or "chimney" effect. Warm air wants to go out the top, and cold air wants to come in the bottom. The bigger the temperature difference between in and out, the stronger that stack effect is. That's why we have more air leaking through the building when it's cold outside (just when we would prefer to have less air leaking through). Fans aren't affected much by stack effect. They move about the same amount of air regardless of outside temperature.

Tight houses are more comfortable than leaky ones. The main purpose of a house is to keep us comfortable inside when it's cold and miserable outside. The house can't do that if the wind blows through it.

Mechanical ventilation allows control of the air flow path. Air leaking out can cause problems. That air contains moisture from our showering, cooking, and breathing. In cold climates, that moisture can condense on the way out on cold surfaces in the walls or attic and damage the building. With fans, we can control the pathway (a duct) and make sure the air doesn't cause moisture problems on the way out. Air going out through random holes is also a very common cause of ice dams. If we don't allow the warm air to touch the roof, then we don't melt the snow and make ice on the roof.

Air leaking in can also cause problems. If you don't know how and where the air is coming in, then you don't know what it's picking up on the way. If your fresh air comes in through a damp moldy crawl space, is it still fresh air? What if it comes in through the attached garage, or the soil?

A tight house with mechanical ventilation allows humidity control. The outside air in the winter is very dry. That's why many of our leakier houses have problems with static electricity, chapped lips and cracking furniture. If you reduce the amount of outside air coming in, you reduce that drying effect. If you increase the amount of outside air coming in, you dry things out more. It's your choice. But it's only your choice if the holes are sealed and you have a fan. If you can't control the amount of air moving in and out, then you can't control the amount of water vapor coming in and out.



Similarly, if you air condition in the summer, your air conditioner is trying to reduce both the temperature and the humidity of the inside air. Any warm humid air sneaking in makes that job harder (more expensive).

Typically, a tight house with mechanical ventilation either has better air quality, or is cheaper to heat and cool, or both, as compared to a leaky house. For every house and the activity it contains, there is an optimum ventilation rate. With mechanical ventilation, we can match that flow to the task and get the air quality we want without

the cost of excess flow. With random uncontrolled holes, we either get too little flow (worse air quality) or too much flow (expensive to heat and cool). We almost never get the optimum rate, because the flow is determined by the weather. We get the least when we want the most (when it's mild outside and the comfort and economic effect is low) and we get the most when we want the least (when it's cold and windy and the comfort and economic effect is high).

It's Really All About Control

Everyone knows we want fresh air in our houses, but we need to control the air like we control water.

Water is another essential compound that we also want in our homes. We use it every day. We can't live without it. We need a reliable source, and we want it to be clean. And when we're done with it and it's dirty, we want to get rid of it without problems.

But that doesn't mean we want the roof to leak.

If it did, we'd only get water when it's raining. We wouldn't be able to choose how much. Sometimes, we'd get none at all. Sometimes, we'd get way too much. It would damage the building. Bad things might grow.

So we control it. We bring water into the building when we want. We can shut it off. We can get the amount we want where we need it when we need it. We can prevent it from damaging the building. If we want, we can filter it, or heat it. When it's dirty, we can get rid of it effectively.

We should think about our fresh air the same way. Air sealing our homes and adding mechanical ventilation may seem odd at first, but it's really the same strategy we already use for controlling our use of water. Air sealing stops the airflow we don't want. The fans create the airflow we do want. Both elements working together, sealing air leaks and fans, allow us to take control of our indoor air.

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A Comparison of Ventilation Strategies

	Leaky House Without Fans	Tight House With Fans
Ventilation rate	Unknown. Erratic. Varies with weather. Mostly more when you want less, less when you want more.	Measureable. Controllable. Whatever amount you want at the time.
Locations of incoming and outgoing air	Unknown. Uncontrolled. Mostly not where you want.	Wherever you choose.
Direction of flow at specific locations	Wrong about half the time.	Correct all the time.
Ability to increase ventilation temporarily	If it's windy, hot, or cold, yes. Otherwise, no.	Yes, at any time.
Ability to decrease ventilation temporarily	No, never.	Yes, any time.
Ability to control quality of incoming air	Poor.	Good.
Ability to manage indoor humidity	Poor.	Good.
Ability to prevent moisture problems in building cavities	Poor.	Good.
Cold drafts in winter	More.	Less.
Bathroom conditions	Damper. More odor.	Dryer. Less odor.
General comfort	Not as good.	Better.
Heating & cooling costs	More.	Less.

David Keefe, manager of training services for the Vermont Energy Investment Corporation, is a former contractor who provides consulting and training services related to building performance. He has delivered more than 1000 technical training sessions to both professionals and homeowners, including building science, energy codes, home energy ratings, low income weatherization, diagnostic techniques and installation methods.