DIFFERENT TYPES OF VENTILATION SYSTEMS

Because the NZ Building code still allows it, a lot of buildings in NZ are still being built with "natural ventilation" being relied upon to provide adequate fresh air. While this solution may be "acceptable", it is not actually effective, because it is usually based on hopes and wishes rather than proper engineering design. Natural ventilation used to be effective in older houses that were very air-leaky and had vents and little-to-no insulation because the wind would blow through all of the assemblies, but within newer houses that are better insulated and more airtight just opening the windows is not enough. In addition, on the days/nights when ventilation is most required (during cold nights and cold winter days) occupants will want to keep their doors and windows shut to stay warm.

Natural ventilation can be effective, while keeping occupants warm and comfortable year round, but only if it is properly designed and modelled, if it uses systems such as atriums, solar chimneys, double facades, automatically opening windows/vents, and has backup ventilation fans for days when the weather does not cooperate. For an example, google the Manitoba Hydro Building in Winnipeg, Canada. Simply having windows of a certain size that can open (which is "acceptable" to the building code) is not adequate ventilation.

So to provide reliable, effective ventilation year-round (instead of just on the days when the weather cooperates), we must go with some sort of mechanical ventilation to ensure that excess moisture is removed, and adequate fresh air is provided.

There are three main types of mechanical ventilation:

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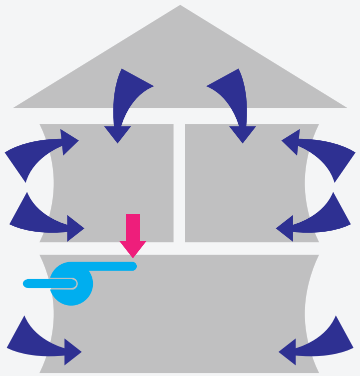

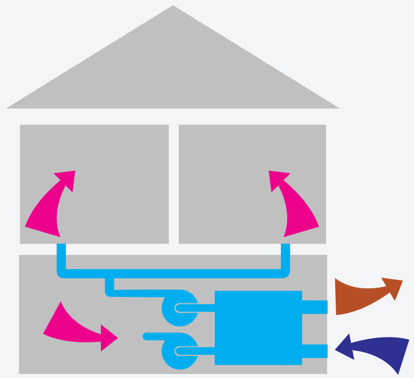

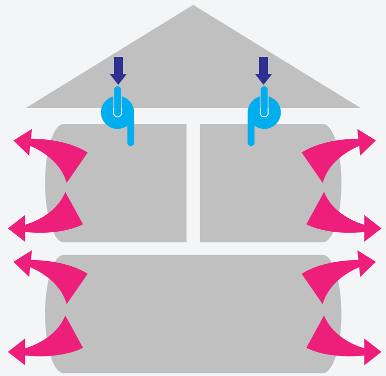

Negative Pressure

It sounds negative, but it's the best type if you're on a budget or in an older house. This system consists of an extract fan (or multiple extract fans) installed in the bathroom(s), and kitchen.

What it does: The fan will constantly extract air from the house at a slow rate and then extract more moisture at high speed when the fan is turned "on" while cooking/showering.
How it controls moisture: it removes moist air from the source (bathroom, kitchen, and laundry) and exhausts it outside through a vent. By removing air from the house, it creates a negative pressure which pulls in air from outside through gaps in windows, doors, wall outlets, and any other small openings.
Pros: Removes moisture from the source. Fresh air is warmed (and therefore relative humidity is reduced) as it is drawn into the house. The cheapest effective option.
Cons: Make-up air comes from unknown sources (doors, windows, gaps), and may not be as clean as it could be. Can reverse the flow of exhaust gases in wood stoves or gas heaters, but this requires powerful exhaust fans and a very airtight envelope.

Price: $100-$300 depending on fan.

Balanced Pressure

This system is just right. It removes moist, stale air from your house, and replaces it with fresh air from outside. Usually it's also paired up with heat recovery, but it only reaches peak efficiency when the house is good and airtight. The system consists of multiple ducts throughout the house, half of which remove air from the house, and the other half of which feed fresh air back in. These ducts run next to each other through a heat exchanger so that the incoming air is being heated by the outgoing air.

What it does: The fan will constantly extract air from the house at a slow rate and replace it with fresh, outdoor air at the same rate.
How it controls moisture: it removes moist air from the source (bathroom, kitchen, and laundry) and exhausts it outside through a vent. The fresh air is brought in through a dedicated vent, heated (and dried) by the outgoing air, and then introduced to the interior to provide fresh, clean, warm air.
Pros: Removes moisture from the source. Fresh air is warmed (and therefore relative humidity is reduced) as it is drawn into the house. Fresh air comes from a known source and can be filtered on the way in, and when paired with an airtight house, this is the highest efficiency system.
Cons: Highest price, and only reaches design efficiency within an airtight building envelope.

Price: $2k - $10k depending on size of house and system

Positive Pressure

The name makes it sound good, but it's the riskiest type. Takes air from outside and forces it into the building. This is the typical cheapest system sold by HRV, DVS, Unovent, Smartvent, Reliance, Etc.

What it does: The fan(s) pull in air from the attic, filter it, and force it into the house when it is at the right temperature (i.e. 8-28 degrees)
How it alleges to control moisture: it forces attic air into the house in the hopes that the extra air (at whatever temperature and relative humidity) will dilute the moist interior air, and then pushes it outside through gaps in windows, doors, wall outlets, and any other small openings.
Pros: It is less expensive than a balanced system.
Cons: it is much more expensive than a negative system. It is based on hopes and dreams rather than scientific/engineering design. Forces moist air from a warmer area (inside) to a colder area (outside), which inherently carries the risk of condensation and moisture damage. Can work in a very air-leaky house if you're lucky, but can cause problems in a newer house. Branz appraisals for this system specifically state that they do not provide adequate ventilation. This strategy is not recommended.

Price: over $2500

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Code Requirements

Code Clause G4 "requires spaces in buildings to be provided with adequate ventilation consistent with their maximum occupancy and intended use... It requires 'products' (such as cooking fumes, moisture, or gases) to be removed for other people's amenity and protection of property. This makes sense, and is an excellent goal/requirement, but the Acceptable Solutions and Verification Methods allow loopholes to be exploited so that systems/methodologies are deemed to comply with the building code, even though there is no proof to show that those deemed to comply solutions actually meet the requirements of the code:

• Within G4/VM1, the code allows for in-ducted mechanical ventilation systems, and the method of verification for "Adequate ventilation" is given by a CIBSE code series, which has since been recalled, and does not have a volume, flow rate, or air change requirement to show compliance.
• This "verification method" does not actually verify compliance, because there is no measurable level or tangible definition of "adequate" to meet.

Within G4/AS1, the code deems that any building that has a net openable area of windows or other openings to the outside of no less than 5% of the floor area is automatically in compliance with the code. There is a requirement for an exhaust fan with a minimum L/s rate of flow within bathrooms and kitchens, which helps, but in practice these fans will only turn on when showering or cooking is taking place.

• This "acceptable solution" does not actually guarantee or verify that the building will be adequately ventilated, as there is no benchmark for ventilation rate, or verification thereof after construction.
• This "acceptable solution" ignores the fact that most people will keep their windows and doors closed during the winter and at night to keep the warmth in. It also ignores the fact that the code does not show specify how open the window has to be (aerodynamic free area), as it just specifies what size the operable portion has to be.
• This "acceptable solution" also relies on the occupant turning their ventilation fan on at the correct times for the correct length of time, which may or may not take place.
• This "acceptable solution also relies on the weather outside cooperating by having the right temperature and wind speed to provide "adequate" ventilation.

What we should actually be working towards?

What is adequate ventilation? The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) states that an outdoor air ventilation rate of 17 cfm (481 L/min) or 8.5L/sec of fresh air is adequate per 5 people in a 100m2 area. This can be easily achieved using a properly-sized fan, but would be impossible to achieve with closed windows.

The key here is designing a system that will actually work, rather than choosing a system that might get through council consent.

What is recommended?

• For a new house/apartment: Build tight and ventilate right with a balanced pressure system. Ensure the air-seals are continuous (especially between adjacent assemblies/systems), and install an appropriately sized balanced-pressure system with heat recovery.

• For an existing house/apartment undergoing a deep retrofit/renovation: same as above. Close all gaps, increase airtightness, and install a balanced pressure ventilation system with heat recovery.

• For an existing house/apartment with condensation issues where budget is an issue: Install an exhaust fan in the bathroom and kitchen that run constantly at a slow, silent speed, which then ramp up to high speed when the switch is turned "on".

• Do not ever use a positive pressure system.

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