Solarcrest
COMPLETE ECO-RETROFIT

MVHR performance gap

As with insulation, heat recovery ventilation can also suffer a gap in performance between 'as designed' and 'as-built'. MVHR systems do not always perform the way they're supposed to. Again, like insulation, the performance gap is due to issues outside the control of the manufacturer. The issues we see regularly make systems noisier, less efficient, impossible to clean and more expensive to run than they should be. They also shorten the life of the motors.

When planning a new property, you first need to demonstrate it will comply with current Building Regulations, particularly part L (conservation of heat and power) and part F (ventilation). These regulations get tightened every couple of years to make new properties more energy efficient. Your property designer must provide SAP calculations before permission is granted to start the build. The Standard Assessment Procedure (SAP) is a methodology introduced by the government to assess and compare the energy and environmental performance of buildings. It's a bit like predicting the EPC for a property that doesn't exist yet.

As one of the most important energy saving technologies, the MVHR features prominently on the SAP assessment, along with airtightness, U-values etc. The MVHR data needed for those calcs comes from the Product Characteristics Database (PCDB), a database set up and managed by the Building Research Establishment (BRE). This impartial former government body tests MVHR units' side-by-side in a laboratory to work out their Specific Fan Power. The SFP is the amount of power or electricity required to move one litre of air in one second, measured in W(l/s). Most modern MVHR units run at less that 1W(l/s) under the right circumstances. Assumptions are made in terms of the amount of air resistance, or static pressure, the ducting adds to the system. More air resistance means more electricity is needed.

In theory, the BRE bench test is a good way to compare the performance of MVHR units. But in practice, many MVHR units use far more electricity than they should do. So much so that BRE felt it was necessary to commission field trials to establish why. Section 3.2 of their report* reveals why there's a performance gap, specifically this table:

MVHR	Air flow rate l/s	System pressure		Specific Fan Power		Approx date of install
		SAP test Pa	Site measured Pa	SAP test W/(l/s)	Site measured W/(l/s)	
Product X[10]	54	150	280	0.80	1.72	2013
Product Y[11]	27	55	85	0.69	1.44	2012
Product Z[12]	27	55	270	0.93	2.70	2013

Fig 1 – laboratory vs. site measured pressure & power

The four numbers highlighted in Fig 1 below tell a story. When the BRE laboratory tests were completed, the ducting connected to their machines had a static pressure of 150 Pascals. With this amount of air resistance, the MVHR unit under test required 0.8W to move a litre of air. However, when this system was tested on site, the amount of air resistance had jumped to 280 Pascals, just under twice the designed air resistance. With this amount of static pressure, the same machine needed 1.72W, just over twice the amount that was predicted.

An additional Watt doesn't sound like much until you consider an MVHR unit could be running at 75W day-to-day. So, if the *actual* fan power doubles the same unit is now running at 150W.

The extra (unnecessary) 75W is 1.8kW over 24 hours, or 657kW over a year, or £100 at 15p/unit. In three years, it's equivalent to a tonne of CO2 emissions.

'Extensive site testing' by the BRE has revealed that high static pressure is having a massive impact on system performance. So why is static pressure higher than it should be? Here's what the BRE say:

The reasons for the significant differences between the tested and measured values were:

- *Undersized ducts for air flow rate.*
- *Excessively long runs and number of bends in primary duct.*
- *Incorrectly sized roof mounted inlet/exhaust terminal.*

In many of the recently investigated cases the design and specification of the duct distribution system has been poor, with installation quality being reasonable and largely in accordance with the design. It is commonly perceived that poor performance has been due to installation quality, but in the observed cases poor system design is more prevalent.

The BRE are quite lenient when it comes to blaming installers, instead they blame designers. In truth, it's the person holding the purse strings who's normally responsible, even if they don't realise it. If the designers brief is to design something for the absolute minimum cost, their hands are tied. Everything will be cheap PVC or steel ducting in a branch configuration. Every 90-degree bend on that system adds turbulence, noise and static pressure. There are no sweeping bends like a radial system. Box ducting is more common because it takes up less room, but a metre of box ducting adds twice as much static pressure as an equivalent circular duct. Branch ducting costs less than radial ducting, but there are hidden running costs, installation costs and boxing-in costs that don't appear on the quote.

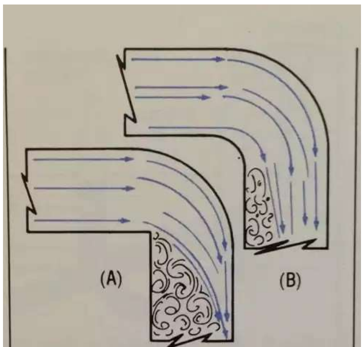

Fig. 3 Effect of elbow throat on turbulence within a duct system. The sharp throat of (A) creates more turbulence than the rounded throat of (B).

If the installer is given cheap materials to work with, they can try their best to make it look tidy, but they can't make a silk purse out of a sow's ear. Semi-rigid radial pipes can sweep around awkward corners, under pinch points, through stud walls, and in and out of metal web joists. Hit any of these obstacles with branch ducting and you can end up with dozens of 90-degree bends, all adding acoustic, air flow and static pressure problems. Compared to a quality radial system, branch ducting takes longer to install, requires more space and can't be cleaned internally when it inevitably gets caked with muck and dust. Cheap ducting is cheap for a reason.

Ultimately, the MVHR performance gap is caused by unnecessary static pressure. A complete system with circular branch ducting typically has almost twice the static pressure of an equivalent radial system by the time it's installed. Box branch ducting has even more. A proper radial design very rarely exceeds 150 Pascals, meaning the MVHR unit works as it should do. While radial ducting material costs are higher, overall the coats are similar when you factor in the hidden costs, including acoustic silencers that are now mandatory for bedrooms and other living spaces. A quality radial system is the way to go, provided there's enough of it, it has a smooth antibacterial lining and the correct insulated ducting is used to connect the MVHR unit to atmosphere. It's even listed separately on the PCDB database meaning it contributes towards your SAP calcs.

* https://www.bre.co.uk/filelibrary/SAP/2016/CONSP-10---Mechanical-Ventilation-System-assumptions---V1_0.pdf