HOUSE PLANNING HELP

Episode 59

What Qualities Should an MVHR System Bring to a Low Energy Building?

The show notes: www.houseplanninghelp.com/59

Intro: We had our Kickstarter documentary, which we successfully funded a few weeks back and there were five corporate sponsors who got on board for that - limited packages. One of those was the Green Building Store so what I thought I'd do is offer the opportunity to each of these companies and we'd dedicate an episode to them. So, we're going to start with the Green Building Store.

You might remember we spoke to Bill Butcher in episode 14 when we took a look at Stirley Farm. Well, Andrew Farr is one of their experts on heat recovery ventilation and I thought he'd be a good person to ask what we should expect from a well-designed system.

I started by asking him for a bit of background and how he came to specialise in this area.

Andrew: Chris Herring at Green Building Store knew of me. We worked together doing jobbing building and all sorts of building; roofing, central heating, wiring of houses et cetera. Before Chris Herring was one of the founders of Green Building Store Company, I had been working, doing fabrication steel work - in fact, multi-material fabrication for some years and I got to the point where I was actually lonely, working alone in a workshop and I very much wanted to be involved in a business with other people.

My background is a mixture of mechanics engineering, building work and also I lived in Germany so I'm a fluent German speaker. I lived in Southern Germany for six years and those various attributes and especially the language made Chris think of me when he was thinking of developing the Mechanical Ventilation Heat Recovery Department of Green Building Store.

Ben: You have mentioned our topic for today which is MVHR. Around the world, I think it's sometimes called Ventilation Heat Recovery. Is that the same thing?

Andrew: People mix up the acronym in all sorts of ways but the normal, and accepted in this country, is Mechanical Ventilation Heat Recovery, MVHR, but I get MHVR, all sorts of mix-ups of the acronym.

Ben: But depending on where someone might be listening in the world, will it be something different for them?

Andrew: Well, if you're living in Germany, it'll be wärmerückgewinnung. Yes, it could be HRV - Heat Recovery Ventilation. You know, there are various other - but the broad idea is that it is ventilating and recovering the heat energy out of the ventilation air.

Ben: What do we need to know about Mechanical Ventilation Heat Recovery? When are we going to need it in the first place?

Andrew: There you touch already on a very complex area. From the point of view of people who are purely interested in energy-efficient buildings, then most people would say that you need to have a building that has an airtightness of three air changes an hour (3 ach) or lower at a fifty Pascal (50 Pa) blower door test. And really, in order to be in straight energy terms, recovering more energy than you're using and also recovering more energy than you're using and covering the cost of servicing, in other words filter changes et cetera, you need to be below one air change an hour (1 ach).

However, that is a really rather simplistic way of looking at it. A building that is not necessarily that airtight and, for example, has several bathrooms which don't have natural ventilation means - in other words, there's no windows - a Mechanical Ventilation Heat Recovery System can be a very pragmatic way of delivering a very good air quality into the building.

It is not a simple, straightforward 'in this house it's right and in that house it's wrong'. It will very much depend on somebody with knowledge, applying that knowledge to help and support the decision making process.

Ben: What is an MVHR system?

Andrew: Ah. Basically, it is a system that delivers fresh air into the house, in other words the air handling unit - that's another acronym: AHU, which is another name for the MVHR unit - the Air Handling Unit or the Mechanical Heat Recovery Device is going to draw air in from outside and then take that air through the heat exchanger and supply it into the clean areas of the building. Clearly in a domestic sense that is usually bedrooms, living rooms, studies et cetera.

Then a completely separate ducting system extracts air out of the fowl air rooms, in other words, toilets, bathrooms, kitchens et cetera where there is a pollution load being put in. That is then drawn out through the ducting system, through the other side of the heat exchanger and exhausted out of the building. So what you have is a balanced ventilation system. You're supplying exactly the same quantity of air into the building as you are extracting out of it.

Ben: I'm prepared to get a difficult answer here but what are the differences between one person installing a system and another person? What qualities will affect having a different system?

Andrew: I'm going to flip that question around because really, there is a relatively short history but it's a history that is getting a very contentious reputation in this country. There has been, in the last five, eight years, a move towards delivering MVHR systems into the mainstream building industry. This has been characterised by the criteria that have been set out by building regulations and Code for Sustainable Homes. Those criteria are primarily intended to create energy efficiency. However, if you're building a domestic building that is to be lived in, the primary criteria should be comfort and by that I mean, that when you walk in the front door of the house, what you have is a good and clean atmosphere in terms of air quality and that the ventilation system is not the first thing you notice when you walk in, nor the last thing that you notice when you're going to sleep. And by that, basically I'm referring to the problems of Mechanical Ventilation Heat Recovery Systems being too noisy and this has been a very common occurrence. And this is due to poor design.

Ben: We're at this stage of design now and I understand that a lot of this will be carried out by a designer, that's fine. But maybe we can dig into it to a degree. So what would we need to know if we're starting out and looking at houses - probably different examples, isn't it? - About designing an MVHR system?

Andrew: Clearly, what you're trying to do is to design a Mechanical Ventilation Heat Recovery System that does not impact on that consciousness of the people who are living in that building. So the main criteria you are looking for is an extremely quiet - in actual fact, to all intents and purposes, inaudible in normal, every day activity - ventilation system. And then, of course, that it needs to be delivering the right amount of air and actually, that is not too much and not too little as Goldilocks and the porridge version of ventilation would say, and that's actually a reference to a talk a friend of mine gave on exactly the subject. So that you're delivering

exactly the right amount of air into the building because if you over ventilate then you will tend to dehumidify in winter and also use excess energy. If you under ventilate then quite obviously, odours and humidity will remain in the building more that you wish.

You asked me what the criteria are and what I answered was: "What are the qualities you're looking for?" and so the criteria for designing a ventilation system, it's arguable - and again, the measurement of sound is extremely difficult - but you should be designing to below 24 dBA - that's a measure of - it's decibels.

Ben: Is this the noise the system will make?

Andrew: Yeah.

Ben: So that's what I want it below?

Andrew: When you start measuring noise, you measure different frequencies and dBA is a way of balancing out the audibility between different frequencies of sound. That's probably not a very exact description of dBA but it is commonly what you'll see as a measurement. Now into a habitable space in the house - so that would be studies, living rooms, bedrooms - you should be delivering the air in at less than 24 dBA. A human threshold of hearing is somewhere around 24 to 27 dBA, so effectively you're below that and I should also qualify that probably and say at one metre to air valve. So that you would measure that at more than one metre away from the air valve.

Then in plant space, you would - well, basically where the MVHR unit itself is situated needs to be considered with the amount of noise that the ventilation unit is going to create. So for example, I would not normally put a ventilation unit in close proximity to bedrooms because bedrooms are the place where you would like it to be the most quiet. Another example is that, alright, people are used to in kitchens and especially in bathrooms - you go into a bathroom, pull on the light, intermittent extract starts up - and associated that with a lot of noise. If there is a little bit of extract noise in a bathroom, nobody ever worries about it. Ideally it would be no noise. Sometimes there's a little bit of noise associated with extract but that isn't a worry to people.

Ben: We have a Mechanical Ventilation with Heat Recovery system in front of us. Will we, as clients, be the people who have to make the decision of which unit we buy or is this something that's likely to be suggested by our designer?

Andrew: The problem is, who is designing the ventilation systems? At the moment, most people who are - and I'm going to put this in inverted commas - 'designing ventilation systems', are the people who are interested in selling ventilation units, so that they will primarily design with the units and specify the units that they're trying to sell. Now, I hold me hands up, we are the same. Green Building Store has the franchise for selling PAUL - that's the German company - PAUL Ventilation Units and the reason why we have that relationship with PAUL is because PAUL units are some of the very best on the market. But I would say that, wouldn't I! [Andrew and Ben laugh.] But I can qualify that as well.

The reason why PAUL Ventilation Units are very good is due to the fact that they are very well manufactured. Out from the ventilation unit itself, they emit a relatively low level of noise compared with some. The noise that they do emit tends to be in lower frequencies which don't travel as well through walls and especially, they have an EBM-Papst electronically commuted fan which has a constant volume function so that they constantly manage to deliver exactly the amount of air that we set them up to delivery at commissioning. This is extremely important because during the year cycle of a ventilation unit, there are various things that happen that changes the resistance to the air moving through the ducting systems. For example, in winter when the outside air temperatures drop, the heat exchanger will go into condensing mode because it is drawing warm, humid air out of the building and as it cools, it will go past dew point and as it goes past dew point, clearly condensation will fall out and that is then taken from the MVHR unit to drain. There's a condensation outlet from any MVHR unit. And so when the heat exchanger goes into condensing mode, the resistance to the air moving through the heat exchanger changes and if - because we effectively have two ducting systems, the intact supply is one ducting system, the extract exhaust is another ducting system. The only place that those air streams meet is in the heat exchanger. And they never cross. All they do is go on the opposite side of the panels in the heat exchanger. And so if the heat exchanger on the extract exhaust side goes into condensation mode, there's lots of little droplets of water forming. That forms resistance to the air moving and so the balance of the two air streams would change. The constant volume flow fans automatically adjust for this and maintain exactly the same amounts of air going through both sides of the heat exchanger. This then directly equates to maintaining the heat recovery efficiency of the ventilation unit.

Probably the last thing I'll say on this now is that the other major influence is the filters on the ventilation system. You have a filter on the intake prior to the heat exchanger that protects the heat exchanger from the very fine debris that can be drawn in, in the air stream and you also have a filter on the extract prior to the heat exchanger. These filters will get dirty at different rates depending on what the pollution load is, whether - and surprisingly actually - on average, they pollute at relatively the same rate but on any given ventilation system, you might well find that due to being maybe situated close to a main road and there's high levels of carbon particulates, that the carbon particulates will block up the very fine filters and so the intake filter will get dirty quicker than the extract filter. And then the fans will maintain a balance between these because they will increase the effort in order to maintain the same volumes of air.

Ben: What is the range of efficiencies that we would expect across varying different Mechanical Ventilation with Heat Recovery units? Or are they all quite high these days?

Andrew: There's quite a lot in that question. When you look at modern units, they are very similar in their tested performance. There is a very real difference between the tested performance - and that will be as they are certificated - and the embedded in building performance. For two main reasons. One of which is what I was just previously explaining, to do with the importance of maintaining the balance between the two air flows and then secondly, that a Mechanical Ventilation Heat Recovery system comprises of many parts. The heat recovery unit itself, the box on the wall which is what people tend to focus on, is only one small part of the entire system. The ducting associated with the MVHR system is of extreme importance to the good functioning in various different ways. Obviously, if the resistance to the air moving through the ducting system is high, then the fans will have to exert a lot of effort in order to move the air and that will cost, use more electrical energy. And also, and importantly, because they are exerting more energy, more effort, that they will necessarily be making more noise. That noise transfers into break-out noise from the ventilation unit itself, potentially break-out noise from ducting and then in-duct noise which needs to be attenuated or silenced - silencers put in place to remove. And so all of these things have an impact on how the system will perform. So just to take a step back, the energy efficiency of the system is the efficiency of the whole system, not just the MVHR unit but the ducting and everything associated with it.

Ben: What considerations do we have to think about when we're looking at the ducting side of this?

Andrew: The most important thing when considering what type of ducting to use is which type of ducting will allow the air to move through most easily. That necessarily means that round ducting is the most efficient because the surface area to volume of air has the best ratio. In other words, the surface area is smaller compared with the volume of air. I mean, if you consider that in the opposite direction and say we're going to take a rectangular duct that is two millimetres high and two meters wide, the surface area to internal volume is very, very high and you will have to use a lot of energy to push the air through it.

Clearly there are a variety of different shapes of ducting. Most people are familiar with the flat channel plastic ducting of forty five by a hundred or sixty by two twenty, common plastic ducting dimensions. The plastic ducting is something I actually really would not use for multiple of reasons. One of which is that being rectangular, the means by which it is usually sealed is by using duct tape. Tapes fail. It is not sealed by design whereas a product like the Safe Seal Systems that you have with spiral galvanised metal ducting are sealed by design, not by the addition of mastics and tapes.

There are other forms of ducting such as what's known as either octopus or semi flexible or semi rigid ductings and these are now coming in a variety of dimensions, the most common of which is a seventy five millimetre OD - that's outside diameter - which has an internal diameter of sixty three millimetres. Now, this ducting is one of the things that is actually, I think, is going to create another problem within the industry and it's because people are not realising how much resistance to air movement it has. It's very quick and easy to fit and with proper design, can be a very good product. For example, if you're going to move the same amount of air as you would move with a single hundred millimetre round duct, you will need somewhere between two-and-a-half and three, sixty three mil. internal diameter semi flexible duct. Did that make sense?

Ben: Everything up until the very last …

Andrew: Okay. If I have a round duct which is a hundred millimetre round, spiral wound, galvanised steel duct, in order to move the same amount of air, I would need three of the seventy five millimetre semi

rigid, semi flexible ducts in order to move that same amount of air at the same resistance to that air moving.

Ben: Increased quantity that is unnecessary?

Andrew: Yeah, well it's not just that it's unnecessary. I mean, the reason why people like to use the semi rigid ducting is because it can be threaded through a building after all the floor joists are in place. For example, when we're designing - and we do primarily design with galvanised spiral ducting - there will be some ducts that we will actually have put in place at the point when the floor joists are being laid because clearly, if you have a three metre rigid length of a hundred and twenty millimetre diameter duct, you cannot then put it through the gaps, through holes in the joists unless you first of all put certain joists in then thread it through. Most modern buildings these days are using either I-Beams or Posi joists - the Posi joists having holes already through them, the I-Beams allowing you to cut a larger size hole through the joist without losing structural strength.

Ben: Are we always looking to design a system so it's as simple as possible? Because if you use more ducting then that's not going to be productive particularly, so just keep the duct runs short - what else do we need to consider?

Andrew: No. What you need to do is to design a ducting system properly using the correct criteria. The correct criteria for designing a ducting system are pressure loss - in other words, what the resistance to the air moving through - and the amount of sound associated with it and attenuation - in other words, silencing on the ducting system.

It is very often that especially on a larger house, we will deliberately design extra duct length on air valves that are close to the ventilation unit in order to increase the resistance to the air to those air valves that are close to the ventilation unit so that they don't get too much pressure on them because if they have too much pressure, they will hiss.

It is very, very important to think that design of your ducting system is of paramount importance in order to deliver a ducting system that you will want to live with. If it is not designed properly and especially on larger houses, you will have problems with some air valves being very noisy because they've got too much pressure on them and in other rooms, not getting sufficient air out of them. I say this very often and I don't think I can say it often enough and loud enough, and that is, being very crude: you say a hundred and fifty square meter house, if you were to duct that all in flat channel

plastic ducting and bits of flexible ducting and all those kind of things that I really don't like, then you would probably pay somewhere around £600 maybe - maybe even a bit less in ducting and air valves. With the systems we design on a similar size house, we would probably end up with a cost of somewhere between £1600 - £2200. Now, this sounds like a massive difference, however if you think that a year later after you've finished your wonderful new house and you realise that the ducting system is not fit for purpose, replacing that ducting system will cost you many tens of thousands of pounds. By saving yourself a thousand pounds at the point of delivery - and that is purely on product cost, that is not taking into account the labour involved in fitting - you will effectively lay yourself open to regretting it for many years after.

Ben: We're getting close to our time now but I wanted your advice on selecting people who really know what they're doing or is everyone just going to push their products?

Andrew: Well it's one of these things. At the moment, there are a few companies who I trust or who are endeavouring to try and do the right thing. There are many companies out there that I have real concerns about the way things are being delivered. Over the past couple of years, the industry has realised that they need to up their game. There are many more people that are now talking the talk. Whether they are actually delivering is another matter.

I was on site just earlier this week and yes, it was a system that was delivered eighteen months ago. Speaking plainly, it was shocking because there was flexible ducting that had been crushed so that nearly no air could move through it and this was meant to be a high spec delivery.

I think that you will find in the next few years that the quality of delivery will go up. That is not difficult because the quality of delivery that has been delivered in this country over the past few years has been so bad that it can't really get any worse. But there are more people who are now starting to understand what the real criteria for MVHR design in domestic buildings is. Again, it's being trite but characterising the industry, what we had up until now is on the one side, commercial mechanical and electrical installers who are very well learnt, very experienced companies who have been doing a certain amount of the domestic MVHR installation but they have been bringing with them their knowledge from commercial spaces and so, for example, the requirements on sound are not the same. In an everyday life, you probably won't notice a bit of fan

noise going through into room because you're busy, there's computers on, you're talking to people. You won't even notice it.

The best analogy I can use is, when you're at home and you're working on your desktop PC and it gets to be nine, ten o'clock at night and you finally get to the point where you turn it off and you realise there's that wonderful prevailing silence that has ensued. And all that is, is the fan that's running on your PC. And the hard drives and stuff, I know as well. But it's that constant background noise that when you turn it off, you realise what a blissful peace follows. Now, an MVHR system should be giving you that blissful peace all the time despite the fact that it's running and if it's not, then it's not designed to quality.

Ben: And that sounds like a very good point to finish it all. Andrew, thank you very much.

Andrew: A pleasure.