Episode 20

An Introduction to Ventilation in The Home

The show notes: www.houseplanninghelp.com/20

Ben: How did you get into construction?

Andy: Well, I think I had the usual interest in architecture coming from, you know, I was quite artistic, I was quite practical, I liked science and everybody said: “Go and do architecture!” [Andy laughs.] Like a good boy I went and did my architecture, got a bit frustrated doing that and I think that was a lack of practical content so when I came out of architecture college I was looking for opportunities to do some building work. I started working with an engineer, Chris Wallace, son of Barnes Wallace, and we got into all sorts of interesting constructions, stonework, timber frame construction, repairing windmills, that sort of thing.

So the combination of the architecture college plus this interest in materials and engineering, that really did it for me, I think, so I’ve become very passionate about all of those things ever since.

Ben: At what stage did you realise you wanted to go down this sustainable route and concentrating all of your work and your practice on that?

Andy: I don’t know where it started, really - reading lots of science fiction, thinking other worlds were possible. I just kind of naturally developed. I always loved nature, living in the countryside and you just start putting one thing together with another thing and you just start to develop a bit of an understanding with ecology. Making things and designing things is part of a bigger ecology. Meeting similar people, which is probably fairly random, but certainly Christopher Wallace was a very interesting man to work for and I think he was probably responsible.

The other thing that was responsible for it was going to the Centre for Alternative Technology very early on, when I was about 12, because Chris Wallace used to do some courses there. So being exposed to that was a big push in the right direction, I think.

Ben: And we should also mention that you are the part time Chief Executive of the AECB, so that's quite a big thing, too. What do the AECB do for anyone who's unfamiliar with the organisation?

Andy: Well, it's a network of people. It was set up by a builder and his wife in 1989, I think it was, with an interest in pretty much what we're talking about, doing things with an awareness of ecology and the environment. It grew from that point and it's got a very broad mix of people involved in the network, who join and become members. We've spent, certainly the last few years, trying to create platforms for better, more fruitful conversations within the network, so the low energy buildings database, the technical discussion forums, the annual conference, local groups is a new development and so on.

It's a very vibrant group of people, about 1500 member organisation now, having a lot of very interesting conversations and sharing their practical experience and expertise with each other. So it's a very fast way of learning, getting to grips with things and improving your business as well.

Ben: Well, I'm one of the members, too, and I find it fascinating and there's so much good knowledge inside there but we'll put a link to the website so that if you want to go and find out some more you can do that.

Ventilation then. Let's have a start on this because I wanted to devote an episode to finding out a bit more, and I suppose it changes according to what your building is, so let's start with that basic question, what is ventilation?

Andy: Well, why don't we start with the International Space Station. It's up there, it's a sealed unit. It's not completely airtight, I believe. Nevertheless they need air to breathe, they need a way of flushing away pollutants, carbon dioxide, other gases and so on, created by equipment or whatever. So if you then bring that down to earth and turn it into a traditional British building, say, then how do you do that, how do you breathe and how do you flush away the pollutants that we create from stuff we put in our houses but also our activities.

Well, traditionally we'd just let the wind blow through. Okay. Early buildings were obviously very well ventilated, although some stone buildings and brick buildings with solid floors could actually be pretty airtight.

Now over the years people have made slight improvements, found new ways of building, many of which in the 60s, 70s and 80s are actually potentially leakier and more open to the elements than some of the older buildings. So, over time people have done certain measures. They've done a bit of draught proofing and so on, which may well be creating some quite unhealthy environments.

Ben: This is if we have our building and we haven't really ventilated it and we're blocking up all the draughts, that could lead to a bad environment inside, so how do we avoid that though as we start to take away some of those draughts, what ventilation options do we have?

Andy: Well, you can either over ventilate or under ventilate . . .

Ben: Can you explain those terms?

Andy: Yes, I can. Over ventilating might mean that you open all the windows because you've built up a bit of a fug and you just want some fresh air. Nothing wrong with opening the windows but it's in the middle of winter then obviously you're getting cold and you're wasting a lot of energy.

If you under ventilate, it might be that it's cold outside, but you've still got your house full of off-gassing carpets and whatever, you're cooking, you've got the gas ring on and so on, but you've shut all the windows and put all the draught proofing, and you sort-of little snakes against the cracks under the door, so you're under ventilating.

They're both extremes. Now, if we just concentrate on the heating season when most heat is lost, either through what is escaping through the windows or through the walls, but also through ventilation because you've expensively heated the air up in your house and you open a window or you just let the draughts blow through and it carries that heat out and you've got to reheat that air.

So, given that over ventilation or under ventilation in the heating season is not necessarily a very effective way of ventilating a house and getting good air quality, we have to take control of the situation, really. What does taking control of ventilation look like?

Our approach now is to recommend a mechanical system of some sort or another. We're talking retrofit here. So again, for use within the cold seasons we would either recommend an extract-only ventilation system, which I'll explain in a minute or a potentially

more complicated system, which is mechanical ventilation with heat recovery.

So the extract-only system basically extracts air from wet rooms, kitchens, bathrooms and so on, and then the fresh air comes in via slots in the windows, trickle vents.

Ben: These are slots that you have decided to put there or just they're gaps?

Andy: No, they're slots that come with the windows. So say for example we're retrofitting a house and we're actually replacing the windows, or we might be leaving some windows in that already have trickle vents. You would specify: "Trickle vents, please, in my windows." That provides a background level of fresh air coming into your house but with the extract ventilation system, which is basically a box with a fan in it, say sitting in your loft, you are pulling air through continuously at a very low level, providing a consistent background level of fresh air, which can deal with peaks.

If you do do some cooking and so on, then that's a peak. You know, you've got your gas ring on, you've got steam coming off your saucepans and so on, now that's a peak load but it can be dealt with with this background ventilation. You don't necessarily have to turn the fan up.

Ben: Do you feel the air flow around for something like that? If it's just extracting the air, it must be moving the air somehow.

Andy: Now, that's a good question. So if you imagine your extract-only system is just pulling the air through the windows, obviously that air is coming in. If it's a cold winter's day outside, you might feel that as a cold draught if you're sitting near the window.

Again you would want to have your radiator, as is normally the case, positioned underneath the window so as the cold air comes in it falls down and to some extent warms up.

In Scandinavia there's a good approach, which is to actually put an air inlet through the wall, maybe behind the radiator, so as you pull in air from outside it comes and warms itself on the radiator and comes in and doesn't feel like chilled air. So that's quite a good arrangement. If you're moving to mechanical ventilation with heat recovery you are both extracting the air from the kitchens and bathrooms but you're also putting it back in via ducts and air terminals in the rooms, so it's a balanced system.

Ben: But that's fresh air that you're putting back?

Andy: That is fresh air, that's right. Although you take the heat out of the outgoing air and put it back into the incoming air, the air itself doesn't mix. The heat is transferred as the air crosses through a matrix, plastic honeycomb affair for example. Just the heat is transferred. Certainly there's no mixing of air.

Ben: So, is ventilation really quite closely connected with air tightness? Because the different options each have a corresponding relevance, don't they?

Andy: Yes, yes. Conventionally, up until this point, ventilation air and air leakage, the sort of air that just finds its way in through all the cracks and gaps and holes in the building, was pretty much the same thing, but as we're talking about low energy retrofits then we are separating these two issues out so we are aiming to make the building structure very air tight or as air tight as we can afford to make it and we are then creating and designing a system specifically for ventilation to give you good quality air without losing too much heat in the process of ventilating.

Ben: At what stage do you start thinking about ventilation?

Andy: You should think about it right at the beginning. If you're approaching a retrofit, you should really give a lot of thought to the strategies. One of the things that we're going to be working on this year is an AECB retrofit guidance programme, doing a lot of research into that to see where guidance is needed and how do we do that in a plain English way. Certainly ventilation is a very important area but right at the beginning of a project, think about the sort of building you've got, talk to as many people, maybe using the AECB forums, for example, about the sort of building you've got and whether you are likely to be able to make that very air tight, not bad, or really it's going to be very, very difficult.

Take a view on that. Don't be overly ambitious and then think about what sort of ventilation strategy will fit with that. So, for example, if you live in a 1970s, 1980s built building, which can be quite difficult to make air tight, you might think seriously about extract-only, whereas if you live in a solid walled property with solid floors, potentially that could be pretty easy to make air tight and you might then start considering mechanical ventilation with heat recovery, assuming you're doing all the other measures, insulation and so on.

Ben: What are the physical components of these systems? How much space do we need and where would they go?

Andy: Well, the one that we've got here is quite large because it was one of the early models from the Green Building Store. Now, the models they're selling now are slightly smaller. I haven't showed you yet but basically there's a cupboard next door there with a large polystyrene box. There are two low voltage fans, low wattage fans, one for extracting air from the house and one for pulling air into the house.

The largest part of the box is the heat exchanger, so as I described, that's a big plastic honeycomb with a separating thing down the middle. So the old stale air from the wet rooms, warm, comes past that, the cold air from the outside goes up the other half of it and the heat is exchanged.

It does take up a fair amount of space, but then the larger the unit, the more efficient because the more space air has to move through, the less work the fans have to do, so very small units tend to be much less efficient than these Passivhaus certified units.

Ben: So from an energy perspective, does it have to be airtight? There's not much point having mechanical ventilation with heat recovery unless the building is airtight?

Andy: We generally recommend that if you can get an air change rate for the house of 1.5 air changes per hour then a heat recovery system is efficient enough to warrant the investment in electrical energy. If we're looking just at the extract-only system where you're sucking air in through window vents then an air change rate of 3 would be acceptable.

It's very hard to plan for the air change rate when you're deciding what sort of ventilation system to have. You might choose, we will go for a mechanical ventilation system with heat recovery and we will get a certain air tightness level, but of course, until you actually test the house and you've done the work, you might actually be surprised that you have not done as well as you had hoped. [Andy laughs.] It's a difficult one.

Ben: So maybe we can talk about the ventilation system here. We're in Grove Cottage, which is your house, and we're sitting in a very nice climate here so what's the air tightness of this house?

Andy: We got it down to 1, 1 air change per hour, so that just about hit the Passivhaus refurbishment target which is called EnerPHit. I've subsequently found out where some of the remaining air leaks are so [Andy laughs] it may well be improving over time. That's well within the 1.5 where heat recovery ventilation is justifiable.

Ben: Maybe you could explain a little bit about the air leaks that you were saying? When you've got this ventilation that's naturally coming into the house, that's one thing but how do you stop an air leak?

Andy: You plaster over it – you need a strategy. What you don't want to end up doing is having to deal with endless little air leaks when you've got the air pressure tester on site, he's opened up your door, he's put a fan over the door and you've got lots of little mini howling gales to deal with. You need a proper strategy right at the beginning.

In a way we took an easy route on this house. It's a solid brick house, the brickwork was of no particular architectural quality, it's painted white, so we put all of our insulation on the outside. As part of that we said: "Let's treat the outside face of the brickwork of the old house as our air tightness plane." And we took a red pen on the drawings and followed it all around, where the weak points were, so what happens when the outside surface of that wall meets the rafters, what happens when it comes round to the gable end, what happens when it comes down to the ground and meets the basement.

Just by following that pen around the drawings or a diagram of the house, you can think ahead about what to do. So, for example, where the brickwork met the roof membrane, which is basically the plastic sheet we laid over the top of the rafters, we had decided to go down to Wickes, buy some bitumen tape, normally used for flashing and we sealed the brickwork to the membrane all along the junction that we'd imagined in our minds. That has proved to be very successful.

So a very clear strategy. Don't leave it until the last minute and make everybody think about it.

Ben: What were some of the key challenges that you faced? Not necessarily for ventilation, but if there is a connection . . .

Andy: Key challenges – funding it! [Andy and Ben laugh.] I think the key challenge is just, I mean I took time out of my practice. Well, we did it within the practice. The AECB actually let me take a little bit of

time out, because we were using it as a learning opportunity for thinking ahead, how the AECB was going to help advise on retrofit. It's that early stage thinking because houses are very different. I mean there are some generic types, you know, solid brick, solid stone, cavity wall and so on, but actually Britain has got a lot more types than current guidance covers.

So, really it's just that early stage, having enough time to think things through at a detailed level, which stops all sorts of problems arising on site and ultimately a poor result at the end of the job. So, yeah, it's just finding that time or paying somebody to advise you at an early stage. It's very hard to sell those sort of services to people because they want to spend several thousand pounds on the measures and if you're offering a service that might amount to several thousand pounds, you could actually save them a lot of money. It's very hard to justify.

At this point in time, Germany has generally got it better with its subsidies and its strategies than this country but I guess we'll probably have to get there over the next few years.

Ben: Well, you've created yourself a house that's very comfortable and fit for the future so that's an exciting prospect. A question that's just popped into my mind about managing ventilation, so you have this system in your house, what do you need to do on a weekly, monthly, yearly, perhaps you don't even need to do anything, but as a user, it's all been done for you, now you've got your system, is there anything else that as a client we need to bear in mind?

Andy: No, that's a good question. You have to remember that I'm very interested in this so I poke about a bit unnecessarily [Andy laughs] checking how things are working and so on. So if I think of what I'd have to do as a bear minimum.

The unit is in the other room. It's behind that wall there. It's on an outside wall where it sucks air in from the roof and then it expels air through that wall there. So it's humming away all the time. Now we do tend to leave it on in the summer. We leave it on continuously. It's partly because we're in a city and it's nice to bring in the cooler air at night in a heat wave, for example, without having to listen to people outside staggering back from the pub. I'm not saying I stagger back from the pub myself sometimes! So generally the system is running away, very low wattage fans, running away consistently, providing fresh air. There's a control unit, which has been programmed to give us a small boost in ventilation at certain points of the day.

So, if you imagine a background rate of ventilation is being provided through these, you can see here up on the wall, that supplies fresh air, which has been slightly warmed, it's not a heating system but it's been slightly warmed by the energy that's been taken out of the out-going air. So the air that's coming in is about 21 degrees, generally, throughout the heating season.

So, it's running away in the background, providing fresh air, slightly warmed fresh air. Sometimes the fans go up to a higher speed, so I've set it, for example, around dinnertime, lunchtimes, it just ups because we're cooking.

To some extent you can just forget about that. Every now and again the light comes on in that unit and it says change the filters, so I will go in, open the cupboard doors, open the cover, take out these cardboard and fleece filters and put some new ones in, so that's one level.

Quite often I will adjust the fan settings myself, just as I pass the control panel. I'll go, oh there's some people in the house, we're having a bit of a get together I'll just put it up a level, turn it on to a slightly higher setting. Sometimes I will say it doesn't need to be on the higher setting and turn it down, so I've just got it into a habit now.

It's not really very onerous. It's pretty simple, but if you had that unit up in the loft or in somewhere very awkward and some jobs are fairly awkward places, it's a bit of a pain. If you don't design the cupboard around it, maybe there's a panel screwed over the unit, for example, then every time you want to change the filter you'd have to unscrew it.

So I just say to people, make sure it goes in the right place, it's very accessible, it's away from quiet areas because once you've built a house like this, you've retrofitted with triple glazing, external insulation, it makes the house a lot quieter. You do hear noises because it's such a quiet house. The fridge is the noisiest thing in this house now!

But I would still recommend that ventilation systems go well away from sleeping areas, just because there is a slight hum and in a quiet house you don't want to be annoyed by that.

Ben: It's a very constant temperature in here, so how do we not feel the flow of the air coming in?

Andy: Yeah, that's a good question. Well, it's very important when these systems are put in that they are commissioned properly. They are balanced properly. There's a number of reasons for that, but in terms of comfort you don't want a room that is over ventilated because you will then start to notice maybe a sense of a draught.

This particular terminal in the wall here is in fact the wrong one. I do intend to change it to one that directs the flow of fresh air – it's quite slow – we don't need a howling gale so it's quite a low delivery rate but it should really be throwing it against the ceiling, across there, so it falls down. At the moment it's actually a ceiling terminal so I've got the wrong one in there.

I don't know if you can . . . Possibly you might notice that there is, do you get a sense of air movement from here or not?

Ben: No, no.

Andy: I've become very sensitive to this.

Ben: I've heard about this before, actually. You almost sense the microclimate?

Andy: Yes, I think that's probably true, actually. I mean, I feel a bit soft sometimes. It is a very warm house. It's a consistently warm house. If you do leave the door open a crack or somebody does leave the door open in winter, you know from somewhere in the house that somebody's left the door open, because you become quite attuned to it.

It's a very calm environment, very comfortable environment and yes, you do become attuned to subtleties, I suppose. But it's partly because I'm learning. I've got a professional interest in this so maybe other people won't be so . . . [Andy laughs.]

Ben: Is there any other question that I should be asking. I've tried to think of all the various approaches that as a client, I might need to know but yeah, is there a gaping hole that you think, well you've missed this?

Andy: I think if you're talking specifically about ventilation there are a number of kind of things that people are doing to their homes, which might not be the best thing to do. An example might be, a lot of people around here are putting in wood stoves which, leaving aside the combustion products and air pollution, I don't want to

annoy any of my neighbours [Andy laughs] but if you put a wood stove in and don't put in an external air supply vent in for the wood stove, in effect when your burning your wood, you're sucking air in, you're increasing discomfort because you're pulling in cold air up through your basement, through you floorboards or through the cracks and the gaps, and you're creating cold draughts, which are then moving across the house, when you're actually trying to put the wood stove in to become more comfortable. That's a way of thinking about, holistically about, the measures that you're taking.

I think heat recovery ventilation systems for retrofit are going to be a small niche. I think we really need to get a handle on ventilation because air quality is very important. Now air quality is not just about how you move fresh air through a building. It's also about things like, are you putting in measures that might create black mould risk? The risks of black mould growing in cavities behind internal wall insulation because the black mould spores have associated with various health issues, asthma and so on.

So it's not just about ventilation but ventilation is very, very important and think we need to start thinking about it in a less confused manner. The thing that we probably most need to look at is extract-only ventilation. I think that that's an underused and it should have quite a strong role within retrofit.

Ben: Well, we've had some fantastic information today, so Andy can I thank you very much and we really appreciated that.

Andy: Okay. Pleasure.