HOUSE PLANNING HELP

Episode 44

Avoiding the Risks of Poor Ventilation

The show notes: www.houseplanninghelp.com/44

Intro: Mark Siddall trained as an architectural technologist before going on to be an architect. He's really interested in Passivhaus, too, and loves all the detailing.

What I like about Mark is how he gets involved in the research side as well. He runs LEAP which is an acronym for Low Energy Architectural Practice and in this session we're going to focus on the causes of poor ventilation and how to avoid them but I started by asking Mark why we might be worried about poor ventilation.

Mark: Well, poor ventilation can lead to poor well-being. If it all went very wrong then you can have mould and fungus growing on the surfaces, in the carpets, etc. and that can cause respiratory problems. If you've got very low humidity that can also cause your immune system to become depleted.

So at the end of the day there's a range of impacts that can lead to increased incidents of asthma and the likes as well. We've got to really get the ventilation side of things sorted out. If humidity gets too high then dust mites can populate a home quite quickly and that can increase the incidents of asthma.

Ben: Looking at a natural ventilation situation, do we actually control it well? In that situation would we always, as the occupants of houses, do a good job?

Mark: I think that there's a reasonable amount of evidence to suggest that we just get on with our lives. We only react when we perceive a problem to exist and in that respect if we're in an old home that's quite leaky and not particularly airtight, it's sufficiently leaky for it not to cause any particular issues but as you move to increasingly airtight buildings then actually the control strategy becomes more and more important.

Therefore designing either a mechanical or a natural ventilation system requires greater and greater attention. One of the issues that can then arise with natural ventilation strategies is actually designing it appropriately to deal with the very different environmental conditions and from my perspective this also goes

back to issues of comfort. Often what you find is that people will close things like trickle vents because they don't like the cold draught and in doing so they compromise their indoor air quality.

Ben: What do we have to have in a house for ventilation? What are the regulations? You'll probably have to say the UK regulations but on the whole as houses are built?

Mark: Well, in the UK there are four different strategies that are recognised within the building regulations. There are some other strategies which are finding recognition within the building regulations in the future but they're not an identified system at the moment.

So the four primary systems: system one is windows with trickle vents and mechanical extract ventilation. You have the same again but with passive stack ventilation instead of mechanical fans, then you have mechanical extract ventilation and mechanical ventilation with heat recovery.

Ben: And the passive stack is not used that often, is it, according to different types that you use more and more. I suppose we're heading towards the latter?

Mark: Yes, passive stack is less frequently used. The mechanical extract ventilation with trickle vents is by far the most common place ventilation strategy that's been used in the UK so far, but increasingly as lower energy buildings are coming into play then mechanical extract ventilation and mechanical ventilation with heat recovery are becoming more predominant.

There does seem to be a jump straight to mechanical ventilation with heat recovery rather than dwelling on any mechanical extract ventilation strategies.

Ben: Having a quick think about . . . Going back to that situation of oh, I'm the occupant, I'm going to switch off the ventilation . . . I know you have a few stories on this, so why? Why if you were in a more airtight house would you ever think of switching off the ventilation system?

Mark: Well, it's a good question. There's a range of different reasons that that can occur to people. Some people perceive that a mechanical ventilation strategy is more costly. They perceive that the electricity that is used is actually occurring them higher fuel bills, which need not necessarily be the case if it's a well-designed system with some

low energy fans. I think that can influence people that are certainly more aware of their finances.

People that are more environmentally aware might think that by switching off the ventilation system they are reducing their carbon emissions so they might perceive that as being a good thing . . .

Ben: But these are myths?

Mark: Oh yes. These are perceptions, these are not realities. And then there's also the issue whereby if there's noise from the ventilation system then people can . . . Well they want to get a decent night's sleep so they'll end up switching off or switching down the ventilation system in that case and that can obviously have an impact on the indoor air quality as well.

Ben: The topic of noise, should there ever be any noise from ventilation or does it depend on certain factors?

Mark: I think that on a purist environmental basis there will always be some noise in some form or another, whether it's a natural ventilation strategy through trickle ventilators, you know, they're not acoustically sound shall we say in the purest sense along to mechanical ventilation systems that have got fans and the likes. Now you can actually get down to levels which are, shall we say, deemed appropriate.

The World Health Organisation defines an appropriate noise standard as being 35dBA - decibels. Then for mechanical ventilation systems, well, there's a range of different acoustic targets that you might try and conform to depending on whether you're referring to UK Building Regulations and its recommendations or whether you're referring to good practice.

Ben: We as clients will come into this thinking we want our ventilation system so how do we know that we're going to get something that's not going to make much noise? Is it a case of just looking at different sheets and it will say this dB or what do we need to be aware of?

Mark: Well, basically with a mechanical system the key is making sure that first of all the designer of the mechanical ventilation system understands the acoustic requirements and therefore they can then size attenuators, so effectively like you have an attenuator on your car exhaust, same kind of concept.

You can have attenuators situated in appropriate locations within the house to prevent break out noise from the ventilation system into your rooms and also to help reduce the risk of noise transfer between rooms, telephonic noise transfer.

Ben: So that's the noise that would just be funnelled?

Mark: Yes, it's the noise that would be channelling itself down the ductwork to the respective rooms from the ventilation system itself. You might also have other noise of course from the outside environment that could also be seeking to get into the home, in a sense. You might normally control that through closing windows and the likes.

Ben: When we have these systems, I know that they always say that you want to have short duct runs but what other parts of the design should you . . . I think what I'm getting at here is, how do I know that the professional that I'm hiring is going to do a good job and to take into account all these things that will make a difference?

Mark: At the moment I think that that's a really challenging one, if I'm honest. My approach is there are certain people that I have worked with before. I know they do a good job and I seek to use them time and time again because I know that they can deliver. If I was to go out into industry in general, I'd be a lot more hesitant. I'd probably have to do a lot more work in terms of policing these other people that I'm not familiar with and that leads to more time and cost, and things like that. So it's swings and roundabouts. In terms of the overall design process I think - I and others - are seeking to deliver a good quality product at an affordable price and that means working with supply chains that you've established.

Ben: Sometimes it's easier to picture the opposite situation. What do we not want to end up with?

Mark: Well, what we don't want to end up with is a ventilation system that's been under-sized so therefore it's not ventilating appropriately or alternatively you don't want a system that's over-sized so that it's ventilating too much because that can lead to dry air in the winter. You don't want a noisy system, so therefore you've got to make sure the design's been right in the first place. You don't want a situation whereby you've got dirty ductwork and debris because that can cause dry throats and sore eyes so you've got to think about that.

You've got to make sure that if you're using ventilation heat recovery systems then there's also condensate drains in the right places so therefore you've got to think about the positioning of the MVHR units. And it goes on. It requires quite in-depth knowledge and time and expertise to really get on top of that.

Ben: As someone who has experienced a few MVHR systems, every so often you're perhaps under the impression that you might be getting drier air. Is that the case?

Mark: In a manner of speaking, yes, but in the ultimate reality . . . I suppose for me the question is - is it a cause of the MVHR system itself or is it some other cause? When you dig down into the details of it you start to get embroiled in some finer levels of physics, which I'll try and avoid right now. Needless to say that if it's cold weather outside, say 0 degrees outside, then the air can only hold so much moisture. When you bring that moisture inside the building and raise its temperature the relative humidity of that air drops . . . in a relative sense. It's that dry air that is then created that we might then perceive through dry noses, dry eyes and the likes.

Now it's important to recognise that this is a phenomenon because it's cold outside and warmer inside, and you're supplying a certain amount of air that's diluting the level of moisture within the home. That's irrespective of whether you're talking about a mechanical system or a natural system, assuming that they're both supplying the right amount or the same amount of fresh air.

What you tend to find though is that where there are reports of drier air it tends to be in buildings that have got more mechanical ventilation systems and that is because, I would argue, the systems are constantly providing that ventilation whereas natural ventilation in itself is inconsistent. So sometimes it's over ventilating. Other times, more worryingly, it's under ventilating. So you end up with this hodgepodge of indoor air qualities that come with natural ventilation.

A well-designed mechanical system will have a lower air change rate in order to ensure adequate indoor air quality as compared to that of natural ventilation because it's more constant than that variable scenario so you get something called ventilation efficiency. Then in doing so you've got a lower air change rate so your humidity levels can be at a higher level whilst ensuring that you've got the best possible indoor air quality for removing of volatile organic compounds and other aspects of off-gassing.

You can also then if it's particularly cold outside, you've got your fan settings. You can drop down for a limited period of time down to a lower setting just to allow the indoor humidity to crest through those particularly dry periods where you might be finding there's a little bit of discomfort.

People's perception of humidity depends on their age and on their gender. So there's a whole host of different things that can start to influence perceptions of humidity and what is comfortable to one person and another so it's very much individual. It's something that building regulations doesn't actually accommodate for at the moment. The mechanical systems have got to ventilate at the same kind of theoretical level as natural ventilation systems and that is why you might be getting issues that can arise from time to time, in terms of in the UK, complaints about dry air.

I must say at Racecourse [Bungalows] the post occupancy surveys that we did didn't suggest that there are any dry air issues there. Though there were people at Lancaster [Cohousing] reporting drier air, having spoken to occupants there they are suggesting that yes it's drier air than they might have been used to but it doesn't mean that it's causing discomfort necessarily. So again, it's how some of these questionnaires are structured. You know is it dry or is it moist or humid? There isn't, is it too dry or too moist and that's where it can create some misunderstandings.

Ben: Maybe we could alter our path a little bit here because I remember that when I came up to the Racecourse Bungalows and did some video work with you guys, that you were carrying out some surveys and taking in some data. So what were you actually looking at there?

Mark: Well, what we doing there is we were actually measuring . . . I was working with Jack Harvie-Clarke from Apex Acoustics and he was measuring the noise within the household. So we were trying to identify whether there were noise issues or potential noise issues from the ventilation system that was installed in those properties. Then that in turn has led onto a paper that we've now written that was tabled at the Institute for Acoustics. In that particular instance at Racecourse we found that the alarm clock and the kitchen clock and the fridge were noisier than the ventilation system, which was a good thing. That meant that we'd done our job right at the design stage, the contractor had completed the work appropriately, the system had been commissioned - and this is a really vital one that I didn't mention before - you've got to make sure that the ventilation systems are commissioned appropriately so therefore you make

sure that the flow rates are correct. That means that you're less likely to be getting too much noise from systems and also that you'll end up with appropriate indoor air quality.

Ben: When we purge air, let's say that there are lots of people in there or there's some reason that you overheat and get uncomfortable, will that naturally create more noise?

Mark: There's different ways to look at things, I suppose, and when you use the term purge, building regulations defines purge ventilation in a specific way which is to open windows. Therefore if you've got humidity from having boiled kettles or making a stew or having had a bath you open a bathroom window that's purge ventilation when you opening a window to remove that humidity.

There might be other times where the house hasn't got too humid. You might push a boost button on the ventilation system and that will help extract any excess moisture in a more controlled fashion.

Yeah I think those are the two basic strategies. You've got the boost button and you've also got the window opening.

Ben: If you're in a Passivhaus I'm always under the impression that you don't really have to do very much. This could be the wrong idea but how much will you be controlling that ventilation?

Mark: Well, ultimately you've got perfect control over the ventilation. It's your choice on how you run and operate the building. There are a range of different fan speeds that you might use with different mechanical ventilation strategies so therefore you can control the rate at which the building is ventilated.

And of course, you can always open a window no matter what time of year it is to adjust the indoor climate or to change the indoor air quality in some form or another if you wanted to do so. You've got ultimate control at the end of the day.

What I've found, experienced from Racecourse was that in the summer because these were bungalows people were sleeping on the ground floor and they were living on the ground floor, and in that particular environment there was greater concern about security than we'd necessarily envisaged.

We'd designed everything appropriately from our point of view as designers thinking about the addressing security issues but what came up in reality was that tenants perceived a greater risk and in

doing so were less likely to open the windows. Even with tilt-and-turn windows, which if you tilt a window inwards it's arguably more secure, somebody can't get their hands through the window, can't dive through the window, those kind of things. But people were not leaving those windows open at night. Therefore there is a higher reported incidence of overheating or the building generally getting warm than we'd necessarily have expected and that's because of - shall we say - inappropriate ventilation strategies in a manner of speaking but for understandable reasons. [Mark laughs.]

So the lesson learned from that is we need to think carefully about those associations between security and ventilation, or between noise and ventilation. You know there's other instances where people won't open windows because of the noise outside and therefore the indoor air temperatures end up rising to levels which are causing discomfort until they finally get to that crisis point whereby it's so hot inside now I'd rather put up with the awful noise outside. It's about these thresholds of discomfort and how people react to them.

Regulations often compartmentalise thinking and people don't compartmentalise that thinking in their own life. So it's those interfaces which are the most complicated and interesting things, and most under-researched elements, especially with ventilation.

Ben: I know we are probably unlikely to do this but if we switched off the ventilation system in a Passivhaus - I've always wondered this - what would happen to you as a person? What would you say the likely behaviour would be? Could you end up suffocating inside because it's an airtight house?

Mark: No, no, no. There is that myth and I mean, it's a myth that I also explored myself because I was concerned about how airtight is too airtight? Is it like putting a plastic bag over your head? And the answer is no.

Basically the background ventilation through the level of airtightness is such that you won't suffocate. You might react because you start to feel it's too humid and uncomfortable, and in doing you'll end up opening windows.

I was recently in a Code 6 home that had ventilation heat recovery but the system was, well, it was switched off when I went into the building and I wondered why. What the occupants had done is opened the windows to help ventilate the property. When I switched on the ventilation heat recovery system, well, basically the ground

almost shook! The MVHR system was located at the first floor and it was thunderous really. I couldn't believe that a system had been built and commissioned and performed in such a way. The tenant understandably had just switched off the cause of the noise, the MVHR system. Once that noise has gone away you don't need to tell anyone about it because they've addressed their problem. So they haven't necessarily fed back to the owner of the property that there is a specific issue with the ventilation system being too noisy. The tenant's just said: "Right it's too noisy, I can stop that through turning the system off," and that's what they've done.

Ben: Did you get an opportunity in that situation to find out how had they coped during that time? Had they felt this isn't as good as it had been and perhaps wanted to get it fixed?

Mark: No, they'd just gone back to what they were used to doing which was, you just open the windows, don't you? So they just ended up having the windows open.

Ben: But their experience can't have been as good?

Mark: They would have been experiencing more discomfort than may otherwise have been the case but if the system was so noisy when they moved in they just switched it off and went back to their old way of living. They don't know any different in a sense and it's wrong to think that they've done something wrong.

Ben: Let's move onto Steel Farm which is a project that you've been working on recently. It would be great to include a couple of pictures in the show notes but maybe you could tell us about that and then also, because we've been talking on this topic of ventilation, how you went about designing that system in a good way.

Mark: Well, Steel Farm was a project that began a few years ago and I was approached by Trevor and Judith because of their interest in Passivhaus. They live in a very remote, rural location and were interested in trying to improve the quality of their life. At one point in time, a winter a couple of years ago, they reported to me that it was warmer inside their fridge than it was inside the house they were living in! So we were trying to fix problems like that and give them a good, pleasant environment in which they could live.

They also wanted to design a home that was big enough to cope with family visitors over time and also so that when the farm was

sold on in the future then it would be a good family residence for another farmer.

So we went through the design. A lot of the detailed developed: 68 construction details to explain to a building contractor, exactly what they needed to do because I was very conscious of the fact that there were no builders in the area that were experienced building Passivhaus buildings of that particular type, capable of dealing with a smaller one-off home. You know, I've worked on larger projects like Racecourse where we've dealt with larger contractors but this was a different kettle of fish.

There was a very high degree of attention given to making sure there was a smooth ride for the contractor, so that they could price things appropriately and they could understand whatever perceived risks there may be. They could work it out in a fair way that was amicable to the client and to themselves.

In that process, thinking about the design of the ventilation system, I was working with Alan Clarke the services engineer because the client had a design requirement for some solar thermal panels on the roof and that goes on out beyond my expertise.

So Alan was on board. He did the design for the heating system and also for the ventilation system at some initial stages and developed some specifications for that. Then we worked that through in more detail with Green Building Store who supplied the Powell ventilation heat recovery unit.

We used rigid ductwork because that ensures that we don't end up with kinks and bends in the ductwork which can have negative impacts upon, well, we need more fan power to get the air to the right places if there's kinks. That can then lead to more noise or more electrical energy used than is desirable - a whole host of different issues. And also Green Building Store designed the attenuators that I was mentioning earlier to get the noise levels down to an appropriate point.

Ben: Clearly there's a lot of piping or ducting that you're going to have on a project. Is that why you're trying to keep it down in size?

Mark: Well you're trying to keep the lengths of ductwork down to a minimum basically because there's more material, more labour and more cost. So it's just smart design to be conscious of those sort of factors. Yes, in doing so you reduce the amount of embodied energy that might be associated with such systems.

Ben: Is it a very small amount though?

Mark: There are different studies that have been done and at the end of the day where you get to is it's the energy in use of the property which far, far outweighs any embodied energy associated with the construction as a whole.

So the first thing you do is reduce the energy in use for a building of whatever type, then the next notch down would be to focus upon embodied energy. There's an order of logic shall we say. It does depend on the life cycle of the property of course, but residential properties we tend to think of as lasting quite extended periods of time.

Ben: Well, as we come to the end of this interview I don't know whether there's any big gaping hole that I've left here. It's a technical subject and I know that you're a technical guy and could go into lots more detail [Ben laughs] but just as an overview for us . . .

Mark: I think we've covered a lot of the basics already. The one thing that we haven't really touched on too much is cleanliness. One of the things that's come out . . . I've been doing quite a bit of research into this area as well and I've come across some great Finnish standards that help classify how clean is clean because the Passivhaus standard says your ductwork should be clean but how clean is clean! What level of cleanliness is it reasonable to expect from a building contractor? Should it be laboratory clean or is a little bit of dirt okay or is the odd crisp packet and bit of mortar okay?

So by and large you need to ensure that the ductwork is clean when it's designed and constructed. By far the most dirt will get into the system during the construction process so you need to pay some very careful attention to that. If you don't then it can result in - as I mentioned earlier on - drier eyes, sore throats, other things that are associated with Sick Building Syndrome in a manner of speaking. That's just through poor attention to the construction processes.

Once the ductwork is installed, do we need to worry about cleaning the ductwork out because of any dirt and debris that could accumulate within the system? Well that was a concern that I had so I emailed Wolfgang Feist and said: "Professor Feist, please can you help me. I'm curious to know what's going on inside of your ventilation heat recovery system?" And he said: "I've had a look

inside, about 10 years later, and it was as clean then as it was the day when we finished."

So there's not really an issue in terms of dirt accumulation provided you're keeping the filters changed on the systems appropriately - and that's something that we haven't really mentioned. So if you keep the filters changed regularly then you're not bringing in external dirt into the building or in through the ductwork system and you're preventing any dirt that's on the way out of the building within the heat recovery heat exchanger itself.

It's very important to make sure those filters are changed regularly and it's very important to make sure that the filters are in place because again going back to that Code 6 project the filters were missing. So therefore you have the issue whereby external dirt would be brought directly into the heat exchanger, could over time compromise the performance of the heat exchanger in some form or another and effectively you weren't actually filtering out the particulates that would otherwise find their way into the home.

Now, does that mean it was worse than a naturally ventilated scenario? Perhaps not in the first instance because it's external air coming inside and therefore the particulate levels would be the same. What you're not getting is that cleaner level of air. The issue would arise if something was going on within the heat exchanger where there is condensation and there's the potential risk of mould growth and cross contamination if the system hadn't been designed and constructed appropriately.

Passivhaus sets limits upon the amount of cross contamination that can and should occur and that's part of the design process.

Ben: Well some great information today. I'd like to sum up [Ben laughs] and maybe you can say if this is pretty spot on but the design of this and the people who put it all together, a lot of it goes back to that, doesn't it? And really as users there's not too much that we need to get involved with but we shouldn't be switching off the systems!

Mark: No. Well, an appropriately designed system is easy to maintain. I had one remark . . . I was doing a tour around Steel Farm, the Passivhaus Open Days and one person remarked upon the fact that MVHR is so much more simple than I realised it was. All they've got to do is change some filters and if they want to they can adjust the flow rates on the fan settings and that's it. As an occupant you shouldn't have to do any more. Anything else is down

to the design and the construction, and ensuring that all of that work is done appropriately so what you really need then is making sure the people have got the right knowledge, the right experience and the right ability to be able to deliver these systems in practice.

Ben: Mark, thank you very much.

Mark: Thank you.