HOUSE PLANNING HELP

Episode 66

The Main Causes of Poor Airtightness

The show notes: www.houseplanninghelp.com/66

Intro: Today's interview is with Stephen Gurney from Ecological Building Systems. He is very knowledgeable when it comes to airtightness, particularly in terms of materials and how they are applied. So it seemed like a great opportunity to discover why some buildings achieve great airtightness results and others don't.

First though, I asked him how he came to specialise in this area.

Stephen: I've worked within the building trade for many years and around about six years ago I became more interested in ecological buildings and sustainability of the materials et cetera, got into natural materials, worked with a company supplying wool. Then I started with Ecological Building Systems four years ago, dealing with their range of products and looking at the technical side. So I deal generally with the technical side of airtightness and vapour control, and how we apply it on-site and how we design it into buildings and then the actual training with the guys who are applying the materials.

Ben: On this podcast we talk about airtightness quite a lot, so I always assume that people know why we're talking about this. In case someone's coming in cold, why is airtightness important?

Stephen: Well airtightness is all about creating an envelope around your building to stop loss of the nice warm air you've created and also to stop cold air pushing into the building. If you imagine the more air you're losing out of the building the more you're having to spend on reheating the cold air that's pushing in. So it's basically getting rid of the draughts.

Obviously when you get to very low levels of airtightness you then need to look at your ventilation system. So MVHR, mechanical ventilation with heat recovery, is the best system you can put in because it's very energy efficient. It's reheating the stale air that goes out with fresh air that comes in, but airtightness is integrated into that because if you've spent an awful lot of money on an MVHR system, if you've got very poor airtightness it can actually mean that efficiency levels of the MVHR will drop right off. It should

be working, a good system, around about 90% efficiency but if you're introducing cold air from around the building and it's not going through the system it's actually making it very inefficient.

Ben: We're talking today about why airtightness might fail or some of the reasons why it might be compromised. So maybe we could talk that through - the design stage, also the installation, materials, et cetera and even when the user is left with the building so take us through that early stage of the design. How do we know that we're going to get a good airtightness design so that when it comes on-site it's all going to work perfectly?

Stephen: I think the designer must . . . It's a joined up approach. So it's looking at each element of the building – the walls, the roof – you'll have an approach where you'll have something like a membrane on the wall and a membrane on the roof and a concrete slab on the floor but it's actually, a lot of it's working out how you're going to join all those different elements up. So we've got a membrane on the wall, we've got this slab here – how are we going to connect the two together? What are we going to do? That needs to be designed into the build and there are other elements. If you've got things poking through your nice continuous envelope, so like soil vent pipes, electrical cables et cetera it's looking at strategies for that, so there are grommets from the Pro Clima range that will deal with both of those elements so you can seal around them properly so you've not got air leakage from around there.

Ben: Just going back to your example you gave, the concrete would be airtight because of its nature?

Stephen: Yeah. As long as the slab is continuous and you're connecting to a continuous slab, or alternatively some people connect to the DPM, so they'll bring the DPM up from . . .

Ben: What? DPM?

Stephen: Damp-proof membrane. So bringing the damp-proof membrane up to join with the membrane above so we would tape them one to the other. So you've got a membrane underneath that connects to the membrane on the wall or you connect to the slab, bringing that round with a glue such as Orcon F.

Ben: And there will always be a membrane on the wall?

Stephen: It depends on your construction type. With a timber frame it could be a membrane or you could be working with a board. There's an

airtight board called Vapour Block, for example, which you would tape all the joints of the board and that forms your airtightness on the inside. So it depends on the build type, even with timber frame, so that's the racking on the inside, so the strength is on the inside of the timber frame wall but you may have a case where the racking is on the outside so the boards will be on the outside of the frame and then you would form an airtight layer on the inside with a membrane.

Ben: When we're dealing with different elements, you talked about what we might have, let's say for example it's a window, will we always be taping around that? So joining that one thing to the walls, for example?

Stephen: Yes, so you tape every element. So a window has to be joined, you have to look at how you join that to wall. It could be a masonry construction but you would still use a tape to connect from the window to the wall so we have a tape called Contega SL that would do that. It's important because you could spend an absolute fortune on a really good triple-glazed window and then the installers come along, bung a bit of foam around it, put a bit of silicone sealer and then walk away. You think, yeah, that's okay but what happens over a few years as everything shrinks back and you start to get leakage from around your very expensive windows. You've actually got a bypass. So you've got a £1000 worth of window working brilliantly but then there's air flowing all the way around the outside of it. So it's an important and integral part of making your building efficient and making all the expense you've laid out for the windows et cetera to work properly.

Ben: How do you spot these leaks then, particularly if they develop over time because of poor installation?

Stephen: It's the good, old-fashioned draught, I suppose. On a windy day you would feel it or on a very cold you always get negative pressure so you'd feel cold air pushing in from around these elements. In the build process the best way is to depressurise the building, so an early-on air test if you can. When that air test is going on you'll be able to actually feel, at negative 50 pascals, you will feel the air being sucked into the building, you'll feel it around any element that is leaking. Or there are small smoke guns et cetera that could highlight it. If you're very much down to low level Passivhaus where you've got to identify very small leaks then you may use a smoke gun or something like that.

Ben: And that actually goes on as a checking process so if they're concerned, *oh the airtightness isn't down to 0.6* (ach), they will go around looking for where all these points are and you have to make sure each one, it's the equivalent of patching up little holes? It's like that?

Stephen: It's patching up the small holes really. They only may be quite a small hole but if it's repeated throughout the building then all those small holes add up to quite a large hole. Especially down to Passivhaus and 0.6 air changes per hour, it's very important to test early. So you get a test once you've got your building fabric in, with the windows in et cetera, that's the point that you would test. You would never leave it until the end until all the finishes are over because you wouldn't be able to identify where the leaks are. You might have a leaky building but you can't spot them because they've been covered over, more or less.

Ben: When we're looking at these different tapes and membranes, in my mind it's all plastic. What are they made of?

Stephen: Well, there's various ones. I mean the membranes, as you say, do have a plastic element to them. We have a more natural membrane, which is DB+ which is a cellulose.

Ben: More expensive?

Stephen: No, it actually works out . . . It's actually slightly cheaper but it's widely used in Germany. They like it there because you can fold it into the corners et cetera, but you can't see through it so when you're actually trying to apply it to the studs with staples, to the timber with staples, you can't see through it to see where the staples are. So you need to be well organised. A good German builder is always very well organised. They'll know where everything is so they can put the staples in the right place to apply the membrane.

There is a difference in the way they work. Intello Plus is an intelligent membrane as is DB+ which means they allow a drying in the summer months into the building. So if you get moisture into your fabric it gives you a fallback position where you can get some drying into the building which obviously will, windows are open et cetera, dry out naturally. Intelligent membranes is a whole subject in itself. I could probably take half an hour talking about how they work. If anybody's interested we're very happy to speak to them about it but I don't know whether we'll have time today to talk about it.

Ben: Well, I know that you mentioned vapour control. This might be moving it on a little bit and I almost got what you were trying to say, but will that be in the airtightness layer that we apply?

Stephen: Yes, the vapour control and airtightness should work very much hand in hand. Both are trying to stop air moving from inside the building to the outside, for example, so we're not losing air. So if you are losing air and it's the air from inside the building, it's warm moist air but it's quite stable so humidity levels around 50% but if that breaks through our envelope, what happens is it will hit a cold point at some point in your structure and condense there. So you will actually get water then gathering within your building and then you've got a risk of mould and rot, et cetera.

In a way vapour control is more important than airtightness because it prevents moisture gathering within your structure and then putting the building and the occupants at risk from mould. Asthma is a well-known result of mould gathering within buildings. Or asthma sufferers get much worse when it's there. So I think airtightness when you relate it to loss of air out of the building, you're reheating that air so there is a cost to it. That's going to affect you in your pocket as such but the actual vapour control levels should be right, I mean the building is a nice safe structure, a nice happy place for people to live, really.

Ben: Let's talk a little bit about these materials again. Presumably they are still relatively new so how well have they been tested? Or are we expecting that 15 years down the line we'll think, oh actually this didn't work - it might have been stress-tested but are they going to be a long term proposition?

Stephen: It's basically down to what's used within the materials, so for example the tapes that you may use for the overlaps or for the joints on a board, all the tapes that we supply for that are solid acrylic tapes so the glue is very very good.

It's the sort of glue you would find in the aeronautical industry so they're holding various sections of plane wings together. It's used because they're very stable at different temperature variations. So a plane at full altitude may be at -40ºC and then on the apron in Saudi it may be 100ºC so the glues have got to take those stresses. That's why we use the glues because they can take a high variance of stress in that way and they're very good with humidity as well, and they're very good in the long term.

Testing-wise Pro Clima in Germany have accelerated tested up to 100 years now. So we've got data that can say up to 100 years testing in that way and they've got on-site testing now of 16 years. So they've gone back to tapes that were applied 16 years ago and looked at them in situ and just checking all the adhesions there. This is important because you could think *I'll use a cheaper tape* and you know it's fine, it'll maybe stick at first, it might not stay stuck once you depressurise the building in your air test. Say it does work in that way, what will happen over time is the glues will dry out, become brittle and then the tapes will stop functioning as air barriers.

Again, you had a lovely designed that was going to work in a certain way, a very energy-efficient way, but if you put the wrong material in, over time the building will perform less and less well. So the energy efficiency will drop off.

Ben: And I'm imagining that it's not a simple '*oh we'll go back and retape that*', it's a huge job?

Stephen: Ah yeah, well once it's all covered up, you imagine trying to strip back a building to its bare-bones as such, wouldn't be worth doing. It's all about doing it right at that point when it's exposed. Put the right materials on . . .

You'll find it easier to use them as well if it's the right type of tape because it will stick immediately, you'll get an immediate tack. On a build you sometimes get where the humidity is quite high, you'll get a tack there on the build and the tapes that we use are also waterproof so if you've got an element, certain elements, that are open to weathering at certain points, so if you haven't quite got the windows in, once the tapes have adhered and cured they are waterproof at that point.

I find on lots of sites there's builders with various bits of tapes over trousers that have been torn. They come along and tell me that they've been through the washing machine 5 or 6 times, or 10 times as I heard the other day and they're still working, they've still stayed stuck! So there's a bit of on-site verification of their durability.

Ben: Are there any other big no-nos or situations that you've seen where the airtightness has been compromised? And why was that?

Stephen: It's generally down to poor education of people that are handling the materials. So nobody explains why they are using them so you could go onto a site where a builder's just been handed a role of

tape and just said: "Go and tape that up." There's no relevance to it for him or her because it's just taping something up. They don't know that they've got to apply the tapes correctly. They don't know why they're applying them. Nobody's explained the efficiency of the building relies on it and the vapour control relies on it so I think it's education at that point and then we'll do toolbox talks on-site, et cetera. So we spend a bit of time with the guys or girls applying the tapes. If it's a self-builder, a lot of the times that self-builders will be applying the tapes themselves it'll be a job they think they can handle. We'll work with them over the phone. We have videos or if we can get a site visit in we'll do that.

There's lots of information out there. We have lots of videos on the site, on our website, that explain how all the systems work. So there's help there.

Ben: And I think I saw you when I was making one of the videos for this year's Passivhaus Awards. This was the one that won in Scotland - Kirsty's project. I was sorting through some photos she gave me and I thought, I think that's Steve in the background there!

Stephen: Yes, yes I was doing a toolbox talk there for the guys there. They were really good builders actually. It was Hope [Homes] builders, I think they were. So it was the first job they'd done to this level of airtightness, to Passivhaus levels, so they really got behind it.

Ben: They did. They embraced it. I remember what Duncan, the homeowner, was saying, how it was actually very very difficult to find someone who . . . They admitted it. They didn't know everything but they were willing to learn and I guess that's got to be a key thing with anyone you hire that unless they have previous experience they've got to want to do this.

Stephen: Yes, they've got to want to do it and take on board what's trying to be achieved. It's also having somebody on-site that's on top of it all the time, so we call it an airtightness champion. As a self-builder it might be yourself or if you're employing a contract manager, it may be them, somebody who's there from the start to the end. They're looking out for all the points where somebody's come in and either applying the materials correctly or somebody later on when your plumbers and electricians have come in, they're not poking holes through your envelope, your nicely sealed envelope and ruining your airtightness. So it's being on top of that job and explaining to people why there is an airtight envelope that needs to be maintained.

Ben: As a homeowner, have you come across situations where that envelope has been penetrated over time, either because of the ignorance of the homeowner - with self build it's slightly different because I'm sure they'd be very protective over the thermal envelope - but if they'd moved into one of these properties and themselves didn't quite understand it?

Stephen: I think there is an element of that, the people that are moving in. I think with self builds or with somebody that's aware they're buying a Passivhaus, by that time they will have bought into it so they'll have a certain awareness. I think within social housing, where lots of Passivhauses are now being built I think there needs to be a communication to the new tenants as to what the buildings doing, how it works and to not go randomly poking holes through because it will affect how efficient is. If you tell somebody that it's going to affect the bills that they pay if they just go and poke holes in the building then I think they'll be on-board on it. So it's a fairly simplistic explanation as to what's going on with the building and why it's different to the last building they were in.

Ben: Now I don't want to open a can of worms just as we get to the end here but retrofit - I suppose in my mind we've been talking about new build. How do things change with retrofit?

Stephen: I think retrofit, [Stephen sighs] it is as you say a bit of a minefield.

Ben: Don't worry too much.

Stephen: I think it falls into two categories. You either look at . . . If you're applying insulation internally you look at a very diffusion open material that works naturally with the building structure, something like Calsitherm or Gutex Thermoroom, which are a wood fibre, Calsitherm is a calcium silicate board. So they are very capillary active. They all move moisture away from the wall, et cetera.

If you're going to build a stud system inside your building so you're creating a timber frame but inside your actual stone or brick building I think it's very very important that you've got to fully seal. You have to make sure your vapour air is actually sealed all the way through and it's all joined up. So you're making a fully sealed envelope within the building. Otherwise you . . . Because your external wall now has become much colder so your risk of condensation gathering against that has risen to a much greater level than you would expect.

So I think it goes one way or the other. You either seal completely on the inside with a very good vapour control and airtightness layer or you go with an insulation that's very diffusion open and allows moisture in and out of the wall.

Ben: Just a little curve ball at the end there. Any final thought that we should think about (when) staying in control of airtightness, making sure that it doesn't get compromised?

Stephen: I think it's just attention to detail, especially with airtightness. For very low levels, to Passivhaus, even the small, little bits, the corner that might be what you would consider as a tiny little hole, if you add that up over 10 windows and you've got every corner, so you've got 4 of them on each window so you've got 40 in total, that's where your airtightness will fail. So it's just looking at those small details. Think about how you join this to this to this. It is a matter of just joining things up and working out how you're going to join them up.

Ben: Steve, thank you very much.

Stephen: No problem at all. It's been great.