HOUSE PLANNING HELP

Episode 9

Retrofitting a Victorian House to Passivhaus Standard – Part 2

The show notes: www.houseplanninghelp.com/9

Ben: I'm here with Alex Rice from Green Tomato Energy. He's the senior engineer and we're going to look at some of the technical challenges today of retrofitting a period property. Hello, Alex.

Alex: Hi.

Ben: So I'm somewhat apprehensive doing this, because you are the technical brains of this and I'm foolishly going into the technical challenges and I know they're often quite difficult to grasp. So, first of all, be gentle! Then maybe you could talk us through, we're doing an episode about retrofitting a Victorian property. When you start out in this process what do you have to do?

Alex: Well, I think there's a couple of things that you have to do. One is the human aspect of it, is to understand the needs of the client and very often you have a situation where there are two clients. There's very often husband and wife teams, and quite a big portion of it is to understand and to help people understand collectively what it is they're trying to achieve from their building because in order to clear brief, people have got to have a clear understanding of what it is they're trying to do and they've got to be together in that. So educating, talking and allowing people to express ideas about what they'd like to do with their building is a very very important first step, a non-technical first step to getting the building started.

Then from that you figure out what energy performance you're aiming for – you set an energy target. In the projects we work on, that is usually Passivhaus or EnerPHit, EnerPHit being the 25kWh per m^2 per year, the slightly more lenient standard geared up for retrofit projects. Although with buildings where there are more constraints, particularly listed buildings, we will set an energy target that is higher than that, but it is very important to nail down that energy target because without knowing what you're trying to achieve in energy terms, it's almost impossible to make the technical trade-offs that are required to say, you know, do you insulate the walls more or do you have better performing windows. It's really that energy target that guides all of those decisions, so it's absolutely critical that that energy target is decided and stuck to throughout the build process because changing that changes practically the entire design.

Then the other thing is, very often we're working on retrofit projects, so a very important thing as well as understanding the client is to understand the building itself. Each building you come to is unique and that's in many ways what makes retrofits so interesting from a technical point of view, because for a new build you just need to understand the way conventional materials work, whereas for a historic, well, old building, you've also got to understand how this building was intended to work when it was first built.

Victorian buildings function in a very different way to a modern building in terms of the way moisture moves around the building and the way they're ventilated and the way people lived in them. So in order to take that building as it was designed and make it work in a way that is almost completely different, you've got to have a really good understanding of the materials and the methods of construction that were used.

Ben: You mentioned moisture there, which I don't fully understand yet but I know it's a big issue. You don't want to trap the moisture, do you?

Alex: Moisture is death to a building. Nothing kills a building more quickly than it being wet. If you look at derelict buildings, they'll stand for ages until the roof falls in and then they'll fall to pieces very quickly. Basically moisture causes wood to rot, it causes bricks to undergo freeze thaw damage… The primary aim of a building is to keep the building materials dry and controlling sources of moisture, both from within the building and outside the building, is crucial to the long term survival of any building, not specifically low energy buildings but any buildings.

Ben: Stupid question alert here. Why is there moisture in a building in the first place?

Alex: Well, there's moisture in a building because it's got people in it and people do things like cook and wash and dry their clothes on the radiators and things like that, or water potted plants, all sorts of sources of water inside the building. Then the other source is water outside the building so rain falling on the walls, water soaking up through the foundations, leaking out of gutters, coming in through roofs. Potentially if you've done a really terrible job on your roofing, so those are the sources of moisture, that's where the water gets in.

Ben: You started out by telling us the process you go through and you set your energy target first. Why would you not just say I want the best target?

Alex: Well, because the best target depends on the building and depends what you're trying to achieve. If by the best target you mean zero energy consumption, your house would be infinitely big. [Alex laughs.] It's not actually possible, so trade-offs have got to be made between how thick your insulation is and what energy sources are

available to provide heat. For example, if you have a Passivhaus that has very poor orientation so that you can't get some south facing windows, then your insulation is going to need to be thicker in order to make up for that.

There's a trade-off between how much energy the building consumes, how expensive it is to build it, how much space it takes up and how costly it is to service the building, so the concept of Passivhaus is that you make the building envelope perform well enough that you can dispense with some of the techie bits of the building – parts of the heating system. The whole point of 15kWh per m^2 per year is that that is a point of minimum cost for that level of performance and the same principle applies to the EnerPHit standard, basically because in a retrofit project, getting the insulation in and getting the thermal bridges insulated is more costly so it becomes cost effective to spend a little bit more on the energy and a little bit less on the building. Those two points 15kWh per m^2 per year and 25kWh per m^2 per year were picked carefully as best level of energy performance but built into those two numbers is assumptions about how much it costs and how difficult it is to achieve those standards, which is why when you go to things like listed buildings that number moves up, because it becomes cost effective and practically achievable to consume a bit more energy a year but make it much easier to build the build.

Ben: So space is clearly going to be one of the issues. We are sitting in a Victorian property but I know being the owner of a Victorian property myself I do not have as much space as this. How do you go about finding that space? We've got a certain amount of equipment that fits very neatly into the basement of this building, doesn't it? But each project is going to be different. Is there a solution for every project?

Alex: Well, one aspect that is often brought up is that in a Passivhaus you can sit right against a window or right up against a wall. You've got much more flexible use of the

space available. So although you may be losing a few hundred millimetres on the inside of the walls, you are potentially not actually losing that much in terms of the practically useable area of the building.

It's also my experience that you can put a surprising amount of insulation on the inside of a room and that once it's all detailed in, you hardly notice it. When you're first putting it on, it looks huge. It looks very noticeable, but when it's detailed in with the plasterwork all done, it really does disappear. The exception to that comes in buildings which are really small where you get things like beds no longer fitting, wardrobes no longer fitting into spaces that they previously did. So that is an area where you start to have to be a little bit more cunning about what types of materials you use. There are higher cost ways of achieving the same level of insulation performance in less thickness. You can use aerogel, vacuum insulated panels, that kind of thing, but that really is an exception. Generally speaking phenolic foam and those types of insulation materials are perfectly adequate and are the most cost effective choice for retrofit projects.

Then the other aspect is that if you're doing something to Passivhaus or an EnerPHit standard, you're probably renovating the building at the same time and this is a stage when a lot of people choose to extend the building. This building has the same amount of floor area as when it started but that's because a basement was dug out to provide space for the services and there was a rear extension on the back of the property that created a kitchen. In fact I think it might have even more area than when it started. Basically you have an opportunity to extend the property if that's practical within the space you have.

Ben: What are the biggest technical challenges when you come to design this and then implement it?

Alex: The biggest technical challenges in a retrofit are working around the existing structure of the building because in a new build you make your walls with your insulation in it already and it's quite easy to design a thermally bridge free well insulated envelope. In an existing building you will very often have areas of the building which are geometrically difficult to insulate, so that is one practical challenge.

The other is… In a lot of existing buildings you will have timber in the walls. It's typical in Victorian construction to, if something is brick sized and brick shaped you can stick it in the wall, certainly for internal eaves of walls. So when you take the plaster off, as Tom mentioned in the previous interview, you find all kinds of gremlins so making sure the pieces of the building you are covering up are in a fit state to remain covered up behind insulation for the next few decades is a small practical challenge.

I suppose really what I'm getting to is that there are actually relatively few technical challenges to doing a Passivhaus. Most of the problems are technically solved and it's a question of working out how to apply those solutions to your building.

Ben: And then making sure that they are done efficiently in the process?

Alex: Exactly.

Ben: So let's go through those practical elements then that you see as key challenges.

Alex: We talked about getting the builders on your side and the universal lament of people trying to build Passivhauses in the UK is the difficulty of finding tradespeople who are skilled and most importantly interested in the project. A lot of what I do in my daily life as an engineer for these projects is a process of establishing a communication with the people who are on site. My background is very

practical. I can actually do many of the things that are required and that is terrifically important in building credibility with the guys on site. You haven't got a chance of being taken seriously when you say that such and such a detail has not been done adequately if you yourself can't do it and demonstrate on site how it ought to be done.

The other aspect is a communication thing. Build a team atmosphere within the project so that when issues come up on site, the guys will call you and say: "Hey, we've found this thing. It doesn't look quite right. It's not working how we expect." Whereas if you have an adversarial culture where if they call you they're expecting to get an earful of criticism about how they're not doing their job right, that will completely kill the project. I'm a part technical, part therapist almost, to get people who've been doing the same thing the same way for years and years to do something differently without alienating them.

Green Tomato Energy is interesting because we attempt to build very low energy buildings and we successfully build low energy buildings using the skills available, using UK tradespeople, materials available in the UK, buildings that were designed in the UK and built to typical UK standards. We, through a combination of education and clear communication with the guys on site, we get the project delivered with the resources available.

Ben: Is it the case that there are more of these skilled tradespeople every day that goes by or are you struggling to find them for each job?

Alex: I suppose there are more skilled tradespeople because there are more and more of these projects being done. One of the biggest indicators that a tradesperson is likely to be good is that they've actually done a project like this before and actually tradespeople are becoming aware of this. We get people who want to do a Passivhaus project

because it would be good for them to be known to be able to deliver to that level of quality.

Passivhaus is becoming a quality mark, like a mark of good building practice in a way that Code for Sustainable Homes isn't really because there is such a focus on quality in the Passivhaus process and such an understanding that the devil is in the details that the whole team is watching the site and flagging up problems as they arise. It's that process of the site being overseen by somebody who knows what things should look like and then flagging up the problems and showing the guys on site how to correct it, and it's actually terrifically rewarding.

One of the things, before I got into this position, was air tightness testing and thermography of buildings so I've seen a lot of air tightness defects and it's actually a rather fascinating process. My childhood hero was Sherlock Holmes and I actually view my role a bit like that. I'm sleuthing around a building trying to find the problems and it's a fun process, and actually when you get a blower door in a building and you get the guys and you take them round the building and you show them, so here's what you did and here's where the air is coming in and here's why it didn't quite work and here's how you can fix it. They're quite excited because you get to see… so having a blower door test makes something that's invisible visible. You can see the air coming in and the same applies to thermography. You can say: "Well, here's a patch where the heats coming through because that insulation wasn't quite installed correctly.

It's quite heartening. You turn up on site at the beginning of the day and quite often people are a bit sullen, they're suspicious of you, they're not sure what you're going to do. At the end of the day you leave site and people are excited about this new thing they've learned, and that's really enjoyable as a professional.

Ben: I think I've done this all the wrong way round in the interview but maybe we can conclude on how you got into this. What was the draw for you as a professional to find this line of work?

Alex: I graduated with a degree in new and renewable engineering from Durham and I'd always imagined myself putting up wind turbines in the North Sea. Through a series of factors I ended up working in the United States in Virginia for a company called CommonWealth Solar and I had the pleasure of having as my boss a gentleman called Ken Schaal, who had been part of the passive solar homes movement in the United States in the 1970s. He built a foam and concrete… It was actually a geodesic dome, very hippy, or part of it was anyway and he built it for next to no money and it used practically no energy. It was built with very basic building techniques and, as someone who had lived in Victorian buildings my whole life I went into this space and I was astounded by the sensation of calm and the light and it was comfortable. It was just a complete eye opener that the way that we've been building buildings, not only is it not efficient but there are tonnes of other reasons why you would want to build a better building. I'd always thought of low energy buildings as complex, expensive… you go to things like the Centre of Alternative Technology and what's very much on show is what I call eco bling, all of the bits and pieces and gubbins that make it work and what Ken really showed me is that none of that's necessary. Make the building well insulated and airtight, and you will need the minimum of stuff to make it work.

Then I came back to the UK and I wanted to continue that process and whereas in the US houses are built and knocked down every 25 to 50 years, the average life of a building or construction in the UK is 100s of years, so there's a massive massive need for retrofit in this country in order to take the building stock that we have and we love and turn it into the building stock that we would like to have in the future. That provides all sorts of interesting

technical and human challenges and that's been a very rewarding line of work for me.

Ben: Alex, thank you very much.

Alex: Thank you.