HOUSE PLANNING HELP

Episode HPH263

A step-by-step EnerPHit retrofit of a mid-terrace home – with Harry Paticas from Arboreal Architecture

The show notes: www.houseplanninghelp.com/263

Harry: I have a background in maths and art, then went on to do a degree in architecture. I've been in practice now for twelve years as Arboreal Architecture and for a long time I've been deeply connected to the natural world and interested in the natural world.

And I would say quite a big professional turning point in my career was doing the Passivhaus training course and suddenly being able to understand how buildings perform. So probably for about the last seven or eight years I've been deeply involved in the real measured performance of buildings, and at the moment very very involved with retrofit.

Ben: And we're sitting in your retrofit project at the moment. How far through are we?

Harry: So we are probably about a third to a half of the way through this project. We're actually, in terms of thermal performance, we've saved about sixty percent of the heat required for space heating on the project, so we've already achieved pretty massive reductions in energy consumption and carbon emissions. In terms of finished surfaces, and finished rooms…

Ben: I wasn't pushing that, I was just doing some context!

Harry: (Laughs) Well right now we're sitting in the only finished room in the house but there will shortly be another room finished and this room contains the MVHR and is actually my son's bedroom. So we gave him priority so we wanted to finish the first room for him.

Ben: When did you begin?

Harry: So we bought the house in 2016.

Ben: With an eye to do this?

Harry: With an eye to do this. There was always an ambition to do a retrofit project so that was our aim. We were going to buy a different property for less money, so there was going to be more budget for the retrofit works. This property cost quite a bit more than we were budgeting for, so we basically had a lot less to spend on the retrofit works. That is part of the reason why we're not as far through as we would have hoped to have been.

We took on the project anyway and buying houses is a pretty torturous process as we all know. So we just said right, let's just do it this way.

In the end it's been a wonderful journey. Learnt masses. It's just meant a lot more DIY at weekends and in a way that's been very very helpful, because for example, I've installed the whole of the MVHR system on my own which was a wonderful learning experience and it means you can then talk to clients with real deep confidence about how to do it, how it performs, what it's like to live with, what it's like to install. So it's been a very good parallel to my professional work.

Ben: What were you looking for in a potential property? And obviously money is going to be a constraint, so what could you get? What did the market have to offer?

Harry: Yeah, that's a really good point. So in the end there's not that much choice. You choose an area and then you have certain criteria: south facing windows are good, not large east or west windows! We wanted a property that definitely needed work. So we didn't want something that was already quite finished because obviously we'd be paying a premium for that and we'd be taking out finishes and we're also incredibly mindful of the carbon emissions of just simple stuff like a kitchen and a bathroom that we wouldn't want to go back and redo if it wasn't to our liking. So this house was in desperate need of work.

It is south facing. It had an eye to form factor and this is a mid-terrace. It's a staggered mid-terrace so it's sort of good but still there's sticky out bits that you have to deal with at the back. So form factor, orientation, and the ability to carry out works.

Ben: What is the construction of the existing building?

Harry: So this house is a bit of a hybrid. There's a combination of a solid brick and block front wall that is tile clad. At the back wall is brick

both sides with a cavity and there's also a few sneaky little cavities at the front on the party wall line interestingly. The cavity is only 300 wide. I discovered them using a borescope and investigating.

Ben: Before you bought?

Harry: No, after I bought.

Ben: How much could you do beforehand?

Harry: The vendor kindly let me in for two full days.

Ben: Wow!

Harry: So I did quite a bit of surveying. I managed to survey the whole house and draw the whole house before we bought, so that was good. There was asbestos here, we knew that. We had a test so that was certainly the first job.

Ben: Where was that?

Harry: Mostly in the ceilings. A couple of sheets of AIB in the services cupboard but the stuff in the ceiling was plasterboard. So it was in the artex.

Ben: And how do you make sure you deal with that responsibly and that you haven't got any dust left?

Harry: So asbestos essentials on the Health and Safety Executive have some fantastic sheets. There's certain work you can do as a person and certain work you have to get somebody in. So we had people in to do the right thing, made sure it's been disposed of responsibly and we also had an air test carried out. And the guy that came round and did the air test said it was the cleanest house he'd ever seen. So we had a lot of reassurance that we'd done the right thing.

Ben: When you think about strategy, you've already mentioned that the budget is going to be tight on this, and to my knowledge there's not a massive amount of phased projects that I know about in the UK, so how did you start this work?

Harry: So it started with a huge amount of energy and enthusiasm and just plugged away, weekend after weekend, and actually got quite a lot done.

The key thing, we were renting before we bought, so we sold a property and then we started renting and then we were in the process of buying. We wanted to give ourselves that flexibility. So we made sure that anything that was dangerous or really cold or very dusty was all done before we moved in. So we had the airtightness works to the ceiling done on the top floor where the bedrooms are, where we are now. So we put in vapour block boards, fully taped between each other and to the walls so we knew the house would be airtight. We put in insulation in the loft, we took out any dangerous materials, the asbestos, and we made the house secure and weathertight. We actually also installed three triple glazed windows as well. So we had all that done before we moved in.

Ben: Your different phases then, can you describe how it's working, where we're up to and what lies ahead?

Harry: Yeah, so the general strategy has been top down. So we're starting at the top of the house. So we got the airtightness and insulation in the loft. The front elevation was double glazed with very poor seals, PVC frames falling apart. They were replaced with triple glazing. That meant that our bedrooms and living room were up to a good thermal performance. And so we also did the insulation to the walls in those rooms as well.

One point that's really interesting, is that we did that work whilst living in the house and so we got to experience the thermal shift during the winter of putting on the cork insulation. We know what PHPP says, we know what the U-value change is, but to actually have the bodily experience of that change over a weekend of installing it. I mean suddenly everything became much less fluctuating and much more stable. We had immediate change. So it was very interesting. We all had a physical experience of that change. So the heating suddenly being on much less and blasting out less heat. Much less temperature asymmetries.

In terms of the strategy, one key part of it was how to maintain good quality ventilation before we installed the MVHR. So we know we had existing poorly sealed double glazing. Very leaky. So we know that there was ample ventilation through that leaky situation.

Then what we do is when we install the new triple glazing to five windows, we specified night vents. So night vents allow you to put the handle to forty five degrees off the vertical and it cracks the window open three millimetres at the top. So you basically get the equivalent of a trickle vent. So we knew that we could do that and

we could maintain decent air quality without having to install a trickle vent and therefore still effectively meet the building regulations and make sure we had good air quality. So we could do that as an interim measure before the MVHR got installed.

And at the same time we've been monitoring quite a few things in the house, including PM2.5 and nitrous dioxide and temperature and moisture content. But we've also been monitoring carbon dioxide and that was actually quite helpful, because occasionally it was going up a bit, so we could adjust which night vent was open or not open. But now we've got MVHR installed and enjoying very nice air quality.

Ben: So again, going back to that phasing. So you said top down, then the front elevation, the south elevation. You've done a little bit of internal cork on the windows? What's next?

Harry: Yes, so we're probably in a little bit of a lull at the moment. We're doing little bits of airtightness works, we're planning the next stage basically. We're finishing a couple of rooms but that's more interior decoration as opposed to thermal retrofit works. But the next big phase will be to work out where our living space is going to be. And when we submitted all our plans to the Passivhaus Institute and they were certified we were thinking of a living room on the first floor, we're now possibly thinking of putting it on the ground floor. So exactly how we phase that is a kind of a critical thing.

But in terms of what our EnerPHit retrofit plans states, the next phase is to temporarily insulate the garage door. The moment we do that we reduce heat loss through the whole of the living room floor, the whole of the ground floor hallway and a back wall of the garage. So it's actually thermally a very good interim measure to reduce heat loss. But in order to do that we need to actually block the door, so we need to create a new entrance to the garage. So that's a planned work in probably the next few months.

There's a little patch of insulation in the porch which is the floor of the living room in the ceiling of the porch. Porches are notoriously difficult to get right in terms of the airtightness line and the thermal continuity. So we've got some fiddly things coming up and that's actually all part of an EnerPHit retrofit plan which is our step three. So step two is complete and step three is that plus some insulation in the bathroom. So once that's done we're finished step three and then step four is basically the ground floor front and back insulation and insulation to the floor.

Ben: And how have you found time to do all of this? You're running a business, we know it's disruptive. And was there ever a side of you that just thought actually I need to wait, I need to build up the money reserves and do this all as fast as possible? I'm sensing not.

Harry: You're right, no. I mean as you know, the project was lucky enough to win the ASBP Awards and I think that helped a lot to have some recognition for all the hard work that went in, and basically two years of Sundays, sort of full Sundays, ten / twelve hour days of graft with cleaning up at ten o'clock at night. Going back to work the next day.

Ben: That's not only physical, that's also mentally very draining because you're not getting your rest, and no doubt disruptive with the family?

Harry: Yes, absolutely. The family have been brilliant. Somehow we've struck the right balance. It's not been that easy but we've done it, and we're doing it and we're seeing the rewards now. We're in my son's bedroom and he's got his magnetic wall and all his pictures up. And he's got lovely air quality and he's got a lovely triple glazed window and he's sleeping well and his asthma's got better and we're sort of feeling like it's all been worth it.

Ben: But you've also used this experience to teach him a bit about what you're doing, haven't you?

Harry: Absolutely, yeah you know about that. So that's been a critical part. He's over the last two years he's become a more helpful helper!

Ben: How old is he?

Harry: He's about to become eight.

Ben: Oh good, I'm glad it gets better!

Harry: So it started off with him basically jumping on insulation and throwing it around, and now he's able to help a bit more. So he's been helping but I was really keen that this experience of our family carrying out a retrofit would be something that he can remember for the rest of his life. But also I wanted him to do a little bit of slightly deeper understanding of what it is we're doing and why we're doing it, rather than it just, as kids just experience life and it is what it is and that is life, but I wanted to contextualise it for him.

So we've done a whole series of A3 posters, one of which was 'What is cork? Where does it come from? How is it made? And how

do we install it?' And he actually does the whole poster himself. I help him with a few images and we cut them out and then he sticks them on and he annotates. And then what's been really wonderful is, we've made about five or six of these posters. One was on airtightness, one was on a thermographic survey we did, another one on insulation, another one on the mechanical ventilation with heat recovery, and he did his own spider diagram of how the pipes got to each room. And it's really quite fun to see him do it.

But what was really great, was he did those with a bit of encouragement from me, but then his class teacher really engaged with that process and she allowed him to present them to his class. So he would take them to school, they'd get put up on the wall for a week and then he'd actually do a little five minute presentation to the class. I never saw any of those presentations so I don't quite know what he said! But it's really nice that that was engaged with as a process and what that's actually led to is me starting off a charity.

So I'm either a charity or a community interest company which I'm about to kick off, which is actually going to be about retrofitting schools. So I'll be delivering thermal performance workshops to schools, to school children and then doing action research with them where we look at the fabric of their classroom and of their school and then come up with a retrofit plan, a retrofit masterplan for the school. And I'll also be helping them with funding. So this is a plan that has emerged out of this retrofit and engaging with my son, and I've delivered some workshops to local schools already and I've had school children round this house for example.

Ben: So one thing that I always think about when your name is mentioned is, it's almost like your plans sometimes are works of art. Is that something you do that's unusual, or do you know what I mean? You do watercolours and…

Harry: I could do a drawing on the computer but somehow the process of producing a detail, it's a process of thought and I feel that when you draw you need to love what you're doing and you need to make it look beautiful. And then if that drawing looks beautiful then maybe it will be built more beautifully. And it sort of has a bit more care and craft to the way the drawing is made and that kind of carries on to the way the detail is drawn. And generally I do find, particularly with watercolours and builders, they get it and they were "ooo!" Because drawings usually end up on the ground, but watercolour drawings generally don't!

Ben: I'll go and laminate it!

Harry: But then I've had the odd little bit of help. The odd person's come round to help, lift doors and things, but there hasn't been that much of additional builders coming in so we haven't really had to experience that. I do have a background in painting and art history so I'm always mindful that things do need to be beautiful as well as technically brilliant.

Ben: And you're also a DIY enthusiast. You're certainly packing a lot in here. Do you think other people can do this? Because you've just drawn on some amazing skills.

Harry: So really the question is, we're facing climate breakdown. We're in a dire state globally, and I think the question is can any of the processes that people like me and lots of others, lots of other great retrofitting architects that we know about, whether our collective understanding, skills, can create a bit more context and a bit more knowledge and a bit more process.

Some kind of template to help other people do these works, and given the councils have signed up to being carbon neutral by 2030, and quite a few of us are scratching our heads thinking how are they going to do that. I mean Lewisham for example is one of those councils, it seems clear that retrofit is going to be a very big part of that process.

I'm very very interested in, obviously not expecting people to do quite what we've done, but to adopt some of the processes or some of the techniques and some of the phasing, and to learn from it. There's been talk about could you do a Haynes Manual for retrofit.

Ben: Not so silly!

Harry: There's sense in that. Your first thought is we all know that you have to manage moisture very very carefully. You need to manage ventilation very very carefully. Those two are obviously intricately linked. We all know that Passivhaus is very demanding on workmanship, so it has to be delivered well and we've got to be very mindful that some people just simply don't have the skills or the patience to sit down and make joists airtight or think that will do. When I see a tiny little gap and I'm "No!" Get the Orcon F in there and put another piece of tape over it and let's get it robust, because we all know that air tests are unforgiving. It will reveal all if there are any gaps.

Ben: Have you learnt anything else or come across any surprises as you've done this, or had any key learnings?

Harry: Yeah, I think one key learning is just how rewarding it is to make things and realise them yourself. I think that's really big. Huge reward.

And then parallel to that is that by doing the work, I mean as a professional, as an architect, by doing work you suddenly know it so much better. So you can talk to clients with even more confidence than you had before because you've actually experienced it, you know how big the MVHR machine is, or how it functions, or how often you need to replace the filters, how those bits of pipe connect, how dusty it is to drill a hole through a wall.

So it helps not only speaking to clients but also in speaking to builders, because you can actually help builders do a better job because you've had a go and then therefore they have more respect for you because they know you're not just a paper architect, sit at a desk and are detached from it but you're connected to it.

And I have to say that one huge realisation of this project, is that by pouring passion in, there are so many benefits that come out. And one is just the whole school thing that was totally surprising, totally unplanned and it's just happened. And when you put passion in you get something out. It's sometimes not a linear process and it just appears. So I would say the school thing was a complete surprise, came from nowhere.

Ben: Is there anything that you're particularly pleased about that maybe initially wasn't planned or whatever, but you've now thought "this is good."

Harry: Hmm. I would say I'm very pleased about the windows. I love them. Everybody that comes to see them loves them. They're inward opening. They've got a central flying mullion and so we can open up a whole elevation and we get very good, rapid night time cooling. So I think that's a real benefit. There's something rather lovely about big, heavy triple glazed windows. That's a lovely thing.

Ben: You and I share that.

Harry: Well I'd never had one before and it's a lovely thing to have one.

Ben: It is isn't it. It's a proper piece of engineering.

Harry: So that's one thing. The second thing is the MVHR has been simply wonderful. We still open windows when we want to. Through the winter generally you don't open a window because then it gets cold, but for just general air quality which we've also monitored with carbon dioxide monitoring pre and post installation of the MVHR, so we've got numerical evidence that it's improved our air quality, but we've also felt better. And there's something about that fresh bedroom through the night that's really nice.

And then maybe the third one is just the sheer fun of working with materials. So getting to know cork for example. We were experimenting with cork finished three ways in this house. So we're looking at different finishes to the cork.

One of the concepts is to see the insulation so that you actually see the thing that's been installed because very often it is behind plasterboard and it's invisible. Now it's not a very easy concept to realise because you have airtightness layers and you have things like electrical sockets and things. But we've generally we've planned everything to keep all pipework, all services away from the external walls. So our external walls are just insulation. And I worked out a technical detail for how to manage moisture and airtightness within the layers of cork whilst keeping that top layer still exposed.

Ben: Why did you pick cork as your internal insulation?

Harry: That's a good question. I would say it was very clear that we were always going to go for a material that was from renewable sources. It was also very clear that we wanted something that would not off-gas that would basically be a kind of neutral material in terms of air quality.

Because we're not a solid wall property, we don't need capillary active properties of insulation. So wood fibre has very good capillarity, very good at managing little bits of moisture that appears through the brickwork. So cork kind of emerged as really one of the most appropriate materials to use.

We're doing some work with Jane Anderson at the moment on embodied energy and sequestered energy of a whole range of insulation materials. And we've got a wonderful schedule that we've developed together that shows which are the lowest embodied energy materials, insulation materials, and then which are the lowest if you also take into account sequestration. And cork is very good on both.

So cork is actually lower embodied energy than wood fibre, quite a bit lower than wood fibre. When you take sequestration into account, wood fibre sequesters even more than cork. Basically cork is very good on both counts. It sequesters carbon but it's also very low carbon to make.

Ben: And as I understand it the one challenge with cork is it's got a very slow renewable process and there's not a massive amount of it in the world? I mean that's the one when they built the cork house and said it was so fantastic, that seemed to be the criticism that came up.

Harry: The amounts of cork we're using here… It's a fair point and it's actually a fair point with every material we use quite frankly.

Ben: No easy wins really.

Harry: Yeah, how sustainable is something.

Ben: It's often difficult to say definitely isn't it.

Harry: Yeah it is. The same goes for timber. If the whole of the UK switched to timber I don't know that there would be enough. I'm pretty sure there wouldn't and then we'd be looking at importing rather large quantities of timber and where would that come from and how sustainable would that timber be etc etc. So there are big questions out there.

So you have to take the market as it stands and then look at the facts as they are. I don't think we're wedded to only using one material. It's just been an interesting journey getting to know that one material. I think wood fibre would also be very appropriate for this project. Would work just as well.

Ben: You mentioned a little while ago about how the insulation had really improved the quality of the rooms, the temperature. How have you been in the summer? I'm sure in the winter it's all going to be lovely and cosy, it always does seem to be in well insulated, airtight houses. How's the summer been?

Harry: That's a really excellent question and I would say in periods of heatwaves it hasn't performed nearly as good as we'd hoped it would. So we've got triple glazing which has got a G value of 0.5 and we were going from a G value of 0.7 or something. So we are getting 20% less sun through the windows. So we knew we were

getting less than our neighbours. Cork doesn't have much decrement factor, so we're not getting much effect from decrement delay.

And we have a medium thermal mass. It's not very heavy but it's also not super light. So on the top floor it doesn't cool down that quickly because there's lots of blockwork walls and brick party walls. There has been overheating. It hasn't overheated in Passivhaus terms, as in over twenty degrees for ten percent of the year. So we're within acceptable.

Ben: So this is an architect worrying about a problem that's not here. Twenty five is fine!

Harry: We have gone up to twenty six, twenty seven.

Ben: Twenty eight is my record, but it was a night cooling thing. It was just so warm outside, but it only did it for one or two hours. But that's the highest and in one room I'm talking about. The other side of the house, probably like your downstairs, much cooler.

Harry: As you know, this house is a kind of experiment as well so we're right now there's a sail workshop down on the south coast of England where three bright yellow sails are being made for this house and they're going on the front windows.

We were really keen to have a low carbon, low tech solution to shading, to reducing overheating in the summer. We're going to have a little bag. These sails are going to live in the bag and they're being made now. It's too late for this summer so they'll probably get put up for some photographs but they'll then get put away in the loft and they'll be brought out next June, May or June next year or whenever there's a heatwave.

And they will pretty much one hundred percent shade the two top windows, and over fifty percent shade the very large living room window. And we did anticipate this so we have allowed for some extra lugs for attaching the sails too.

And the concept that I'm really excited about is the concept of being able to tune your building. I like the fact that you can actually be a little bit involved in your building. That you actually might decide to go and put up that solar shading. It will take five minutes per sail but then it takes five minutes, you put them up and then you're going to get a rather amazing effect, so we'll be shading on the outside of the building.

Ben: And the one real benefit that I see by doing this is that you can control the temperature a lot more. If you're prepared to shade you can get it down, I'm guessing here, to twenty or whatever. And that will make a huge difference if it's thirty five or whatever outside.

Harry: Yeah, and in order to prove that we've actually installed sensors both in our house and in our neighbour's house and in various rooms and on the outside and on the inside. And we're already collecting data now. When the sails come in we'll be able to actually show before and after data and actually really show what a difference it makes.

Ben: It's fascinating. You do seem to, I can just tell you've enjoyed this whole experience and that idea of how else can I use my project for learning. Installing sensors in the neighbour's buildings – that's brilliant!

Harry: Well, thank you neighbours!

Ben: Nice neighbours obviously! Is there anything else, any other key part of this that we should be mentioning? I don't want to gloss over it. I know we've only got a short time to talk about it.

Harry: Yeah, well thanks for asking. It's been, I appreciate your questions. I think one thing that we've done which was recognised by the ASPB was a very fine grain understanding of the materials that we were bringing into the building, and also really respecting all the materials that were at the building already. The process that we've adopted here has been very much try not to replace something if it actually works quite well. So there's a little bit more of a lean towards embodied carbon, rather than very demanding interior design aesthetics.

And what we're finding is that actually it leads to some fun moments and to a little bit of variation and we're just accepting that and we're just saying no, that's what this is about. It's not about putting your architectural stamp on everything as a kind of a perfect thing, but actually accepting that sometimes you might just keep a door because well, it's a bit thin, not a very nice door, but if we sand it down and re-treat it we actually get a door that fits and we're not throwing a door away and bringing in new doors.

So we've sort of adopted an approach of just being very fine grained with everything and it goes down to measuring the VOCs in this carpet in this room and the MDF which is a valchromat. And we

actually developed a little system of how to measure the VOCs by putting it in bags and putting the sensor in the bag and then comparing it with other products. It's just that we've gone into detail and that detail is I guess one of my traits, which is I guess one of the things that's seen us through because I'm just following everything through to its natural end.

Ben: And talking of natural end, what's the plan from here then? Money is tight so can you keep on moving forwards?

Harry: Yes. So we have a little bit of surplus from salary and monthly costs and that usually goes towards a few materials. And just before you arrived I was measuring up some battens for the hallway ceiling, so we'll be putting an order in for those soon and then we'll be putting up the ceiling. We just heard that we're going to probably put some clay plaster up. We're working with Clayworks and they're keen to help us and get some clay plaster into the house as well. That will be fun and that will be a new material to try out and install.

Ben: Well, I wish you well. Thank you Harry.

Harry: Thank you very much.