

## Episode 72

# A Radical Retrofit of an End of Terrace House

The show notes: [www.houseplanninghelp.com/72](http://www.houseplanninghelp.com/72)

**Intro:** Today's interview is with Tim Nicholson. I have known Tim for about a year now and have followed the progress of his retrofit. I took a couple of videos of the project too and will link those into the show notes. Tim is going to tell us the complete story behind the build and explain what he has learnt along the way.

First though I asked him when he started thinking about living in a more energy-efficient home.

**Tim:** Well, that was quite some time ago when we were in our previous property. It needed refurbishing and we made the conscious decision that we wanted to do it in a way that would be low energy and using natural materials and give us a healthy, energy-efficient home.

**Ben:** So this property here, this is quite an exciting story for me because I think it's the first time I've seen a building go all the way through from having everything ripped out - that I'm sure you're going to tell us about - to making it airtight and now we're back to the finished house.

Just rewinding to the beginning of that story, what were you looking for? Were you drawn between either building new or retrofitting, or was it always retrofitting for you?

**Tim:** We had thought about new build and we did spend a little bit of time looking for a site here in Oxford but they are very difficult to come by and they're very expensive when you can find them. But also I became increasingly concerned about addressing the problem that we face with the existing housing stock. There are some 25 million homes in the UK and by 2050 they need to be pretty much zero carbon. That's a huge challenge and there's very little being done in the way of ambitious, energy-efficient refurbishments and in a small way I felt that we could progress the experience by doing our own ambitious retrofit.

Ben: Were you prepared for the fact that this could be quite difficult for you?

Tim: We knew when we embarked on it that it was going to be challenging, that it was an ambitious project and I was keen to really go for it in terms of particularly the levels of insulation that we were putting in, the levels of airtightness and the extensive renewable energy to really see how far could we reasonably take our 1960s property but yeah, it's been a hard slog actually. It's been pretty tiring and challenging in many ways.

Ben: Did you source this property with the retrofit in mind?

Tim: We had been looking for a property that needed refurbishing and therefore that we could refurbish it in an energy-efficient way. So, yes, when we bought it we knew that we were going to refurbish it and we knew that we would seek the best way to do that.

Ben: And how did you go about doing it?

Tim: First off we met with a number of different architects and explored the different possibilities; particularly the approach to the insulation was one of the main issues that we had to address. And because of where we are and some legal constraints, the aesthetics of the property as well was a significant consideration. What was it going to look like? And we first off looked at the options for external wall insulation with a render but because the house is brick currently we ran into issues of permissions that prevented us from having a rendered finish.

So we then looked at internal insulation and came up with some of the challenges are faced with internal insulation being loss of thermal mass, loss of occupational floor space, the risk of interstitial condensation. That was a real challenge for us, how to resolve that, and in fact one of my former colleagues - an architect specialising in energy efficiency - called Steve Harris, he came up with the suggestion of externally insulating but then cladding the insulation with a new brick skin. So a new brick wall to match the original architecture and the existing aesthetic but forming a second cavity 20cm wide to externally insulate the house to make it very, very warm.

So we benefit from the thermal mass, we don't lose any floor space, the risk of interstitial condensation is very low and we maintain the existing aesthetic.

Ben: If these planning restrictions weren't in place, would it have been a lot simpler?

Tim: Yes, I think it would. By going down the route of building a new brick skin it meant that we needed to lay new foundations for the new wall, it meant that we had to tie the new wall into the existing one. It introduced the bricklaying trade on site. We had to address the detail at the roof level, at the eaves and at the gable so we had to extend the roof to accommodate the new wall. However, what it does mean is that we have a very robust finish. It is consistent with the existing architecture. It will last as long as the building as a whole. There will be minimal, if any, maintenance issues.

So in some ways it's a bit like we've built an extension to the house but we have no more floor space. It's a substantial piece of building work but it's one that has meant that we could achieve what we wanted in insulation terms without compromising the aesthetic.

Ben: A quick sidestep for a moment because I know this property is an end terrace which means you've got other houses going in the other direction. Did you ever try to bring your neighbours along with you?

Tim: Well, yes we did. We had an initial meeting at the outset of the project, where we hoped that we could communicate and explain the merits of what we were trying to do and the ambition. There was quite a lot of anxiety about how we might . . . or concern about how we might spoil the aesthetic of the development. Because it's in a terrace they were very keen that we should not change the elevations to a great extent. They did in fact reluctantly give us consent to externally insulate and render the gable wall but they weren't happy with us changing either the front or the rear elevation, which was then why we started exploring internal insulation options.

Having then come up with the brick cladding solution they gave us consent to do that on the gable on the side and on the rear, but they were then concerned about the step that it introduces in the wall and they wouldn't give us consent to introduce that step on the front. So we had to internally insulate on the front. So we did try to bring them along with us. They were very concerned and resistant to any significant change.

I think many of them, having seen what we have done, I hope that they're impressed with what we've done and certainly the feedback that we've got from some of them is that they're very pleased with

the aesthetic of what we've achieved and I think that some of them that have visited are impressed with what we've achieved internally as well.

Ben: You haven't even got a winter visit. That'll be when you can, in December, bring them in here and show them around.

Tim: Yeah, we experienced, or our experience of the house before the refurbishment, was that the house was quite cold, and particularly the concrete floor that had no insulation underneath at all, was really quite sapping. And sometimes when we had visitors they would sit with their feet up on the sofa just because it was so cold. It wasn't a terribly pleasant environment in which to be, but now with the super insulation to the walls, the roof, the floor, with the triple glazed windows, with the airtightness that we've done and with our wood-burning boiler stove I'm confident that actually the house is going to be nice and warm through the winter.

Ben: Thinking about this floor for a moment, with an existing property how did you address that to actually get a decent amount of insulation underneath you?

Tim: Well the floor was a challenge. The existing concrete slab had no insulation underneath it and was cold, and we explored a few different options on how best we could improve the situation. In the end we went for an ambitious, but ultimately probably quite costly, option which was to break out the concrete slab and dig out the dirt beneath it in order that we could lay a new slab, but importantly 20cm of polystyrene EPS insulation so that the new concrete slab we would benefit from the thermal mass and it would be well insulated.

Breaking out the slab and digging it out was a challenge. It was time consuming, it was very noisy, it generated a huge amount of rubble and spoil that we had to get off site and one of the alternatives which, if I was doing it again I might find more attractive, would be to leave the existing floor slab in place, accept that you're going to have some heat loss through the floor, but install a skirt basically, a sort of insulating skirt around the foundations and the external walls below ground, to avoid the loss of heat outwards from the building and from below the building. So trapping the heat beneath the building and accepting that the thermal mass comes from the floor slab and the soil beneath it, and although that would mean it would take a while to heat up but hopefully by having this skirt running around the outside it would

mean that you don't have any loss of heat in a lateral direction, ultimately there's a limit to how much heat you'll lose going down.

Ben: What does that mean, a skirt? What is it made of? Is it something on the exterior of the building that is insulating it or are we talking about something, a little trench that you dig out on the inside?

Tim: So it would be on the exterior of the building, digging a trench down adjacent to the external wall, down to the foundations and then inserting insulation, probably EPS, in order to insulate the walls below ground to reduce the heat loss from the building below ground. Now I call it a skirt because it runs all the way round the exterior, probably a mini skirt is ...! [Laughs]

Ben: Is this your made up name for it? [Laughs]

Tim: Well, I don't think I can claim the credit for making it up but it is an idea, an approach, that for a property, an existing property where you want to super-insulate the floor, but you don't want to break out and dig out the slab, is an alternative. Probably not quite as efficient because you're not insulating directly beneath the concrete slab, but it is probably a good second best approach that would certainly be a lot cheaper.

Ben: This is something we're going to find with retrofits; the more that get done that they're each going to have their problems to solve and that's quite a major decision isn't it, you going one way or the other on that?

Tim: It is yes, I suppose it's coming up with the right solution as a result of lots of different factors. It's what the occupiers or owners want to do. It's the budget, it's the timescale, it's the ideas and inspiration of the people that are coming up with the solutions.

Ben: How did you find the disruption over all? You home-school your kids and you managed to secure next door to stay in! How did all that come together?

Tim: We did contemplate the possibility of staying on site during the refurbishment. Could we move upstairs whilst the downstairs was being done and then vice versa? But we quickly realised that actually the cost implications of doing that, it was going to require a lot more cleaning up of the site at the end of the day, it was going to delay and slow down work on site and it would just make it a much more challenging process. So we came to a conclusion that we really needed to move out.

We looked at a number of different options. We were keen not to spend too much money frankly because we wanted to invest our money in the project itself and not on rent to live somewhere else and we were very lucky ultimately in managing to rent the house next door which was just changing hands. So it was going to be empty for a period of time so we were able to live there which was fantastic and meant that we were on site so we were here to be able to monitor what was going on, to take deliveries, to ensure the site was secure, and yet we had our own space and with our young children that was really valuable and I think from a point of view of our sanity as well, that was very helpful.

Ben: When you came to do this retrofit you've also taken that opportunity to change things to suit your needs, so what have you done to the building in that respect?

Tim: Well one of the biggest changes I suppose is that we've changed the layout internally. Because we wanted not only to make the house very energy efficient, but we wanted it to work better for us, to turn it into a family home that suited us better. So we've gone for a much more open plan layout downstairs. I mean I think that in some ways has helped from an energy efficiency point of view, in that we heat the whole of the ground floor with our wood-burning stove. Ironically given the size of the stove if we hadn't opened up in the way that we have it would have been prohibitively hot to have it in a single smaller room. The fact that we've got it now in an open plan situation, it's able to heat a much greater proportion of the house without it being unpleasantly hot.

Also from the point of view of natural light, having opened up the ground floor and put in one large new window, that means that the ground floor is a much lighter space than it was previously.

Ben: You've mentioned the stove a couple of times and I think in my experience of heading round certain properties, a lot of the time the stove doesn't get used much. So I know you haven't really tested this yet, but how much do you think you are going to be using that stove?

Tim: Because we've disconnected from the mains gas supply in the winter our wood-burning boiler stove will be our primary heat source. Our solar thermal system will still be contributing but only really very little in the depths of winter, so our wood burning stove is what we need to run the space heating and to provide the domestic hot water. So to some extent we can only speculate at this stage

having not been through a winter but I would think for some of the time we will run it every other day and in the depths of winter when it's very cold I should think we'll be running it every day. How long we're running it will vary on how cold the house is, how much water we've used or need. It's a very efficient stove. Because we're in a smoke control zone we had to get a stove that was exempt from the smoke control regulations because of the cleanliness with which it burns, and in order to get that level of cleanliness it needs to be a very efficient stove so it's very good at converting the energy in the wood into heat.

Ben: And let me see if I understand this correctly. So what's happening is when that heats it up in the winter you haven't got enough from the sun to heat up your hot water so you'll be using this, and then the heat from the stove, somehow it's not making this space really, really hot because it's feeding that excess into a store? I probably said that in a really bad way, but is that sort of what's going on?

Tim: Yeah, that's exactly right. In the winter the harvest from our solar thermal system, and for that matter the solar PV system is very modest. There's very little heat or electricity in the depths of winter that you get. So our wood stove is where we will get our heat from and it's a wood-burning boiler stove so it has a water jacket integrated around the body of the stove with a flow and return pipe coming out of the back of the stove. Those pipes run into our hot water cylinder which is our thermal store, and that hot water is then available for us to use for the underfloor heating in the ground floor, for the radiators in the first floor, for the towel rails in the bathroom and shower room and for our domestic hot water for our taps and showers and bath.

Ben: At what stage was the house coming back together and you could seriously think about moving back from the house next door in here?

Tim: Well, the works that we'd done to the new wall happened pretty quickly so in the space of six weeks the new wall was built and the roof was about to come off. Then the works shifted to the inside of the building once we had moved out. The floor was dug up, the walls were taken down, the steel went in and we sort of continued in a vein of stripping things out internally and then started putting things back together. The airtightness membranes and tapes were put in, the plastering was started upstairs, we'd stripped out the bathroom and the shower room so then the plumbing and electrics first fix started to go back in and steadily the house started to come back together having been seriously ripped apart.

I mean it was very much back to just the shell, so it was re-wired, it was re-plumbed, all the windows were replaced and we took down some of the internal walls on the ground floor. So it was just back to the very bare fabric of the shell of the building but as we then started putting it back together it took shape again and there were various stages I suppose that it kind of jumped forward. So when the floor had been dug out we then laid the insulation, the underfloor heating was put in, and that then the new floor slab was cast. So that was a big step forward to suddenly get back to having a solid floor again and not walking around in the dirt. When the plaster boarding was done that started to make the house feel a bit more like a house and less like a building site, then when the flooring went in again it started to feel much better and the windows as well. Putting the windows in, that was a big step forward on the road to it returning to our home.

Ben: Often this question crosses my mind and having seen this myself and the amount of work that you've put in it, have you ever equated it against a demolition and starting again from scratch, because it's so difficult to know the amount of work and the amount of energy and all those things if you could've recycled all those bricks, how do you think that would shape up?

Tim: Well one of the architects that we spoke to about the project did say had we considered knocking it down and starting again. That I think would have been challenging and probably our neighbours would have found that very difficult to come to terms with. The fact that we're end of terrace and not detached would have meant that there were complications in terms of shoring up the neighbouring house and any structural damage that might have occurred.

We also wanted to use as much of the existing fabric of the building as we could, so that we didn't incur any additional resources, and particularly the emission of additional carbon associated with the fabric of the building that was okay and that could remain. One might argue that actually there wasn't a lot of the original building that was left, but there was the walls and the timber in the floor and the timber in the roof and the roof covering itself we took off and put back on, so we felt that although we went a long way to take the building apart there was enough of what was left that we should keep it.

I think because of the challenge of retrofit it's good to explore how best one can do this kind of thing and for example, with the floor if I did it again I might not actually dig up the floor slab because that

was a lot of work. It cost a lot of money, it was a lot of time and logistically we had to deal with all the rubble and soil. It would have been a much quicker, easier, cheaper solution to do the insulating skirt around the outside. Not quite as ambitious result, probably good enough in many cases, but in a sense it was only by doing it that we can now say, well it's a serious undertaking and you might want to think very hard about whether you really want to go down that route.

In relation to the project as a whole we don't hold it up as an example and say that everyone should do it like this. It's a case of this is how we did it and let's see what the results are like. Let's look at the costs that we've spent and see how we can achieve the same or better result in a quicker, easier, cheaper way next time round.

Ben: I have no doubt that you are very happy with your house. You mentioned cost though. Are you happy with the money that you've put in to it to create this house?

Tim: It's cost a lot of money to do this refurbishment, there's no getting away from that, and there will be a limited number of people who want to spend this amount of money on making their house energy efficient. However, we haven't just made the house energy efficient, we have done a refurbishment to the house that has updated it. It was some 46 years old. Very little had been done to it prior to that.

How you disentangle the cost of refurbishing it in an energy efficient way to the cost of a high standard refurbishment is difficult. I mean, okay if you might have said well there was a mixture of uPVC double glazed windows, some of which were okay, some of which were failing. There were a few single glazed original metal windows. Somebody might have taken the view well we'll replace all the windows. They might have only done double glazing. We've gone for triple glazing timber windows, so we have spent more than somebody might have done if they weren't as focussed as we were on energy efficiency, but there's a marginal cost there that we have incurred to make it very energy efficient and I would say that that marginal cost is not massive. I mean we spent something like £15,000 on our windows. You might easily have spent £10,000 or £12,000 on re-glazing the whole house with cheaper, double glazed windows. So £3,000 - £5,000 maybe we spent more on having these triple glazed windows. I think over the lifetime of the windows, the next 40 years, I think that's probably a reasonable investment.

Ben: It may be too early to answer this next question, but what has it been like to live in this house for the first few months?

Tim: Yeah, it is pretty early in some ways and there has been ongoing works that we've been doing to finish off to turn the house ultimately more into our home and less like a building site. And the list of outstanding jobs is diminishing and it is indeed becoming much more like a home and we're really starting to enjoy it. It's really nice having the open plan living space, having the new kitchen, and enjoying the benefits of the renewable energy systems that we have. So it's been quite a nice summer and there's been lots of sun and we've had a good amount of hot water as a result of our solar thermal system, and that makes me feel good that actually we've not been burning gas and we've had lots of hot water. So that's been satisfying. There've been some teething troubles along the way. At some points we've had too much hot water and we're putting in place the solutions to address that so that it doesn't become a problem.

Ben: What happens, sorry I've never heard that before, you've got too much hot water? Does it all evaporate?

Tim: No, because we have a larger solar thermal system than typically one might install, we've got 9m<sup>2</sup> of solar thermal collector. Therefore on a very hot day, or particularly after several hot days and particularly if we're not at home or we've not been using very much hot water, then the hot water in the cylinder in the thermal store can get hotter and hotter and hotter and it can get to the point when it starts boiling. And that's not good for the cylinder and it's not good for the plumbing connected to it so we want to avoid that happening. There is a failsafe that means that at 95 degrees it runs hot water down the drain. That's not something that we want to do, so we have a heat dump circuit which means that when the tank gets to a certain temperature a pump will switch on and it will pump hot water down a pair of pipes, outside the building, into the garden where we have our log store. And we've got underfloor heating in our log store so that we dump the excess heat, and it will help dry out our logs ready for the winter.

Ben: I like it! Are there any other challenges or anything that we haven't mentioned that we should do about the build?

Tim: I think it's been challenging in many ways. I think the research and looking at the options, when you undertake a project of this type there are a myriad of options and decisions that you have to take, and that in itself can be quite exhausting because of the level of

research that one has got to undertake. Determining actually which option you want to go for and whether the product that you're looking at, whether it satisfies your needs in terms of energy efficiency, in terms of aesthetics, in terms of cost, in terms of manufacture, in terms of sustainability of the materials that have been used.

So there's a whole raft of different issues that one's got to look at and that's why one of the aspects of our project that I've been trying to do is to share our experience through our website and list the products that we've used, the suppliers that we've used, the specification of the products, show photographs of what we've done, so that we don't sit sort of smugly in our house feeling nice and warm and cosy, but actually we can share some of our experience, some of the successes, some of the failures and help other people that are thinking about doing a similar project to learn from what we've done.

Ben: Tim, thank you very much.

Tim: You're welcome.