Episode 93

Building a House . . . And 10 Years Later Retrofitting It

The show notes: www.houseplanninghelp.com/93

Intro: What happens when you build a house and then learn about the Passivhaus standard? Well, energy adviser Tad Everhart from Portland, Oregon, decided to retrofit his home! He's a lovely guy and he's going to share the story with us today.

I started by asking him how he got into ecological construction.

Tad: My brother was a contractor in college, working his way through college in summer and my parents were always fixing things up. They added onto their house when I was a kid. After the energy crisis in the US in the 70s, my dad built a solar office building that my sister designed and it had thicker walls than code required and he was kind of a pioneer in that. So I guess I come at it from that view.

And then I was just a traditional builder for about 8 years and by training I'm a lawyer, and I've been a lawyer for 28 years so I've had first a legal career then a career as a builder then back to being a lawyer. And I'm very conscious of the environmental challenges that we face so in 2008 I heard from a friend, who is a very experienced green builder, about Passivhaus, and looked at this and said wow, buildings that don't need a heat source that's wonderful, and took the training and took it from there.

Ben: What I was interested about, that you told me that you built a house to begin with and then you retrofitted it at a later date. So we're not going to go too far yet, but how was that experience of building your own house?

Tad: Oh, building my own house was great. Actually I've built two houses for myself. When you're a builder and you're building on a speculative basis, if you complete a house and you can't sell it often times you end up buying it yourself. And that's how I built the first house that I lived in. It was our first project, we built it in 1992 and didn't sell right away and it's good value, and so I bought that and

then I met my wife and we were going to start a family and so we built a second house in 1998 and it was kind of our dream house.

Building it was not a great experience. A lot of things went wrong, but we designed it and it was in a neighbourhood where we had been building houses. It was actually one of 10 houses in the sub-division that my brother and I developed. The process is difficult as a builder and having employed these sub-contractors for years and paid them regularly and complimented them on their work, I thought they would rise to the challenge and build like an extra special building for me. And the plumber messed up and flooded the house, the electrician drilled through a structural beam. It was just not a happy situation.

And actually that was one of the things that caused me to leave the building career and go back to being a lawyer. But the house turned out great. I mean it was a wonderful house. In 1998 pretty energy efficient for its time which made it all the more painful to start taking it apart only 10 years later when only a small fraction of it was paid for.

Ben: Do you still live there now?

Tad: Yes. We have to live there a long time to enjoy what we've created! And to pay for it! [Tad laughs.]

Ben: Once you had the house, when was that first realisation that you could go further, or perhaps that you had to go further? You really wanted to, what was that motivation to retrofit it?

Tad: Oh well the motivation to retrofit it was really an accident. I took the training in 2008 to become a Passivhaus consultant and I was the first person in Oregon to take it. And I was, like everyone in our initial class of 30 people, I was on fire, this is great, we all need to start doing this. This is the only way to build buildings.

And so I immediately looked for a plot of land where we could build a demonstration Passivhaus. And my brother was still general contractor and we looked and we had brokers finding property for us. And at that point we were right about ready to tip into the housing crisis and everyone could see it coming who was watching, and so I didn't really want to tie up $100,000 on a lot that was going to be worth half that a year later, and invest all this money in something that might not really fetch the value.

And so I spent about 6 to 9 months looking for a lot and then just finally concluded that that was... We actually made some offers on lots and went out and negotiated.

And finally I was talking to my wife and you know I said we have a lot of equity in the house because we built it ourselves, we only owed like a quarter of its value, and you know we might as well enjoy it. And as a lawyer I'm always conscious of liability. It's kind of like a lot of this stuff is not really well developed yet, so if we did it on our own house we would be the victims of any mistakes and we would not be having to worry about being sued by someone. And so we started talking about that and developing plans to retrofit it and everything fell into place.

It was easy for us to get financing. We had a lot of equity, we were able to get a home equity loan to borrow a bit more and my brother agreed to donate his services as a general contractor. A couple of carpenters were intrigued. We met with them. They were like maybe Tad's crazy but it kind of sounds interesting. So we dived in and as all things go we didn't start at the right time. I got certified by January 2009. The process of trying to find a good lot took 6 or 9 months so it wasn't until September, the first day of school, that we started taking apart our house and of course that's one good month of building weather and then the rainy season starts.

Ben: You mention some of the issues that you had around finding a lot. It's a similar situation that I'm going through at the moment, trying to find land in the UK and being in a place that's really a good distance to commute into London. It's really, really hard. So what were the issues? Why was it taking so long? Was it just the price you were trying to get something that was a bargain?

Tad: No, it was, they were either lots that didn't have a good orientation, that were very expensive, that were close in the neighbourhoods where we wanted to live, because both my wife and I commute downtown to work by bike, and we wanted to stay in our neighbourhood because our kids were in schools. Or it was to go out to neighbourhoods where lots were less expensive and the worry was that if we built a house in those neighbourhoods those might be people that would never be environmentally conscious enough to appreciate the value of a Passivhaus, so we would spend all this extra money to build it and then not be able to recover that. So everything kind of started pointing to just do your own house for us.

Ben: I imagine it's a massive benefit when you're doing a retrofit that you've built the house yourself?!

Tad: It's a massive benefit but it's also incredibly painful because we had a 30 year mortgage so I think we had paid the mortgage down from like $120,000 down to about $70,000 and all of a sudden it was kind of like you know what, in 15 years we could have the house all paid off, or we could put all this money into it and not have the house paid off for another 30 years. I'm not young. We started this project when I was 54, I guess. But my wife was really pretty supportive. She said you definitely want to do this and you're not going to be happy unless you do it, and it's important to do it!

So it's bad from tearing apart things you've created, it's really an asset though because you know exactly what's there and when you retrofit buildings most times you have no idea or no certainty about what's behind the finishes. I had the benefit of having seen all that and photographed it.

Ben: I almost want to jump the story to find out whether you're happy with everything you've done at the end, but all in good time! What have you done to the house?

Tad: Originally what we were going to do was add 10 inches, I guess for you folks in the UK that's about 22cm.

Ben: That's alright we can work in inches! [Ben and Tad laughs.] Inches is good!

Tad: Can you work in inches?! [Laughs]

Ben: Yes we can, we're very multi-skilled maybe!

Tad: Okay, well coming out of Passivhaus training where we're all putting on a freak show with feet, pounds and inches! So yeah, it's 10 inches. Originally it was going to be 8 inches and then we ran the software and we wanted to achieve the Passivhaus standard so we thickened it to 10 inches, we knew that wouldn't make any difference. So the idea was we would just add 10 inches to the outside of the walls on all 4 sides of the house. You know, we would get new windows, Passivhaus quality windows, and we would put in a heat recovery ventilator because at the same time we're doing all that we'd make the house more airtight. So it was a relatively defined scope of work.

And then what happened is as all re-modelling projects do I'm told, the scope expanded almost exponentially. Because we took off the Sheetrock, it would be your lath and plaster, on the inside of the walls to resize the windows and found that the fibreglass insulation had already signs of water damage. You could see the moisture was condensing on it and dripping and it was getting discoloured. We could see air leaks through the walls where you could tell that air was bringing not only moisture but probably contaminants because the pink fibreglass bats were stained.

At that point we kind of said we're taking so much Sheetrock off the inside of the walls anyway, let's just take it all off, except for the kitchen and the bathrooms where we didn't really want to do too much work. In the end we took off the Sheetrock off the inside of the walls on 90% of the house.

Ben: Can I just jump in there for a second because this insulation, presumably the first time round you would have been keen to get it right? So in 10 years, something that you've overseen, did that concern you at all?

Tad: Oh yeah definitely. I mean we followed standard building practice. Every part of the construction was inspected and approved by the building official. It just goes to show you that the standard building practices don't result in a building with durability. And that was on the inside.

On the outside actually the house was in pretty good shape. We took extra time taking the wood siding off the building in a way that we could reuse most of it. Ultimately we were able to reuse about 60% of it. It's not great looking because it's got some nail holes but over time as you paint it it's looking just fine.

So the first part of the project was, we've got $80,000, we're going to build these Larsen trusses 10 inches thick, put them round the house and fill them full of cellulose insulation. At the same time we can see that we've got to take the bats out of the inside so we'll blow in cellulose on the inside of the walls. And that part of the project was kind of a discreet part and it went well but it was very costly.

And so at that point in about 4 months we had that process completed. We had the new windows in. We had the new Sheetrock on the inside of the walls, the Larsen trusses on the outside and our money was gone. Because we had 5 carpenters

working and we were paying them pretty much from $25 an hour to $40 an hour and it goes fast when you have 5 carpenters working.

Ben: That's just the walls?

Tad: That's just the walls! So the money's spent and then it became kind of the do it yourself endurance marathon because the money's spent and we had more money but it's kind of like, wow you can spend that much money that fast! You know, what could you do in a year?! We can't do that!

So we on our own air-sealed the attic and insulated the attic. All but the last part which was to hire someone to blow in the insulation. But we did all the air-sealing ourselves, a lot of the special insulation around the perimeter of the roof where it's hard to get that sufficient depth and thickness of insulation. And then we went into the crawl space so we...

Ben: What's that? I'm not sure whether this is just something...

Tad: Yeah, you don't have in the UK, like in the eastern part of the US in the mid-west, most houses either are built on a concrete slab right on the ground, or they're built above a basement. We have what are basically miniature basements, about 1m tall, and that just allows air to circulate under the house so there's no moisture.

Ben: Got it.

Tad: And that's because we have wood floors. So I crawled under there, and that's why it's called a crawl space as only about 2ft of room for you to crawl around, and the insulation was just awful. It was fibreglass so every time you went down there you got covered with this itchy, dirty stuff. And we kind of concluded it was best just to get rid of all of it.

So one horrible day I put on full body armour basically! Went down there and ripped it all out, brought it out. There's just a kind of a hole in the floor in a closet where you can lift everything out. We filled half of our garage with it. My wife put a notice on Craigslist and someone came and fortunately took all of it for insulating their garage. And then we cleaned it. It was a lot of work to clean it. We wiped it down, vacuumed it and then air-sealed it. We got caulk and sealed all the seams in the plywood, so it was actually pretty airtight, but we made it as airtight as possible. And then we bought 207 blocks of EPS foam. And the floor is plywood on top of 2 inch wide by 10 inch deep lumber joists.

Ben: We'll get some pictures that we can put into the show notes just to make this clear because sometimes when we're talking about things we can visualise it here and other people are thinking what?

Tad: So, the floor joists are just boards on edge that support the floor and they're about a foot and a half apart. And so all the Styrofoam blocks were cut at the factory to fit between those boards and so we basically laid on our back and my youngest daughter who was, let's see, 8 at the time, she was the best worker in the crawl space because she was small! [Tad laughs.]

Ben: So you're under the house, looking up and attaching it just with, how are you attaching it to the house?

Tad: So at first we thought we'd just push them up into place and then shoot around them with liquid expanding foam. But that's messy and it drops on you. So we just took wooden shims and pounded them in place. I mean the Styrofoam's quite light, and we were going to put a second layer underneath those. So we just put the first layer up, almost temporarily, and once we got all of the first layer done then we ordered the second layer and it was not so thick. The first layer's about 10 inches thick, the second layer's roughly about 4 inches thick. And the second layer's screwed into the pieces of wood so the second layer holds the first layer up. It can never fall down. But now our floor is basically about 14 inches of EPS foam so it's warm to the touch all winter.

Ben: I think we've covered most of the house in terms of insulation haven't we? We've done the walls, we've done the ceiling and down under the house. What happened next?

Tad: So, gosh, what was next in the initial work. We had put in the heat recovery ventilator system and that's always performed flawlessly. My wife can hardly stand going into some buildings now because you're used to that really nice fresh air. No odours, no staleness. So that went smoothly.

We noticed, and talking to other experts, that because our concrete foundations come right up underneath the floor, that there would be the thermal bridge right under the exterior walls. And we had actually considered lifting the entire house up but it would have just been wildly expensive and cause them to destroy half the concrete foundations. So what we did is we actually hired college students to dig about 3 feet of soil away from the house on all the sides and then we added Styrofoam blocks to the outside of the foundations

and then a 2 inch layer of FOAMGLAS, because FOAMGLAS is impervious to insects, rodents, UV, it's waterproof, so it's a nice kind of armour that's insulating as well. So we added that to the outside and that's helped the energy performance of the house.

Couple of other things that we've done in the following years, is I had learned about clothes drying cabinets when I was a Passivhaus consultant, and yet no one sold them in the United States. And a clothes drying cabinet is this fantastic way of using the air that's already moving through your house with a ventilation system, to run that air through hanging clothes to dry them. And we had always done that just by hanging clothes in the bathroom but for something that's a little bit tidier we wanted a cabinet.

And we had a hard time finding one but ultimately did find one and so the air is pulled into the top of the cabinet. The cabinet is about 6 feet tall, 2 feet square. It's just a metal, white metal box basically with a door on the front, and you hang up clothes on the racks in the dryer, close the door and hit the setting and basically it'll either pump fresh air from the house without heat, or it'll heat the air from the house. It goes in, circulates through the clothes and then pulls out and goes back through our ventilation systems. So people joke about heat your house with a hair dryer, I obviously have no need for a hair dryer being bald since the day I turned 30! So we now say we heat our house with our clothes dryer, because all the warm moist air goes out of the clothes dryer and goes to the HRV where the moisture is ejected to the outside but the heat is recovered through the heat transfer core. So it's worked out quite nicely. This is the first full winter that we've experienced and I can see a drop in our energy consumption.

Ben: I've never heard that one before! In terms of the airtightness once you've done all this work, was there a lot that surprised you or were you hitting the airtightness that you wanted fairly quickly?

Tad: Yeah, so we have had I think 4 tests at different stages of construction and we thought that the walls, we were hoping that we'd put the Larsen trusses around and we'd be 0.4 and we'd rock and go out for beers, and it didn't happen that way! It was more like, well, you're down to about 1.0 so then in the process of doing the attic and the floor it came down even lower and then we taped and caulked the electrical boxes, we taped where the walls meet the floor and we did a little bit more airtightening when we put the insulation on the outside of the foundations, and we think we're right around someplace between 0.5 and 0.7. We will get a final

blower door test this fall. So we'll either make EnerPHit standard or with any luck the new Passivhaus standard.

Ben: Are there any other stages or parts of this before we get towards the end and start seeing how is this for you?!

Tad: Yeah, yeah. So we're doing a couple of other things that are kind of, you know it's your own house so you can try it, we're using foam insulation to trim around the outside of the windows and the inside of the windows because that's a common thermal bridge and I just wanted to try it to see if that would work.

The clothes drying cabinet we call Lady Asko because she's tall and white and made in Sweden! The girls call the HRV, they call him Harvey, so Lady Asko next to Harvey! Those have been done and there's really not much to do.

The only other thing that we've got, we're putting in a light well. Our kitchen doesn't have a window in it and so it gets a little dark in the corner and we upgraded to all LED lights but it's still I hate to turn on lights if you don't need to. So the room above the kitchen actually has two windows, one on each side, and where they coincide it's always nice and bright so we're actually going to put a plate glass panel in that floor so the light will come down into the dark corner of our kitchen so the idea's that we'll do light recycling. So that will finish the project and I'm hoping that we'll have that by the end of the year.

Ben: And all of the time you were in and using the house?

Tad: Yeah, we lived in the house even without Sheetrock and without any insulation all the fall that we did the walls. We were gone out of the house for about 10 days when they were hanging new Sheetrock and plastering it, and then for one day the painter came in and painted the downstairs and then we made a family project of painting the upstairs. We made it a family project to put on the siding on the front of the house. It's been a family project to paint, re-paint the outside of the house, yeah.

Ben: Here we go then. Here is the million dollar question then, was it all worth it?

Tad: Yeah! My 17 year old daughter will never admit it, at least probably not until I'm dying and she wants to be sweet to me, but she's really proud of us. She's kind of embarrassed when we talked about our

project with our friends, but she's said some things that make it pretty clear that she's proud of what we've done.

My youngest daughter, not being such an old teenager, is genuinely proud of what we've done. And they both, well my eldest daughter feels that she says you know that there's no hope, we're all going to die, climate change is just going to take us all out. I've never talked to my youngest daughter about climate change but you have to take action. You can't wait for other people to do it. I mean almost the worst thing that happened in America was when Obama got elected. Because then it's kind of like well Obama's going to take care of everything. He's going to sign the climate change legislation, he's going to put a tax on carbon, he's going to fund everyone doing this, and it's so unrealistic.

Ben: But none of this really we should leave to anyone else, which I think is probably what you're trying to say. There is a side for politicians to set laws and agree this and that. I think it does come down to assessing our lives, seeing where we're at and then just constantly trying to improve it.

Tad: Exactly. And that's what angers me is that a lot of people are waiting for the politicians to take care of this problem. You cannot wait for politicians. You need to jump in. And that's what's exciting to us. Since we've done our project we've met other people that have retrofit their houses and other people that have come on tours that are saying you know I'm going to do this. And they're genuine and they may not do as extensive a job but I know they're going to do it and I've seen some of them start and they're under no misconception that it's going to be easy or cheap, and yet they're going to do it. The revolution begins with you!

I think the biggest advocate has been my wife. She jokingly said Tad this is either paying this $100,000 to retrofit our house, or you could go get a PhD, so consider this project your PhD. But she's totally on board with it. She's become as, probably more adept spokesperson for Passivhaus than I am. I think it's been, for our family, a cool project. You know we're not the Swiss Family Robinson, we didn't get on a ship and go someplace, but we did take our family into effective action to solve this crisis that requires everyone's best efforts.

Ben: And finally, if someone is thinking about retrofitting their property, realising how big a job it is, can you give any advice?

Tad: Yeah, the advice I give you is to talk to everyone who has any remote chance of helping you, and you will find that without exception they will provide something that's helpful.

You know my dad when we were doing a project, he was pretty ill. He was in really bad health and he would still sit on his window and ask me what we'd done and say time to get it done. My mum said if you guys run out of money and you need more money just let us know and we'll loan you the money to get it done. And she actually came over and helped paint because she's a perfectly good house painter at 87 years old!

And my sister, my older sister we're really close. She was the best worker because a lot of the men that came on the job, kind of traditional contractors and carpenters, they'd always question you. Like why are you getting it so airtight, like let's just do it and get it done. My sister just went what do you want me to do and then she worked meticulously. She is the best person for making a house airtight.

I've got a list of like 50 people that I asked for help. Some of them I paid but they always provided more expertise than what I was paying them. And actually the only times I got into trouble was when I tried stuff and didn't check it out with my friends. So what you find in the Passivhaus community is this intense realisation that we all can learn a lot from each other, and we've all made enough mistakes that we might as well tell each other the mistakes we've made.

Ben: Tad, really enjoyed this, thank you very much.

Tad: Cool.