

Episode 56

Which Build System is Best to Create a Low Energy Home?

The show notes: www.houseplanninghelp.com/56

Intro: In this episode my guest is Piers Taylor from the Invisible Studio Architects. You may know Piers, if you're in the UK, from the TV show *The House That £100k Built*. This is £100,000 and just showing that it's entirely possible to do it on this tight budget. If you're listening out in the States that would be around about \$170,000. A second season of that coming soon, although today Piers is helping me answer a question from Arun Alex on building systems.

However, I started by asking Piers how he got into architecture.

Piers: OK so I was a mature student when I started architecture. I had had parents that were interested in engineering, architecture, design, those sorts of things. My mother was a really progressive interior designer that was Australian, that came to this country in the fifties and was amazed by the sea of beige. My father was a ship designer and was interested in mechanical objects. They always lived in really interesting houses, so really interesting houses that my mother would completely strip out and remodel in a really unconventional way.

But what's interesting is that I didn't know that I wanted to be an architect until I was travelling in Australia, my first child had been conceived very young and I suddenly realised that I needed to go back to university and get my life together. I'd gone to art school as a kind of wayward late teen and was uncertain about what I wanted to do so I had founded, founded sounds too grand, but set up a construction company and went travelling in Australia. My eldest child was conceived, realised I needed to go to university, enrolled in Sydney in graphic design actually, strangely. The first term of design in that design school in Sydney was a shared design school. So architecture, graphic design, interior design, industrial design all shared the same first semester. Now what was interesting was that the first talk to this shared group of people from multi-disciplinary subjects was an architect called Glenn Murcutt who is an extraordinary figure, a charismatic architect who is passionately

interested in the environment landscape, the wider context of how you place buildings and as soon as he opened his mouth I realised that I wanted to do architecture, and went out of his lecture and re-enrolled in architecture. He changed the course of my life with one talk and that was 25 years ago or something.

Ben: And going strong still. Well we like to focus these episodes down. I know that there are a few things given the work that I've seen through your TV shows that I would like to talk about at the end. First up I have a question here from Arun Alex. I'm going to read it out and then maybe we could go through and address some of these elements.

He says: "One really important topic I would like you to explore is the best building systems to achieve a Passivhaus standard. I would love to hear from an unbiased source...." Is that you?

Piers: Yes I'm unbiased, very much so.

Ben: Good OK, unbiased source, "...the differences between SIPs, masonry, ICF, timber frame, etc. and perhaps give an idea as to which system makes the best environmental and economic sense to achieve Passivhaus standard. And also explore the insurance and mortgage feasibility of it at some point as many mortgage companies are averse to modern building methods."

So that's quite a lot to take in. Maybe we can start at a basic level. What is a building system?

Piers: OK so there are lots of ways of constructing a building. I think of it actually in terms of lightweight or heavyweight and within those camps there are various subsections, different ways of doing things. Let's widen this up a little bit and look at this issue to do with heavyweight construction and lightweight construction and also on-site construction and off-site construction because I think, crudely, most buildings fit into those categories.

Dealing with houses, or let's deal with one-off individual houses because one-off individual houses are very different from housing where you have repeated units and the economies of scale. All houses need to be constructed from something and the question is what is most efficient, what is most economically sound and what is best environmentally. I instinctively think timber, because timber for me is a material I know, I'm used to it. It has of course sustainable credentials, it's a renewable material etc. etc. etc. In this country we have huge stocks of untapped low-grade timber that's entirely

suitable for construction. What's good about timber is that it is very very workable on site and people, everybody knows how to work timber. Every builder, every carpenter, you know, it's a readily available material that a lot of people know how to use so it's an unskilled thing, people with a limited amount of skill and very ordinary skills can do it, and it's easier to get a good quality finish with a lightweight timber building.

So for 20 years I've been sitting on the fence between heavyweight and lightweight construction. I've done very lightweight buildings and regretted it and then I've done heavyweight buildings but now I suppose my instinctive position is that lightweight buildings are easier to achieve quality, and quality in terms of how the building performs. So let's assume we are talking about timber. Timber if you make something off-site is typically more expensive because if you make something in a factory where you are paying for lights and heating etc. etc. etc. and rent, all those sorts of things it's more expensive than doing it on-site. I was labouring under the misapprehension that it was better to always prefabricate things. It generally isn't. I still think the simple fact that people making things by hand on-site is the most efficient way to do a building in this country if you are talking about a single building and that is with sticks and studwork effectively.

The lowest common denominator of building systems is a stud frame and I think that is still the most efficient way to do a single building in this country because it's incredibly cheap, it's incredibly quick, it's incredibly widely available. You can do it on site, doesn't need any off-site construction and anyone can do it. My feeling then is that Passivhaus construction depends on getting airtightness critically and depends on workmanship. With that system you can get airtightness and the type of building that allows the insulation to be, minimum thermal bridges etc.

That's my kind of simple response. Let's just talk a little bit then about why it's hard to achieve with a masonry building. With a masonry building you're dealing with blockwork and wet trades, and it's always been difficult and expensive to get a good quality finish with wet trades. They're the sort of materials that ground workers and block workers throw together very crudely because they assume someone else is going to finish those things and I'd say proportionately there are far far fewer Passivhauses that are masonry than timber.

However, masonry has huge advantages in terms of its thermal mass so thermal mass is something that's a heat store and

effectively you get radiators for free in a building that has thermal mass. So the only drawback with a lightweight building is that you don't have thermal mass. There are hybrid buildings where you have concrete floors or concrete ground floors and then above that lightweight timber construction that is super insulated and well sealed and taped.

Ben: It's quite interesting in Arun's question how he was saying an unbiased approach and view of this. Is it worth going through each individually or do you find yourself generally just using timber framed projects now because that's how you have settled because of your experience?

Piers: Well I think as you get older you make decisions that in theory are based on experience and you develop an instinct for things but I'm still I would say unbiased. I don't use timber because it's timber. When I started out I was suspicious of timber, in a way suspicious because it came as a position of bias, it seemed that everyone who liked timber thought you had to use it and was really full of misinformation about things like concrete. Now concrete is for example the world's most environmentally sound material in terms of . . .

Ben: Whoa, whoa, whoa, we've got to slow you down there! Really?

Piers: Well the problem with concrete is the amount of concrete that is used not the raw material itself necessarily. Sure there are all sorts of problems with its manufacture and the lazy use of concrete so let's just step back and look. If you substituted concrete for any other material in roads, in big span construction, in tall buildings it would have a far greater carbon footprint. So if you use steel, for example, you would have a far greater carbon footprint than concrete.

Concrete has its places, it makes fantastic foundations, it makes fantastic, you know, cores to buildings and it has its place. It isn't necessarily always a bad material. I think that the problem with concrete is its ubiquitous and lazy use. I think at a stroke you could halve the use of it and then I would say quite quickly you could get down to 25% of its current use. I think if you took what's left, the key infrastructure projects, you'd have about 20% of the current use of concrete. Then we can start to explore things that could be different and timber is the one thing that I haven't mentioned in this context because, of course, it's difficult to build tall buildings in timber. Now we're getting up to eight storeys etc. etc. Over time timber technology will allow us to replace concrete and, sorry, when

I say the most environmental sound material I mean in terms of big span commercial buildings and infrastructure projects. For houses there is no need to use concrete really unless you desperately want the thermal mass in the floor, I would say there is almost no reason to use concrete in a house.

Ben: So these build systems, how do we compare one to the other? What are the factors that are going to change between them as we look at the independently?

Piers: Assuming that we are talking about houses because that's the thrust of this, I think that in a way houses are usually quite simple things in terms of their construction. They are usually one-off bespoke projects that aren't repeatable. SIPs panels you don't usually get the advantages of economies of scale or again in houses where you are dealing with conventional spans, even in interesting buildings you are dealing with spans that aren't vast. You are not dealing with a project that's three dimensionally incredibly complex. SIPs panels are fantastic for some things but in a building like a house I struggle to see the real advantage of SIPs panels because they are expensive, they contain all sorts of formaldehydes and glues, and they are made in a factory and thus people on-site can't just put them up and you are paying for the overheads of the factory and everything else so . . .

Ben: But it must have a speed factor when we talk about SIPs on-site?

Piers: Yes it does. You are absolutely right. All timber frames are quick. What's interesting about timber frames as opposed to masonry is it allows you to get your roof on very quickly, so you can have your roof on in a matter of days in a lightweight construction. Block work, you are starting from the ground and you're working up and then eventually you get round to putting the roof on. Timber frame, you can put the walls studwork up in a matter days, get the roof studwork on and get the roof on very, very quickly.

Similarly with SIPs panels the advantage of it, if you take the cost out of the equation, it's hugely full of potential in terms of speed, in terms of saving time because you make it in a factory come to site and you put it up and, bang, your roof goes on. But actually you could say making a timber frame in a factory would be just as quick, you know as SIPs panels. So SIPs panels aren't intrinsically better than timber frame for any type of construction other than, what's good about SIPs panels is that you do away with beams effectively because they are in themselves structurally, they have a structural capability. So for example you can use an upstand of a wall to

make a beam to hold up the floor below if you like. When you have an application when they are repeated, for example, when you are doing 20 houses or 30 houses I can see SIPs panels are fantastic.

For bigger buildings when you are dealing with big span roofs they are fantastic. You know by changing the roof construction in a library, which a friend of mine did, they saved 21 years of operational carbon by going from steel to SIPs. That was an extraordinary saving so SIPs panel are fantastic but in domestic buildings you rarely see the economies of scale.

Ben: Just rewinding a little bit when you were talking about the timber frames and how constructing it on-site without going through a factory, how would you be doing that? Would you just be cutting it up manually each day as you go? Sorry I just couldn't picture how .

Piers: Good question. Well timber frames are quite simple things. There are two types of timber frames. One is a post and beam frame where you have big posts and big beams, and then you make a frame on the ground effectively and then you lift it into place. I've done that quite a lot. There are also a kind of balloon frame, a lightweight skinned frame where you have studs that are then sheaved in another material to give them a kind of rigidity. And actually you start at the bottom again. If you want to make an in situ panel frame you can, you put a wall plate up, sorry, sole plate and then you put your studs up then a wall plate and really it's as simple as that. They are pieces of timber that people can handle very easily, they are very lightweight things so timber frames are very low tech things. They are bits of 89 x 38 or 50 x 100 or 150 x 50 bits of timber and I have to say in probably 20 years of doing this I've almost never had an off-site timber frame manufactured, except for the most bespoke one-off post and beam type frames that are oak or larch or very particular thing made by craftsmen in their yard. For stud frames I have never had one made off-site. I've always wanted to, I haven't resisted it, it's just for me I have never found the economies and when you design a project you put it to the market you take what the market gives you and this is contractors telling me it is no cheaper to make it in a factory.

So last week I went up to the Midlands, to Leicester, to meet a big volume house-builder to look at doing some work with them. These people are hugely efficient in terms of their construction, their construction method is highly evolved. We may not like what they build, and I don't particularly like what they build but their method of construction is engineered down to a tee and they don't make

timber frames in factories. They make the components, they make the studs, they make the doors, they make the beams and bits and pieces they need, but they will always make things on-site because they are not paying the overheads of the factory, they are not paying the heating, they are not paying rent basically.

Ben: I think that is the first time I have almost heard something semi-positive about houses that are mass produced if we can find a glimmer of light in there.

Going back to Arun's question initially he was saying to reach the Passivhaus standard, so can you reach, I think the answer is yes, but can you reach the Passivhaus standard with any construction method?

Piers: Yes there are masonry Passivhauses and of course there are lots of timber Passivhauses so there are heavyweight and lightweight, absolutely with all methods of construction. Remember that Passivhaus, Passivhauses don't depend on thermal mass all they are interested in is building performance and energy use really. That's the kind of core of it and it doesn't matter which constructional system you use as long as you achieve those things and with both systems they are achievable. It's just more complicated I think or harder because it depends on ultimately we are talking about skill and craft and technique and craftsmanship. Those are the things that allow you really to achieve a good standard of fit which is what a Passivhaus is all about and that's harder to achieve with a masonry building.

Ben: If we look at things like straw bale construction, is that another building system? How many are there?

Piers: Yeah good question. I mean straw bales are nice, they are low tech, they are available, they are cheap. They're relatively inefficient because they are big, they are not particularly good insulators. I mean a 600mm thick straw bale is about the same as 150mm of rock wool or standard insulation. Usually they are a labour of love, people use them because they want to use them.

And again this isn't . . . None of this is just about efficiency, remember a building is about a labour of love and it's about eccentricity and experimentation. So I would applaud the use of straw bales if people wanted to use them to find out something, to discover something or because they had a lot of them going cheap or they wanted to use the system that they, you know liked. I'd say if we were just talking about efficiency I can't see a use in that

sense for straw bales but they are beautiful, they are interesting, they're low tech. I mean, I think also that within all of this materials have provenance, they come from places, they have miles that they have travelled, they have history they have character and straw bales have a huge amount of character, huge amount of personality. I love them because they don't need to travel. You can get them from your farm next door, fantastic, I think that's brilliant.

The unsaid thing in all this is that everyone thinks timber is so environmentally friendly but usually it travels vast distances. It either comes from Scotland or it comes from Scandinavia or Canada. I mean that's absurd for me so I would rather use a straw bale that came from my farm next door than something that had to be mass produced in Scandinavia and shipped over and trucked down from wherever.

Ben: And you have their word really that it's sustainable.

Piers: Absolutely. That's absolutely right and more and more we are facing this question. Pre industrial revolution materials spoke of their place: post industrial revolution materials didn't speak of their place they could come from all over and that's something architecture tried to encourage. There was this whole thing called international style. Now the big question for us is how can we use materials that tell us about our place and straw bales can and will and do as can timber if you get it from a local sawmill or a local supplier.

Ben: Does the build system influence the look of the house or is that silly because you'll just have cladding or whatever you want on the outside?

Piers: I think it doesn't need to but I think it is invariably better when it does. I mean I am interested in construction and I like buildings that are talked about in terms of their method of construction. There are some architects I admire very much, you know, like Ted Cullinan who can only describe a building in terms of the method of its construction. So if you sat down with Ted and he drew you any of his buildings he would describe them in terms of the process of construction and I think that, certainly the buildings I've done, I'd like to think that the constructional system was visible and legible. So my own house that's a very crude, simple timber frame, there's a legibility in terms of what's in tension and what's in compression, what's doing the sheathing, the bracing, all of those sorts of things. I really like to think that buildings are immeasurably better from those things being legible and I think one of the things that is so

sanitised about our current method of construction, you know, lightweight timber frame is in that camp is that you don't see the method of construction, it's all this sanitised stuff that sits behind beige plasterboard basically.

Ben: I know that we haven't mentioned . . . Well we mentioned steel briefly. I'm going to go back to the original question and just have a quick look through. He says SIPs, masonry, ICF - I think we've talked about all of these things - timber frame, but steel frame? Is that more when you're talking about bigger buildings? We're houses here unless it's something epic . . .

Piers: Good question. I mean masonry buildings usually need some steel, either ridge beams or lintels or something. And actually, going back to my thing about concrete, I slightly tongue in cheek said concrete had a low carbon . . .

Ben: Backtracking now! [Ben laughs.]

Piers: No, because that's the myth that is fed to you by the concrete industry and strictly in terms of the science of substituting concrete for steel it's kind of right. The problem with concrete is not the pound for pound carbon emission or the tonne for tonne carbon emission, it's the amount of it that's used. It's used so much and that's the problem.

The problem with masonry buildings and I actually think that concrete block is quite an ugly material. There's a beautiful precision with timber. A masonry building with lose steels has to be covered up. There's no beauty in that construction. You have to cover it up because it fits so badly. You have to put a layer on top of it that allows you to keep the air in and the air out.

Steel frame in domestic buildings is usually, again, not terribly efficient because you don't have the spans that necessitate a steel frame, even if you're dealing with little steel studs it's much less ubiquitous than timber manufacture so you pay a premium to get people who know how to work steel. Again I've hardly done a steel framed house. I don't think I have done a steel framed house. I've done a house with bits of steel frame in but I haven't done an entire steel framed house because there's never been the need. The market has never let me do it. It's always been too expensive and so on.

Ben: I probably should have thrown this question in a little bit earlier but at what stage do we need to finalise which route we're going down?

Piers: I mean, again, good question. When you're starting out and you're young you think that design is an iterative process and you do one thing and it leads to another thing and it leads to another thing and leads to another thing. And you think about designing the abstract and you get a scheme and then you think, *oh well how am I going to build it?* Now, as you get older, certainly for me I feel right at day one you think *how am I going to make this thing, what is the character of this building, what are we talking about, is it steel, is it concrete, is it masonry, is it brick, is it timber and if it's timber what type of timber is it?*

I think right at the beginning projects are immeasurably better if you think about how should we, how could we make this? Design is a web where you explore all sorts of things and you gradually hone in with increasing certainty on one thing. And for me, right at the beginning you're considering I can make this out of all sorts of things but what is this? Remember that buildings that speak of their construction, including masonry . . . I mean, let's talk about masonry at its best is a beautiful thing. So load-bearing buildings with hugely thick walls and small openings in hot countries and cold countries are beautiful, beautiful things. They speak of their construction in much the same way that a timber building with posts and beams and trusses speaks of its construction. So in the abstract I like all ways of building buildings. The question is what is the most appropriate? What gives this architecture, this scheme, this building its character? Right at the beginning I think you need to be considering materials.

Again, what's interesting is that that is something that the modern movement try to banish because the whole legacy of modern architecture since 1930 is that buildings were made out of modern materials that were covered up and they had no presence in the legibility of the building. We're just talking about raw space and generally it was painted white. I think those days have gone. I think everyone now is interested in construction. You know it's called building tectonics, are exciting beautiful things.

Ben: As we just round off this segment, is there anything else that we should bear in mind? I feel like we should certainly talked about the different systems but is there anything I've overlooked?

Piers: Well, I think efficiency is a big deal. I don't mean in terms of cost or even programme, in terms of how long things take, but there's a joy in using materials wisely and intelligently and sensibly. That's part of the conversation that you need to be having when you're

designing something. You know, how do I make this thing? How do I use this material intelligently and well? And how do I not use it in a wasteful way or an inappropriate way? All the way through a project those are the things we need to be balancing with what does it look like, what does it feel like, where does the light come in? All those sorts of things.

So construction is incredibly interesting. I think most people, in a way, don't realise how interesting construction is. It's a beautiful, amazing language to make things with. I mean, look at the cathedrals or our best modern buildings. They are amazing, amazing things really.

Remember of course that when you're designing a house it's a big deal. Typically you haven't built or designed a house before. It's a minefield and I think the best thing you can do is get a simple bit of design advice right at the beginning that will help you navigate some of these things because otherwise how do you make decisions if you haven't done it before.

And if I was to give one bit of advice it would be to keep it simple. There are all sorts of ways of doing things and your head would explode if you explored all those things. Initially I would choose one system until it didn't work and I think I would say that timber is the best system to use. I can't think of a single drawback other than the fact it has no thermal mass. It's quick, it's efficient, it's cheap, it's available everywhere, it's ubiquitous, anyone can use it, anyone can do it and it doesn't harm the environment if you choose it wisely.

Ben: Well, just as we finish up, a complete change of tack here. I know a lot of the TV work you do is on quite budget property which is interesting to us and particularly to me as I don't have a massive budget but have you learnt a lot in your time of doing this show? Any nuggets of information you could throw our way?

Piers: Well, I suppose I have. I've learnt a great deal. The contributors are fantastic. And in a way as an architect you're divorced from this whole world of people trying to build a house on a budget because as an architect you're so used to trying to make the process efficient. If people use you as an architect you manage this whole process. What I discovered, really, is there's a world which is an absolute minefield of people not knowing how to go about the process of entering this world of design, architecture, construction, building . . . And it is a minefield and it's a kind of terrifying minefield. In a way it made me feel a bit sad that there isn't a clear

and easy route into the construction of your own house here. The thing that you need really early on is someone to guide you through that minefield and that's one of the things that I'm most interested in, which is then this process of how you build your house should determine what you build. So, for example, if you don't have any experience and you want to build it yourself that will mean that you build a different building than somebody who is very experienced. So how you build it, in terms of your own experience, the process you use to build it, whether you use an architect or not, a main contractor or not, will affect how you do it. What interests me is some buildings that have been built by low skilled, first time self builders which are extraordinary. And what's great is that the architect has set them up and then left them. You know, set them up with a system that allows them to build an extraordinary building using the skills that they have. They benefit from the low skills. The buildings are nicer because there's bad blockwork stairs and there's timber frame construction that they've learnt on the job. They're their own character and personality in it.

The other things I've learnt are, again, just how hard it is to realise your own bricks and mortar, your own roof over your head if you're starting out in this country. I think the biggest crisis of our lifetime, the biggest humanitarian crisis is that the bulk of this country now find it incredibly hard to aspire to owning, if you're young this is, to aspire to owning a roof over your head and I think it's a big problem.