

# HPH329

## **Ben Adam-Smith 00:00**

This is House Planning Help episode 329. Hello, I'm Ben Adam-Smith, and this is the podcast for you if you're interested in self-build or retrofit. I'm exploring what houses we should be building in the 21st century and trying to break down the major roadblocks that may get in our way.

## **Ben Adam-Smith 00:18**

Coming up in this session. My guest is Beth Williams from Build Collective. We're going to be looking at what a structural engineer does.

## **Ben Adam-Smith 00:27**

First, mention of Cath Hassell. She has been on the podcast a few times before, water expert. I think we talked about drainage, we talked about saving water, we talked about rainwater harvesting, all in different episodes. And I mentioned her today because she's also a children's author. I think we've talked about that on the podcast too. Her character, Frankie the Flamingo, is enticing lots of kids into learning more about different topics in construction, and there is one on engineering. It's called the mysterious case of the elephant that forgot. And the bit I always remember is when they're looking to design this bridge, and thinking that jelly might be a good option. Not sure that's gonna work out. But fun books. And I clearly I haven't caught up with Cath in a while because I see there's another one, The Mysterious Case of the Leopards that Change their Spots. And she's on a roll, because I think possibly another one in the pipeline after that: The Mysterious Case of the Frog in the Toilet System. That will intrigue everyone. I want a podcast on that please! So we'll put a link in the show notes. If you can support Cath - she does great work. Also going and taking these books into schools and reading and talking about all the different material. So we love Cath.

## **Ben Adam-Smith 01:42**

Let's get to our featured interview with Beth Williams from Build Collective. And a few years ago, we ran a mini feature just looking at different jobs, finding out what people do. And I decided, well, let's try some more. So here we go today, looking at a structural engineer. How they might spend their day, some of the jobs they're doing and scratching the surface just so that we have a sense if we're going to need one, or if we're going to be working with a structural engineer, just knowing a bit more about their role. I started by asking Beth to tell me a little bit about her background.

## **Beth Williams 02:16**

When I was a teenager, I wanted to become an architect. My dad's a builder, and he's been a low energy builder for a long time. So I thought what can I do that was related. And yeah, so I chose to do architecture, and that was what I aimed to do. And I studied that at university as well. So that's what my degree is in, structural engineering and architecture.

## **Beth Williams 02:37**

But then I graduated in the middle of the recession. And the only jobs that were around were structural engineering jobs, so I sort of fell into it really. I did a little bit of architecture work actually, before getting into engineering. I worked at small practice in Sheffield, designing like house extensions. And well, pretty much the same thing as I do now. And part of the reason I've got into low energy work was because I wanted to keep a bit more of that architecturally type focus. I find that designing the structures for low energy projects, because you're looking at things like thermal bridging and airtightness, you're having to work a lot more closely together with the rest of the design team, and MVHR routing, and all of that kind of stuff, to make it all work together.

**Ben Adam-Smith 03:17**

You're going to help us get a sense of the sort of work that you do, and maybe the scope of what different structural engineers, what that might be. So where would be a logical place to start?

**Beth Williams 03:32**

Yeah, I thought I'd start hopefully, from the very beginning, really. Just talk about structural engineering is partly related to civil engineers. So, because we get a lot of questions, because we work with domestic clients a lot, and one of the questions is, do I need a chartered structural engineer? Do I need a chartered civil engineer? What's the difference? Why are there two institutions? What do these letters mean?

**Beth Williams 03:54**

So structural engineering is technically a sub discipline of civil engineering being the wider title. But that came out of the engineering that was based in the army and then obviously, civil engineering being not army based. Nowadays, civil engineering tends to cover things like highways and bridges and drainage and those kinds of things, larger scale stuff, whereas structures is obviously much more specific. But then also can be quite wide because it covers things like bridges or masts. And then buildings is obviously a subset again of structural engineering. So you've basically got that sort of hierarchy. You've got civil engineering as a wider discipline and then structural engineering as a specialism of civil engineering.

**Beth Williams 04:39**

And that sort of then relates into my qualifications specifically because I call myself a structural engineer. I'm technically a chartered civil engineer. That confuses people a little bit sometimes. But basically, if you're looking for a structural engineer, you can look for a chartered civil engineer or a chartered structural engineer. If you're looking for a chartered civil engineer, you'd want them to be specialised in structures. If you're looking for things like reports for cracking in buildings or that kind of thing, there's not really any difference in terms of insurances and liabilities. It's just a sort of technicality. So you've got the MIStructE, which is a chartered member of the Institute of Structural Engineers, and the MICE, which is the chartered member of the Institute of Civil Engineers.

**Ben Adam-Smith 05:23**

And when would we need a structural engineer on board with our project, because might there be a scenario where an architect just wouldn't consult an engineer?

**Beth Williams** 05:35

It tends to be the smaller projects, things like redecorating, removing partitions that aren't structural, moving things around, adding walls that aren't structural. But again, if you're removing things, you might want to get a structural engineer involved to find out whether the walls are structural in the first place.

**Beth Williams** 05:52

Obviously, you've got the Building Regulations, the Part A, which is the structural part. There is a generic outline of structural principles in that part, which would allow you to design a building, very limited building, without a structural engineer. It tends to be things like garages that that gets used for mostly where it's less risky. But basically, you would end up with a building that looks like a house developer, bog standard, small windows, lots of walls, not open plan.

**Beth Williams** 06:27

Even if you're doing that kind of thing, you will have structural engineers involved on the periphery, whether they were directly appointed by the client, but designing things like roof trusses, there'll often be a structural engineer involved in that if you've got truss rafter roof. Usually things like the foundations will be something that you can't really get away without asking a structural engineer about if it's for a house, or a building that people are going to use regularly. I say that, not a garage. It also relates to liabilities as well. So it used to be more the case that people doing architectural work would have a small cover in their professional indemnity insurance for designing small structures.

**Beth Williams** 07:07

With all of the change that's gone on in, in the insurance world and Grenfell and all of those others, a lot of basement collapses in London, all of those things, have meant that a lot of architectural people have lost their insurances for those small structural things. So it's fallen back on to us to deal with things that maybe we wouldn't necessarily get asked about before that.

**Ben Adam-Smith** 07:30

Yeah, that makes sense. And this phrase, "scope of work" then, what does that entail?

**Beth Williams** 07:37

Yeah, that's something that we come across a lot. Because we work with domestic homeowners or house builders, so they're directly employing us. They're not professional clients, just maybe the first and only time they've ever appointed a structural engineer in their lives. So we tend to work on a fixed fee basis. So we'll give a scope of works, and then we'll give a fixed fee for that scope of works. Whereas larger projects will often get appointed on a percentage basis of the construction value. So that gets a bit more complicated to manage.

**Beth Williams** 08:04

But yeah, so we do a fixed fee, because that's people know what they're getting. You do a fixed scope as well for the fee. So you have to make sure that if you're putting something like that, that you're reading what they have included for and what they haven't included for.

**Beth Williams** 08:18

On a general point, structural engineers, we get drawings from an architect or technologist or whoever's designing the building. And based on the spaces that they've allowed for and, and all of that kind of stuff, we make a structure that will stand up for that layout, and that shape of that building. We're not often involved in organising the whole project, and the scheduling and meetings and all of that kind of stuff. We basically work as a sub consultant under the architect. So they will organize all of that kind of stuff, and manage all of the health and safety. And then we will just come along and tell them how big things need to be and how deep foundations need to be, and all of that kind of thing.

**Beth Williams** 09:02

So a lot of engineers will tend to base their fees on getting the drawings once, doing one pass of the design, and there you go and that's your structure. We don't like working like that, mainly because we work a lot with domestic clients and bespoke homes. So people want more input. And they want more opportunity to feed back on the structural options than just having that one input and output pass. So we like to do a two stage pass. So we'll do a preliminary design, give some rough sizing, rough structural layout, so that then the architect can develop their details and get things up to construction stage. And then we'll do our detailed design after that. And we'll go through and then pick up any pointers where the architects said I don't want that to be quite there, or I don't want that to be quite that size. And we'll try and work with that, obviously, within the structural parameters that we've got.

**Ben Adam-Smith** 09:56

Now this is possibly an aside but do engineers ever over design structures?

**Beth Williams** 10:05

It's an interesting question. If you're only doing it once, there's less of an opportunity to potentially feed that back and to tweak sizes of things so that they fit within your parameters. So they might not actually end up being quite the way that you wanted them to be in the first place. So there's something to be linked back to looking at the scopes and reading the scopes as to how many design passes you're paying for, and what they've included for.

**Beth Williams** 10:33

Then there's another point on this sort of over design is whether you've got the data that you need to be able to design the thing to within an inch of its life. That often comes into foundation design, particularly. Do you have enough, do you have enough information on the ground conditions of that specific site to be able to confidently design your foundations to bare bones? Which is rarely, rarely the case, particularly in the ground, because things are so variable. There's lots of things that feed into that.

**Beth Williams** 11:06

I think I'm generally I'm of the opinion that I don't think most engineers are over designing stuff. That isn't something that I see.

**Beth Williams** 11:13

And also, the other thing that comes into that as well as people's perception of structures as well. I've had people say to me, oh, but structures don't fall down do they? Well, they do. That's what we're here for. And the reason you don't see it a lot is because there's a lot of engineers doing their job well. But

equally, there are places if you're interested in seeing how structures fail, there's confidential reporting on structural safety - CROSS - I think it's called now. Yeah, CROSS. They've got fire safety reporting, as well. But they do monthly reports, I think on, it's an anonymous reporting system for anyone within the construction industry about structural safety. So there's lots of interesting things about how things are designed and how they're failing.

**Ben Adam-Smith** 12:02

Who else is in the office then? You have your structural engineer - is that all you need? How do you work as a team?

**Beth Williams** 12:10

Yeah, depends on the size of the company. In our company, there's six of us. We've got three chartered engineers, and the scale of projects we work on tends to be that each engineer is sort of running their own project. And then we've got a technician who will flip between all of us and do drawing work for whoever needs it most. But then obviously, we've sometimes I'm doing my own drawings, as well as the calculations. And then in larger practices, you'll have principal engineers who are running the projects and organising a team. And then beneath them, they'll generally have a team of graduate engineers, or newly chartered engineers who are sort of less experienced, who will be doing the calculations generally. So the principal engineer will do generally do the layout of where they want all of the structure to go within the building. They'll sort of mark it up for the graduate engineers then to calculate all of those various things. And then between the principal engineer and the graduate engineer, they'll be feeding into a technician who will be drawing up all of those things.

**Ben Adam-Smith** 13:13

We talked a little bit about health and safety, but CDM is something that you see every now and again. So maybe just dig into that a bit and what we might need to know.

**Beth Williams** 13:24

Yeah, the CDM is the Construction, Design and Management regulations related to health and safety. Within that regulation, there are defined roles as to who's managing what in terms of the health and safety of the project as a whole. In the design stage, you've got a principal designer who's organising everyone. And then in the construction phase, you've got a principal contractor, who's then managing everyone else who's involved in the project.

**Beth Williams** 13:49

So we, as engineers, tend to on that process we'll work as a designer, underneath the principal designer who tends to be the architect. That's how it tends to be because sometimes we'll get involved in the principal designer role on projects that are small enough that they don't have an architect, so things like being knocked through, sometimes we won't have an architect involved. So we'll do that role as well. But generally on sort of things like from an extension, loft conversion through the rest of the scale of projects, there'll be an architect involved, and they will generally do the principal designer role.

**Beth Williams** 14:22

Again, whilst we're talking about the roles in health and safety, there's a client role as well. And there are responsibilities that the client has to fulfill in order for the project to get built safely. So one of them is appointed a principal designer, one of the others is making sure that people have enough time to do their design work safely.

**Beth Williams** 14:41

So principal designer, they organise all of the information process basically. So they will feed all the information through to the other designers for what they need to be able to do their design work. And then all of their information gets fed back through to the principal designer, and then they coordinate everything to make sure it all is safe, there's no clashes between various different designer's information. And then they coordinate what's called a pre-construction pack. And that is then all of the information from all of the designers and all of the health and safety risks. And they pass that on to the principal contractor in a pre-contract meeting or a pre-start meeting. And then that principal contractor in the construction phase takes on all of that, and then it's their responsibility to do the same thing in the construction phase.

**Beth Williams** 15:28

I sort of wanted to bring that up, because we quite often get asked about our role in terms of getting information from various people. An example would be the M&E design. So when I'm designing Passivhaus, there's often there's a ventilation system which has got large ducts that usually needs to go through some structure somewhere. And obviously, the M&E designer is designing, the mechanical electrical engineer is designing the ventilation system, and they've got their drawings for the ventilation system.

**Beth Williams** 15:59

And yeah, so my process would be to ask the architect, or the principal designer, to give me the M&E engineers information. Sometimes we get into things like Why aren't you asking them directly for that information. But it's because of all that health and safety process to make sure that I'm getting the right information, but also the architect knows the up to date information. If it's bypassed them, they might not know the latest information. But it's all to do with making sure that it's safe.

**Ben Adam-Smith** 16:28

Yeah, it's probably a podcast in its own right, isn't it? And I'm sure, I've never done one so maybe that's one to jot down on my list to come back to.

**Ben Adam-Smith** 16:37

You're always talking about other exciting things. For example, if we come to you with some great system that we have seen and say, Look, I've seen this. Beth, can you help me? And can you check? How does that work if I've looked at a great construction system, and now I want to get it into gear?

**Beth Williams** 16:56

Yeah, people have often put a lot of effort into researching lots of different things in terms of the construction project, the site, and the costs and all of that kind of thing. And one of the things they'll have looked into is what materials they're wanting to look at.

**Beth Williams 17:08**

So yeah, we regularly get people coming to us, usually with a set of planning drawings, and then going, I also want to use this product that I've found on that set of drawings. Often we'll find that there are limitations on the design of that product that haven't been factored into the architectural layout. Thinking particularly of self builds, there's generally a lot more glazing on them than perhaps on standard new build homes. And corner windows, fancy overhanging roofs, flat roofs, all of those things will impact on the structural system that you've found and whether that is appropriate. I'm mostly in my head, I'm thinking about various different systems that are used for walls. So whether they're an I-joist frame, timber frame, or whether it's an ICF frame, or whether it's a large format clay block.

**Beth Williams 18:05**

And when I'm talking about it standing up, it's not just the vertical loads of the people in the building and the materials above and all of those kinds of things. What happens to it when the wind blows on it? And will it take those horizontal loads suitably? Because that is the main thing that factors into the Have I got enough wall question. Are there enough walls to be able to resist the wind load and to be able to make it stand up?

**Beth Williams 18:05**

There's different considerations that go into all of those different things when we're designing them. Probably one of the big ones is how much wall there is. Because if you're using any of those systems that I just named, they're all based on having some wall somewhere in the building, in order to make it stand up. So if you're going for open plan layouts, if you're going for large glazing, all of those kinds of things, they obviously limit the amount of wall that you have, and that we have to make the building stand up.

**Ben Adam-Smith 19:00**

And how do you work that out then? What are you going to do? Are you going to put it all in a computer and it says this is happening?

**Beth Williams 19:06**

That would be something that you would do in a larger practice, because they have larger modeling software. I don't. I do it by hand. So it does exist, it's just very expensive for small practitioners like us. So yeah, I still do things by hand. And I use then a 2D analysis software. So I'm just designing beams and columns and, and walls in two dimensions.

**Beth Williams 19:28**

And this is the first thing I do when I'm looking at a building, I'll go through and I'll mark up where all of the walls are. Generally sort of rectangular or square plan buildings I'm then looking at the walls in those two orthogonal directions and seeing, seeing how much wall I've got for one thing and where they are distributed around the building. So do I have like loads of wall on one side of the building and then say on the south side because they've got loads of glazing facing south, there's less wall on that. So it's one about how much wall there is and where it is distributed because you want it to be evenly distributed around the building.

**Beth Williams** 20:05

And then also coming into another building that I've just been designing today actually, are their elements, so like floors and roofs to distribute those wall loads around all of our stability system. But if you've got things like large stair openings, or double height voids, and things like that, then obviously you've got less floor to be able to distribute your loads around the building. So yeah, the one I've just been looking at today had some big double height void, and then a large stair void as well, so there wasn't actually that much floor left at first floor level then to be able to transfer the loads around. So I'm sort of looking about how I might use some other systems in order to transfer the loads around the building so that I can still assume that I'm using all of those different stability elements to their best extent.

**Beth Williams** 20:50

And then I probably ought to explain what the stability elements are as well. Generally, when I'm thinking about that, I'm thinking like I said, walls. And then if I've not got walls, am I going to have to put in portal frames or gablepost frames. You've probably seen those in steel work generally. So yeah, those kinds of things that basically the stability elements tend to be walls or frames.

**Ben Adam-Smith** 21:10

All this is making me wonder, you talked about planning drawings and so forth. Are you just being handed - this is what we're going to build? Because it sounded to me like you want to say, well, couldn't we do this?

**Beth Williams** 21:23

Usually, it's this is what we're going to build. I really like getting involved in projects earlier on in the planning stage, because you can have more impact into the efficiency of the structure, which then also relates into the cost effectiveness of the structure as well, which is what people are more interested in. But generally, it's post-planning we get involved and yes. So obviously, people will have spent a long time with their architect looking at layouts and what they actually want for the building. And that's a whole process that's gone on before any structural input has been had usually. So then it makes the conversations after planning, I guess, more fraught often, sadly,

**Ben Adam-Smith** 22:02

Is this also architects that are doing this? That they know full well that they want their design to go through. And you would hope, particularly it seems in the Passivhaus circles and so forth, people understand a bit more about how you optimise things. But I wonder whether some of the architects perhaps don't want to do that, would that be a fair comment? Or am I being harsh?

**Beth Williams** 22:27

I'll generally try and give architects a bit more of the benefit of the doubt in terms of that they didn't know that that was the requirements of the structural system that they've chosen. We try to not get involved in why the situation has come to be what it is and just deal with what it is.

**Ben Adam-Smith** 22:42

Very sensible.

**Beth Williams 22:43**

It is something to keep in mind when clients are shopping for architects. I think there are different, from our experience there are different types. Some who have got very clear aesthetics within their practice that they are wanting to promote. And obviously, if you'd like that aesthetic, then yes, go use that architect, because that's going to be what you're going to get. And then there are others, which tend to be on usually the ones we work with more often who are more flexible and more client led in terms of what the clients are after in terms of the aesthetic in their spaces.

**Ben Adam-Smith 23:18**

It's such an interesting dynamic isn't it, because it can change. You can get the authoritarian architects, "it's my way or the highway," or you can almost get the reverse as well, it just depends on all the individual players.

**Beth Williams 23:29**

Yeah, in the same way that you can get architects who are really interested in planning applications, but not really interested in taking the building through to construction. Because you might want an architect who's really strong on getting the planning application through because they've got loads of experience in dealing with particularly like Paragraph 55 buildings, they have specific architects, they've got all of the experience of dealing with the planning system, and all of that kind of stuff to get it through. And then it may be that they're also good at doing the construction. But it may be that they're not and that you do want to find another architect who's more construction focused, or technologist or specialised builder who can do the design as well, all of those kinds of things, that would be options.

**Ben Adam-Smith 24:11**

Let's have a look at ground conditions now. So when we're first coming across the site, I guess most people will have bought a site before they start thinking about an engineer. So how do we look at the grounds, know what we're playing with and so forth?

**Beth Williams 24:28**

Yeah, lots of things. Although, just going back to what you said, most people have bought a site before they appointed an engineer. Yeah, that is true. But also, it's not a bad shout to talk to particularly local structural engineers when you are looking for sites, because we'll often know the weird areas of ground conditions and things to watch out for in the local area.

**Beth Williams 24:48**

I work in the Bath/Bristol area, or that's where we're based, a lot of projects in there. And just from working there, we know that Bath has a lot of historic landslip material that is really dodgy to work on. There's a lot of very cheap sites in Bath they're going for, but they often have really horrendous ground conditions. Bristol has a lot of coal mining areas which get into other issues around it. And then still some slope stability issues, some bomb, bomb striking issues as well. So that there's lots of things out there. But most engineers would be happy to come to site, have a look around or to have a look at

your, the geological maps for your site and give you advice early on if you wanted to, to pay them for that just for a few hours to have a look at that kind of thing. I think it's probably a good use of money.

**Ben Adam-Smith 25:33**

So you say the geological maps, this is something that's just available that it's mapped out already?

**Beth Williams 25:39**

Yeah, it is actually yeah, and you can look at it yourself. It's the British Geological Survey have online viewers of the geological maps of the UK, which are great. And they also tell you things like landslip material is often marked out on there, whether the site's been used as a quarry, where the coal seams are. They've got all the logs of what the actual bedrock geology is, although to be taken with a pinch of salt, because I think a lot of the geological maps, this is just sort of hearsay that I've come across, haven't necessarily been updated since the initial guy went round to map the geology of Britain, who was a guy whose name I've forgotten. But basically, who went around on horseback and dug a load of holes around the UK. But that's the level of quality of information a lot of the time. So yes, they exist, but definitely to be taken with a pinch of salt. And things are obviously not accurately sort of measured out. So things vary a lot and like local disturbances or local more recent uses of sites won't necessarily be on there.

**Beth Williams 26:44**

And then also the other thing to look at is if, to give you, in London or there are I think a lot of other cities, Bristol's certainly got a map now. They've got some online maps of the recorded bomb strikes from World War Two and various raids. So those are things that you can be looking at yourself as well.

**Ben Adam-Smith 27:01**

If you wanted for some reason to do a survey, who is the person you use, or is it still the structural engineer?

**Beth Williams 27:08**

They will be specialist geotechnical companies. You can do things with trial pits often. So just digging some holes in the ground, looking down and seeing what's there, taking some really shallow soil samples, if you need to. That's usually more useful for things like extensions, smaller scale stuff, things like to find out how deep the existing foundations are on a building that you're looking to extend. So we do site restoration from trial pits, and that would be the structural engineer that goes and logs those trial pits typically.

**Beth Williams 27:38**

But anything bigger than particularly new build houses, if you're going for like a self build, new build house, I would definitely recommend getting a proper geotechnical survey. They usually cost, this is just very ballpark depending on the area of the country and what your specific site is, but they're usually around about three and a half to four, five grand scale of costs, to have a specialist geotechnical company come out and either do bore holes or trial pits themselves. And then to have a specialist geotechnical engineer, come out and log the findings, and then to do lab testing, as well. So they take

samples and send them off to a lab for various different structural properties and chemical properties of the ground.

**Beth Williams** 28:24

So I think it's usually worth it, particularly in the scale of the risk. And because usually in terms of cost risk on projects, the main one is the ground conditions, knowing what's going on in the ground, because obviously once you've got out of the ground, you've got much more certainty about what things are going to cost. So if you can get a good ground investigation early on, that mitigates a lot of those risks.

**Ben Adam-Smith** 28:49

So when we're looking at the ground, can we work with any ground conditions?

**Beth Williams** 28:54

Basically, like I'd say about most things in terms of structural design, you can do anything as long as you throw enough money at it. So it might not necessarily be cheap, but you can usually get most sites to work. I'm thinking of one in Bristol that I'm struggling with at the moment where it's very limited access, as in no machinery, and then also on slopes tip issues and then also next to a railway. So there's all sorts of things going on on that, so that one we are struggling to find a piling contractor that can do hand installed piles for that ground condition. So that one's probably the only one where we may end up with nothing that we can do there. But again, if we had enough money there, you could crane over like a whole terrace of houses together. So again, it's a sort of it's usually a money thing.

**Ben Adam-Smith** 29:42

I remember one, I think it was an award winning project down in the southwest that I went to years ago. And they almost underpinned a cliff to be able to build this house. It was quite extraordinary. And I think at one point, he said, you know, half of the house went off down the slope. You might be building in the wrong place here! But it did look fantastic, I've got to hand it to them once they did it.

**Ben Adam-Smith** 30:07

Just thinking of things that are a bit simpler then, if we're not building on the edge of a cliff. You talked about piling, is that one of the most sustainable ways of going?

**Beth Williams** 30:18

Yes, usually one of the easier ways to get rid of concrete in the foundations, if you're looking at sort of embodied carbon. It's usually more expensive than most other types of foundations because you're getting a specialist in to install the piles usually.

**Beth Williams** 30:35

Yeah, so I guess to summarise sort of ground conditions very, very vaguely, you've got a range of how big the particles are in your ground from obviously rock, which is large rocks, and then through down through to smaller particles, so sort of gravels and then sands and then clays. So in terms of the foundation types, you've got maybe shallower foundations on rock, and then gravels. Gravels are pretty flexible gravels. And sands are pretty good because they don't have volume change potential that you

get in clays. So you've got more options there. And you usually get pretty good bearing capacities from those.

**Beth Williams** 31:11

And then clays which you've got specific issues like I say: clay heave. The clay will swell and shrink over the seasons as it takes on more or less water. With clays you've got depth of foundations, which is often something that leads to piling. So in order to get round that clay heave issue you dig the foundations deeper to where the clay isn't affected by the heave, but that may be then too deep to dig safely. So then you're onto piling.

**Beth Williams** 31:39

And then so you can do piling in gravel sands, you can do piling into rock if you... Because then you've got sort of, you've already got those types, but then also where they appear vertically in the ground in the site. So if you've got rock at depth, you might be looking to pile down onto that rock and you can get piles that will lock into the top surfaces of the rock.

**Ben Adam-Smith** 32:01

Now, I have seen people that I consider very green builders sometimes opt for a concrete slab foundation. So what are we thinking about concrete? How evil is it? Is it sometimes just good to have that solid base, as you said, once you're out of the ground, you can really get going with the sustainability.

**Beth Williams** 32:21

I think the thing is, which is true of most material usage really, is to use it efficiently and to use it in the right place. So concrete is really good in the ground. Although I say that it can get a chemical attack, but it's pretty... It doesn't respond to water ingress in the same way that say masonry would do. It is obviously very carbon intensive. So it's making sure that if you are using it, you're using it efficiently.

**Beth Williams** 32:48

I do a lot of insulated raft slabs on Passivhaus and low energy projects. And it does work as a nice foundation solution for timber frames, particularly because you need some weight in the building somewhere in order to hold it down. Again, talking about the wind loads to stop it either blowing over or blowing upwards. So it is a good option for those kind of things. Otherwise, you're maybe looking at something like a pile, that has some tension capacity in order to do your uplift for your timber frame. We're looking at a few of those at the moment, screw pile or other types of pile options with a suspended timber floor. So that then you've got rid of all of the concrete.

**Ben Adam-Smith** 33:24

Now, was it an AECB talk that you did where you were going through alternatives to concrete foundations?

**Beth Williams** 33:31

Yes, that's an AECB. I think there might be a couple of versions of that on YouTube, actually, because I did it for the AECB. So that's accessed through the AECB website. And I did do a talk for Timber

Development UK, university competition, which was basically like a shortened version of the AECB one.

**Ben Adam-Smith 33:47**

We will link that but are there any nice takeaways or anything like that, that we could just insert here?

**Beth Williams 33:56**

Get a site investigation? I don't know. That's usually my take away on foundation design.

**Ben Adam-Smith 34:02**

It's interesting, isn't it? Because when you were saying that you're saying spend 5000 pounds looking at your site, I'm thinking no one wants to do that.

**Beth Williams 34:09**

No, they don't.

**Ben Adam-Smith 34:10**

But now I'm starting to see the light a little bit and thinking Oh right, so this is important.

**Beth Williams 34:16**

And it's particularly if you're wanting to do things like concrete-free foundations, something unusual in the ground. We as engineers want to mitigate our risk. And like you were talking about earlier in terms of making sure that we've got enough information to do our design. So if we're doing something that is unusual like that, where we're maybe wanting to look at using masonry bearing into the ground rather than concrete, for example, or steel piles or something like that. We want to know that in order to design the things but you want to know that ahead of time.

**Beth Williams 34:48**

And because I've had projects, I've got on to designing screwpile projects recently but I've had a lot of enquiries previous to that. But it seems like every time somebody would enquire about screw piles, they would do some trial holes or site investigation and then they would find that they had rock at 300 mil below the ground level, and you're like, well, we're not doing piles then. There'll be no point in that. Yeah. So it's no, you want to know that before you've gone through all the hassle of designing a building that worked with screw piles, and then found that they weren't actually suitable. Screw piles seem to be the one that people fixate on I think from a low carbon perspective, but there are lots of other options.

**Ben Adam-Smith 35:26**

Now, before we move away from foundations, is there anything else? I know it will go deep, if you excuse the pun, in terms of information, but just key points around this area.

**Beth Williams 35:37**

Probably another thing that, that probably warrants its own conversation really, as well is that the foundation choice is impacted by the above ground structure design. So like I was talking about timber

frame, needing some load somewhere to hold it down. And that impacts then the foundation choice. So it requires thinking about together.

**Ben Adam-Smith**

Let's move on to the superstructure now.

**Beth Williams**

Which comes then into if you're looking at systems where a supplier will provide the design, for example, for the ICF above ground structure, and then you're needing to find another engineer for the foundations. They're not always independent of each other. And that conversation between those two engineers needs to be had. I've got one at the moment where I'm designing the timber frame superstructure. And then there's another engineer designing the basement underneath. But yeah, that's been a really good conversation process on that project. So we've been able to have good chats about how those two things interact with each other. They go together whilst they can be separated.

**Beth Williams**

Yeah. So the above ground structure, we generally sort of take the split between the two as a damp proof course level, generally, DPC level.

**Beth Williams** 36:55

So the way that we tend to do our design processes, we will do a design and we'll specify performance criteria, structural performance criteria for the products to be used. Because we want to be able to give the builder, or whoever's specifying, the actual materials choice between different options. So things like there's lots of different suppliers of just standard concrete blocks. And we could get right down into the nitty gritty of specifying one particular product manufacturer's range of systems, but the builder chosen on the product might have a different supplier that they like to use.

**Beth Williams** 37:30

Actually, one that comes up a lot on the work that I do is the engineered timber, I-joists. There's a lot of different suppliers of those. And invariably, if I pick a supplier and design to their criteria, the builder will go, oh, well, this other supplier is cheaper. And I will have stabbed for the wrong one. So now I like to I know the performance criteria of most of those suppliers now. So I basically design for the worst case one. And then if somebody chooses something different, then we don't have things like the client having to pay me to redesign the structure.

**Beth Williams** 38:04

But when we're getting people coming to us with specific products that they're wanting to use, then we need the data from the supplier to be able to design. A lot of the low energy products are being developed in Europe. So this is one specific issue with getting the technical information out of them. It might not necessarily be in English. So I've learned German, and Danish and Norwegian and all these kinds of things. So over the time, or very specific words from those ones that are related to the structural design.

**Ben Adam-Smith** 38:35

So when we have the designs that come across from the architect, can you just take us through that above ground bit, and what you will do. What order you'll go through checking it? Or are they asking for specific thing: I need this because I'm worried about this.

**Beth Williams** 38:51

Sometimes, either because they're building from the ground up, or because they're wanting to get quotes from things like screwpile manufacturers, they'll want the foundation information first. But we work top down, obviously following the loads down the vertical loads down the building. And so I need to design the roof or at least have an idea of where things are spanning. And where beams might be, where point loads might be in the above ground structure before then I can do the foundation. So that tends to be the main way where people will want me to approach the design in a certain way or a different way to what I would usually do.

**Beth Williams** 39:28

Because there are ways that you can take, we call it load takedown, which is literally just that: take the loads down of the above ground structure to the foundations in order to design the foundations first before you design the above ground structure. So it's possible, it's just not how I would usually go about it. Because doing that load takedown, it's actually not that much more input to do the design of the various different elements. I tend to do the roof design and then I'll do any suspended floors in between, or if you've got second floor, first floor, or ground floor suspended floor. And then I'll design the walls and the lintels in the walls.

**Beth Williams** 40:09

But actually, before I've done all of that taking the vertical loads down, I will look at the overall stability. So that is the first thing I do. I calculate the wind loads, and I calculate the snow loads on the overall building on that site. And then I look at how it's actually going to stay up. We call it overall stability, for which the horizontal loads, the wind loads usually, are the critical thing.

**Ben Adam-Smith** 40:37

Do you always have complete information?

**Beth Williams** 40:40

No! Rarely. I can do a preliminary sizing off something like a planning set of drawings. But when we get into our detailed design, it's always surprising how much information you need in order to be able to fully do the structural design.

**Beth Williams** 41:04

Probably a good example of that is things like staircases, because again, thinking about bespoke houses where you're not necessarily just getting a standard MDF stair from wherever. So you've got where you've got your stair opening going up through the floors, you have what we call trimmers around the opening. And then often, you'll have some kind of balustrade off the edge to protect people from falling. And then what that balustrade is made out of will impact the structure. So if it's timber, that's one thing, sort of more spindles and traditional. If it's glass, for example, steel is easier, but glass obviously has much more significant tolerances or limitations on the deflection that it can take before it

cracks than a lot of other materials. So that's something. It's got different fixing requirements at the bottom, and then how those fixing requirements then sort of coordinate with all of the rest of the floor levels and the finishes. And whether you're seeing all of that, whether that's hidden within some covering that's hiding all of the fixings for the balustrade.

**Beth Williams** 42:14

And then staircases are a whole other thing, but similar in terms of particularly if you're going with something bespoke and then how all that ties into the structure, what levels the stair comes up and joins onto those trimmers, where those balustrades for the stair itself join onto the rest of the balustrade. That's it usually.

**Beth Williams** 42:32

So there's lots of things in that, that then feed into how we would produce our final design for in that case for the stair trimmers. Because usually the stair itself is designed by a specialist, although you can, if you don't particularly go for a bespoke stair, you can get a structural engineer to design that. Yeah, so there's lots of things that feed into the structural design that people don't expect to impact the structure but do.

**Ben Adam-Smith** 43:04

Now, anything else on the superstructure? I'm aware we're not going to cover, you know, again, this is a big topic, but any other key things or key takeaways, particularly in regards to self build projects?

**Beth Williams** 43:18

Mainly to highlight that you can get engineers involved earlier on in the design process. In fact, most of us quite like to be involved earlier on in the design process! So that you can get advice on, if you've had a look at a specific product or system that you're wanting to use for your house, get advice on how that might impact what the structure looks like, what the layout looks like, where your windows might go, how many walls you might need inside, just to get it designed efficiently.

**Beth Williams** 43:42

So sometimes I'll do like preliminary rough structural layout markups, ahead of planning so that people know where the beams might go, where frames might go. Usually without sizing necessarily at that level, just so that they know roughly the layout and the architecture and start to sort of feed that into their, their designs.

**Beth Williams** 44:03

Don't be afraid to get your engineer involved. Even if it's just for like an hour or two to sort of have a look, we'll overlook at some systems or to have an overlook at the overall sort of layouts and where the structure might go. So it doesn't need to necessarily be like a full, massive scope, but just some initial input is useful.

**Ben Adam-Smith** 44:24

And what is the mark of success then in terms of this low energy Passivhaus world? What means that you've done your job well, other than the house staying up?

**Beth Williams** 44:35

I think the big things that have been, are moments where I felt proud and it was where people have found our drawn information, like builders have found that our drawn information was useful and clear. And then I still remember one comment from an architect when he got my calculation package, he was like, I actually understand which bits you're calculating in the package. I can follow this calculation package. So that was a very proud moment for me where we're communicating what we've done to other people who aren't necessarily specialists.

**Ben Adam-Smith** 45:09

And then just going back to our question of what does a structural engineer do? Have we had a good stab at this?

**Beth Williams** 45:15

Hopefully, yeah, I think we generally like, say, like a subconsultant, I guess, but falling under the architect's responsibility to sort of manage the flow of information, and to manage the project as a whole. But yeah, that we can have, I guess, have inputs wider than maybe necessarily just, well, I don't like it when people think that we're just basically like a glorified calculator. That we just come with some drawings, and we just spit out some, some structural sizes. But I think there's more knowledge and experience within structural engineers to input and to have an impact on your, your performance or your building as a whole. Particularly if you're looking at like Passivhaus and low energy, there's definitely loads of input that structural engineers can have in terms of how easy it is to achieve those targets. And how cost effective it is as well.

**Ben Adam-Smith** 46:07

Well Beth, it's been lovely to have a chat. Thank you very much.

**Beth Williams** 46:11

Thank you.

**Ben Adam-Smith** 46:12

Head online to take a look at the show notes that accompany this session: [houseplanninghelp.com/329](https://houseplanninghelp.com/329). You can review the main points once again, we have a summary for you. Also, if you've got a comment, or you'd like to ask a question, you can do that within the show notes. Just head down to the bottom or on social media. We'll provide you with links. And of course, we'll show you where you can find Beth and also Build Collective: [houseplanninghelp.com/329](https://houseplanninghelp.com/329).

**Ben Adam-Smith** 46:43

There's a new review in the Apple Store. Thank you to Stuart Dodd in South Yorkshire for writing this one up. I have now listened to every single episode and finally joined The Hub. "What a fantastic resource for anyone building or retrofitting a home, whether that be a self-builder or professional contractor, learn, learn, learn and we might just build better homes. I've built my own Passivhaus and now I'm starting a deep retrofit barn conversion for my mother-in-law. Never stop learning. Great work, Ben, keep it going." Thank you so much, Stuart for this. I'll see you on the inside of The Hub.

**Ben Adam-Smith** 47:21

And yeah, these reviews, whatever podcasting app you're using, generally there is an option to review the podcast. If you do that and let others know what this is all about then that will flag this up to others so that they can get started on their journey.

**Ben Adam-Smith** 47:37

Next time, Andy Moger from Tetlow King Planning is my guest. When might you hire a planning consultant? That's the topic for next time. Thank you so much for listening. The House Planning Help podcast is produced by Regen Media: content that matters.