HOUSE PLANNING HELP

Episode 70

Can You Create an Ecological Building with Insulated Concrete Forms?

The show notes: www.houseplanninghelp.com/70

Intro: My interview today is with Jake White from Ecotecture and we're going to be talking about concrete. Perhaps you already have your opinions on it - good or more likely bad! Well maybe we can challenge that today.

We're going to be looking at a case study called The Curly House, which is an award-winning project built with insulated concrete forms.

I started by asking Jake how he got into sustainable architecture.

Jake: I come from a background of much more traditional buildings and design. My experience lies mainly in, basically, house bashing. That's where I originally came from.

Ben: What does that mean?

Jake: What does that mean? House bashing is large scale development of family units, a hundred plus unit developments of very traditional design, very traditional construction methods. So my experience lies mainly in the technical side of that kind of thing.

So my main interest in low energy design and sustainable design was brought about through seeing the other side and seeing how badly it can be done and how poor the quality of the workmanship is, the quality of design, the standards of understanding in terms of thermal performance just really, really wasn't there. So I knew something was wrong. I didn't know what was wrong and the more I investigated, the more I understood.

It coincided with teaming up with my business part Jo ten years ago now. We basically started off from scratch, pretty small and worked our way through numerous projects, learning as we went and learning from the AECB as well. Very keen members of the AECB and what it's taught us has really, really changed the way I look at buildings and the way I understand them.

Ben: Today we want to look at insulated concrete forms. Just before we get to that though, what is concrete?

Jake: Concrete is a crystalline structure which is formed in aggregate and traditionally, Portland cement. It's a highly dense and highly stable product. It does have negative connotations with regards to CO_2, in terms embodied energy, but it does deliver a long lasting, very dense structure.

Ben: This bad reputation that it has, where is the balance in when you're going to use it?

Jake: I think the most critical point in terms of decision making is at briefing stage, when you assess your client's needs and when they assess their own needs, are they looking for something that's going to last their lifetime? Are they looking for something that's shorter than their lifetime? If either of those questions apply, if that's a 'yes' to either of those questions, concrete's probably not the answer because we like to design structures to last generations and be still just as energy efficient as it was originally.

Ben: Moving on then to insulated concrete forms, can you just describe what that is? Hopefully in the show notes we can show one of these as an example but a verbal description?

Jake: Insulated concrete formwork works in a similar way to traditional formwork. So concrete is poured in a liquid until it starts to set and crystallise into a dense, solid structure. So it needs a form to be poured into in the first instance and typically when you're digging foundations, that form would be in the form of earth being cut back as its dug and concrete poured into the void. When you construct reinforced concrete for beams, retaining walls and such, traditionally we use plywood for shuttering to enclose the volume before the concrete is poured. The difference is that the insulated concrete formwork does this and is formed literally in insulation. So there's an interior and an exterior surface which is both highly insulated.

Ben: Why would you insulate it? I can't quite get my head around this, that you think of, perhaps, insulation on one side but why are you putting it on both sides?

Jake: This is something that I questioned a lot when I first came across the product and yeah, it's an interesting thing because traditionally, thermal mass should always be exposed. That's what we

understand. But there's a difference here in terms of how responsive the thermal mass is. So typically you're looking for thermal mass to re-emit heat during the evening that's been absorbed during the day to balance that daily temperature swing. But when that's locked away in an insulated structure, it changes and I think – I've got very little data to prove it but my understanding from what I've seen in terms of the buildings that we've designed and built from, we see that swing, that lag for it to be re-emitted as a longer lag and more of an annual store. So it's a case of getting much longer benefit from that thermal mass than a single day.

Ben: That's interesting. So you're still getting benefit from the thermal mass?

Jake: Yeah.

Ben: For some reason, I thought it might almost be shut off.

Jake: That's exactly how I would see it in the first instance. That's my initial understanding and over time, I've understood that actually, what we're seeing is better thermal performance typically than other constructions of the same U-value. That's just our experience, it's hard to prove, it's hard to go into an analysis but I do think that you'd see the temperature of the concrete core to be quite similar to the interior temperature of the space at any one point. But not massively swinging high and low. Much more stable. That's how I see the product working.

Ben: We're normally talking about airtight structures when we're interested in proper energy-efficient buildings. I know that concrete when it's poured well, it's an airtight structure but is there any other consideration to make sure that you've got that continuous airtight line all around?

Jake: Yeah, sure. So you often have to look at combining materials. You don't often completely build a structure from insulated concrete formwork. The Curly House which we will mention in a sec., that's been built with an insulated concrete formwork roof as well. So in that instance, the concrete is poured continuously from the wall, up into the roof and then back down the other side. So in terms of airtightness, there is no possible weak point. You're looking at massive structural collapse for it to start leaking. But that's a bit of an unusual scenario. Not every ICF build is in that manner or form. So quite often, you'd see a timber structure as a roof, whether that's flat or pitched. There's always methods to seal the building well. To be honest, it's pretty much the same as any other

structure. So when you go for a pitched roof for instance, you'd see a similar level or airtightness detailing as you might see in a standard timber frame, just from the eaves upwards.

Ben: Take me through The Curly House. When was ICF something that you wanted to consider for this project?

Jake: Well we initially discussed a very different design and due to local restrictions, we found that that particular design was not going to be practical. So we initially started the process looking at straw bale as the alternative construction method. When we had that feedback, that that particular design was not going to be considered appropriate for the site, we had to look at hunkering the building down and designing it into the landscape.

Ben: Maybe describe the landscape because it is beautiful. I have been there as well, I'm working on a video of this site so hopefully at some point I can link that into the show notes.

Jake: The site is part of the South Downs Way. It's a beautiful, beautiful location and it's highly exposed. It's one of the interesting things about the site because in hindsight, selecting that construction material was very, very clever when it comes to such a highly exposed site. We've not seen anything in terms of that level of exposure, the negative temperature figures, anywhere else on any of our other sites. So it's very appropriate.

When we started redesigning from the initial scheme, we looked at hunkering it down and producing these curves that undulated and can be sculpted into the landscape and the natural undulations in the site allowed that to happen very neatly. But in terms of selecting materials, for instance such as straw bale or timber frame, that's where things started to get a lot more complicated and one of the things that we like to do is try and avoid mixing constructions. So quite often we see people designing the basements which might be in concrete and then as they come above ground, then they'll be looking to switch construction to maybe timber frame. I see the two different construction types as jarring and not necessarily working well together. They may well achieve the airtightness figure to begin with but those two types of constructions are going to want to move differently.

Ben: Would that be typical on most projects, that you'd always try to stay to one build method?

Jake: Ideally, yes absolutely. I think that the optimum for simplicity in terms of construction method, cost and energy efficiency in my mind is a single construction method.

Ben: Can you explain the process of how this gets created then? So the insulated concrete forms – is it a regular foundation at the bottom?

Jake: Yeah, so in this instance the foundations were on chalk so they're very, very slim line. So low level strip foundations and rebar is located out of the top of the foundation. And then that is treated with a tanking treatment.

Ben: What does that mean, sorry?

Jake: So that could be Synthaprufe or something along those lines which is a bitumastic treatment that you apply to the top of the foundation itself and over the rebar.

Ben: For what purpose?

Jake: To prevent moisture coming up from the foundation. So you're treating the foundation as a wet structure and then above that point, you want it to become dry. So the key to making the insulated concrete formwork last a long time is to ensure that that central concrete core stays dry. And so tanking the underside of it is critical. And then from there, the insulated concrete formwork blocks are installed with the rebar between them. The building is set out and typically you can do about one and a half metres in about an hour in terms of the pour. So there's a lot of preparation that has to go into it. You have to have the insulation in the right spot, tied down neatly, taped at joints and corners. There's a lot of forethought that goes into it but when the structure starts being poured and starts being moved forward, that's really when it starts picking up speed.

Ben: How did you select the particular system that you were going to go with, NUDURA, on this project?

Jake: The particular system was suggested by the contractor and that was because of his own personal experience with it. There are numerous other ICFs on the market but there are key features which we've learnt to look for. The adaptability, the quantity of details that they have and they thought through are really critical and also just the technical support as well. Having a technical rep that you know if you've got a question, he will always have an

answer for. You're not left out wondering what's going on and what you need to do to get over an issue.

Ben: Does the concrete level ever change as in the thickness? For different projects, you'd need different amounts?

Jake: Yeah, so most systems come in different widths and there's a big advantage here because basically we're talking about a structure that might be underground in part and then above ground in part. So typically for a retaining wall, you might see two hundred millimetre thick concrete core that's heavily reinforced to be able to take the load of the soil it's retaining. But above ground, you might find that you want to reduce that. So the products are designed so that you can easily step the thickness to suit and I see this as an opportunity to really reduce the quantity of concrete used and one thing that we certainly learnt is there's got to be ways that you can reduce that further and ideally, I think taking a key from Georgian architecture where you've got thinner windows which are taller because the lintel technology was slightly under capability there, that's what informed a lot of the design process. So you could take a key from that and start reducing the spans of the opening and as a result, reduce the thickness of the core and reduce the quantity of concrete and the CO_2 impact as a result.

Ben: I had a chat with Piers Taylor and I remember him saying about how concrete, it's very much overused. There's got to be a line though somewhere hasn't there? That you don't want to go too thin? It's almost getting the optimum amount but do you always want to go a little bit over?

Jake: Absolutely. There is an absolute optimum and typically, the point at which that you need to be concerned is not actually the minimum width you can do in terms of calculation but the minimum width you can do in terms of physically pouring it. Because you have to have a vibration rod to be able to ensure that there's good settlement of concrete and continuity throughout the forms. So that means there's a minimum width that you can get your vibration pole down into the core and with the rebar that is necessary within the structure. So there's physical limitations to how thin you can take it which I think is about the point where we should be stopping anyway.

Ben: When you've got everything in place, how is it rendered? And is it rendered on both inside and out?

Jake: Depending on the system, some of the higher quality ones enable you to do pretty much anything on the outside. So you could look at a render finish to the exterior, a wet plaster finish to the interior. It's one of the rare products where you don't need to look at a wet plaster finish on the interior for the purposes of airtightness. So as designers, we tend to try and avoid plasterboard because of the fact that you tend to get thermal bypass, air leakage and often when you're fixing into something, it creates a new air leakage path. So we tend to steer clear of the plasterboard but with ICF, because the insulated concrete formwork provides the airtightness to an astounding level, you can use pretty much any interior or exterior treatment just fixed to the webs that come through the structure.

Ben: What did you go for on the Curly House?

Jake: So the Curly House is designed with a mixture of materials. We've got a small amount of timber cladding and that's in oak. We've also got flint and that is reclaimed from the original cottage which was on the site. So we are using that in a curved format and that is designed to take influence from the local vernacular where there are flint walls throughout the Downs and that was really the source of inspiration and also a method of helping with the restrictions that are on the site. The rest of the building is finished in a render system and that's a silicon render approximately about six millimetres thick.

Ben: I've got a design question for you now. You opted for a curve, we know that the site is down into the ground a little bit. But why a curve?

Jake: The design strategy was to inversely follow the path of the sun so that the bedrooms sat on the western wing of the curve, get the morning sun and the living space starts getting the sun as the sun comes around. So the curvature is really in response to the sun and the brise soleil is in response to the height of the sun with regards summer and wintertime and shading.

Ben: I know you got a really good airtightness result on this but I have to question, why are all buildings constructed this way not getting similar results?

Jake: That's an interesting question. We've actually seen a site that's used ICF down in Brighton. We were doing the eco-homes assessment on it and the airtightness results that they got using the system were in the region of three metres cubed per metre squared

per hour which is not brilliant but it's better than a lot of developers achieve. And they achieved this by accident. So there was zero attention to airtightness. You can get an amazing background airtightness before you even started applying treatments.

Ben: They haven't thought about airtightness basically?

Jake: They really had not thought about airtightness at all and it would take very little effort for that project to go from where they are to below passive house airtightness requirements.

Ben: When you get to the windows, is it the same as you would for other buildings that you're using tapes and membranes?

Jake: Yes, you do need to use tapes and membranes. This is probably the only spot in an ICF structure. So if you were looking at an ICF roof deck and floor deck and walls, so a full ICF structure, the windows and the door installation is the only area that you really need to pay attention to with regards airtightness.

Ben: The Curly House also has some great views. Were you very particular about the window specification?

Jake: Yes, the window specification took a very long time. The product that went in, in the end, was Alphawin which are excellent, excellent windows. Very pleased with the results from them. And the level of detailing, the time it took particularly at the horns of the crescent where the triple-glazed windows come to meet at a finite point, ensuring that that particular detail was airtight and also low thermal bridging, that was particularly difficult. So it was quite challenging and I do have to say, the design as a whole might not have come out as well had the contractor not been so experienced with the systems and so capable. So Kithurst Builders, the contractors on the site, were really quite astounding in the level of attention to detail.

So I think this is particularly pertinent to high quality design. When you're looking to push the boat out with regards design, you need the contractor to be extremely capable with the systems, not trying the system out for the first time. But equally, far more simple designs, cubic forms, standard format designs, that's an area where contractors cutting their eyeteeth on the products will be able to easily get into the product.

Ben: A couple more questions, I just want to rewind a little bit to when we were talking about designing this and this is obviously a curly house

but how does this compare in the design restrictions that you had compared to some of your other ecological projects?

Jake: It's one of the most tough sites that we've encountered because the requirement was that we were basically no more than a single storey tall. We had to meet our client's accommodation needs and we had to meet their design aspirations. So all of these factors has steered us down this path and as a result it's taught us a lot and has opened doors with regards design for us for future projects.

Ben: And do you have a final thought just to reflect on what we've talked about today?

Jake: Yeah, I think that the insulated concrete formwork will always be contentious with certain people and I completely understand other people's viewpoints. This is our preferred methodology in specific scenarios. We don't specifically stick to that one methodology. We're happy using timber frame, we're happy using solid wall construction. We try and stick away through a cavity wall where we can but this is one of the construction methods. And for me, I've got no problem with the negative connotations attached to it because we just feel really confident in being able to disconnect our clients from the effects of fuel hikes and fuel poverty in a way which other constructions are so heavily reliant on building technical expertise where you can use contractors that might not be able to otherwise deliver such a good result.

Ben: Jake, thank you very much.

Jake: No worries. Thanks very much too.