HOUSE PLANNING HELP

Episode 128

Closing the performance gap – with Helen Brown from Encraft

The show notes: www.houseplanninghelp.com/128

Intro: In this episode we're going to be looking at the 'performance gap'. What is it, why does it happen and how can we avoid it on our projects?

Helen Brown heads up the building physics practice at Encraft, and having conducted a lot of research in this area, she seemed the perfect person to answer my questions.

I started by asking Helen to tell me a bit about her background.

Helen: I've been working at Encraft for 8 ½ / 9 years now. And when I first started I was very into the idea of renewable energy and micro generation, and how that could be bolted on to existing buildings. But as I progressed through my career, become more and more interested in construction and particularly in new build housing and low energy construction within that sector. So the primary focus for me these days is Passivhaus and that's keeping us busy within the building physics team at Encraft.

Ben: Encraft are quite interesting because you tend to carry out research from time to time, which I always think I would love at House Planning Help to be able to do a few bits of research. So how does this research come about?

Helen: We have ideas for research projects all the time and we try and find funding for them.

So we first started out, probably one of our first research projects that I was involved with at Encraft was called the Warwick Wind Trials. And that was all about micro wind turbines and how they are mounted onto buildings and how they perform in that situation, and I did a lot of data analysis from these building mounted wind turbines.

But the project was first conceived as just an idea that Matthew Rhodes our MD had off the back of the fact that there were a lot of what we thought were false claims around micro-wind and how well it could perform.

So Matthew actually went and sought funding for that project from Pilkington Energy Efficiency Trust and had also some funding from BRE Trust. So it just came about as an idea, and we got funding for it and away we went.

And similarly when the Retrofit for the Future call was announced by the Technology Strategy Board which is now Innovate UK, that was a project that aligned really well with the kind of work that we were doing at the time on retrofit of existing homes and trying to achieve really really deep cuts in carbon emissions. So we actually were involved with three of those Retrofit for the Future projects.

And that started us down a journey with Innovate UK in general and we've had now, I can't remember, somewhere between 5 and 10 funded projects by Innovate UK and we've had very good success rate with our funding applications to that particular funding body.

Examples include the OWLs project which is with Beattie Passive TCosy system where we're refurbishing a block of 6 flats, and our current project which is called I-LIFE is all about the idea that we can develop an insurance product that guarantees homes' energy performance. So this is an insurance product for new build housing that would enable the developer to take out insurance on behalf of the future occupants of the home so that they are in a position to be able to make a claim on the insurance if their energy bills are too high. So this is quite a long term research project funded by Innovate UK like I say, and involves a number of project partners including Oxford Brookes University, Willmott Dixon and Building Life Plans as the insurance provider.

Ben: We'll probably come back round to this in a little bit because it fits with today's theme.

Just one final question on research. I'm assuming that you need a long amount of time to conduct any research in construction, or maybe I might be wrong here and in other words you need a lot of money too? Is that how those two things generally need to happen?

Helen: Yes. Especially if you're trying to monitor performance of buildings, which is our primary focus at the moment. We have an idea for example for a project that would look at indoor air quality in homes

and look at the effectiveness of different ventilation systems within the home.

And we've scoped out the project, we've scoped out how many different types of ventilation systems we want to look at and how we're going to monitor the homes and we'd be wanting to monitor them for at least a year and possibly even longer than that. So the overall length of the project is going to be several years and because we need to get a large dataset in order for the data to be meaningful as well that's going to involve a lot of houses, so it quickly adds up to quite a lot of money.

And for that particular one we're hoping to approach, well we are approaching a funder in the health sector who has an interest in indoor air quality and its relation to health and wellbeing for building occupants. So that's a potential alternative source of funding there for us, so from outside of the construction industry.

Ben: I was going to ask you one more question on top of my final question on research! How often does this research go on to help improve something or make a change, or does quite often it fall on deaf ears across the construction industry?

Helen: Good question!

Ben: Or does it need an entire body of research to discover?!

Helen: Well say for example the Innovate UK funded Building Performance Evaluation programme, this project was really exciting because it sought to monitor a large number of new homes and see how well they perform in use. This is an area where we have very little data actually in existence on this kind of topic.

But the findings from all of those projects that were in the BPE programme are very much case study type material, case study type data, and it's very difficult to go into all that data and extract meaningful meta analysis across the whole dataset. Just because of the way the data has been collected and stored.

And also because although it's the biggest project that I know of that has sought to monitor new homes and see how well they perform, in actual fact it's still quite a small dataset and it's still quite difficult to draw any statistical analysis from it.

Ben: Let's get on to today's topic, which I think is going to be quite interesting because we've mentioned it a few times in various

podcasts but never actually dedicated one podcast to it, and that is the performance gap. What is it?

Helen: The performance gap is basically the difference in actual energy consumption compared to the designed intent. The performance gap can range from 0% gap, which means a house is performing exactly how you intended it to, to sometimes as much as 200%, so the house is actually consuming double the energy that you would expect it to. And it can be that pronounced and it has been shown to be that pronounced.

So how does it manifest? Well Zero Carbon Hub have done a lot of research in this area and have identified a number of causes for the performance gap and these can be things to do with quality of workmanship on site, or quality even in the design stages. Or it can be due to a lack of skills or knowledge or understanding, again either in the design stages or during construction. Things like using the wrong materials, using the wrong products, so not following the specification, or not having a clear enough specification to start off with. So all of these sorts of things can contribute to a degradation in the energy performance of the home.

Ben: Is this something really that the construction industry wants to get on top of but the clients often don't even question, because when you commission a building, unless you're someone deep into the building, I don't know. Do you know what's coming?

Helen: The problem is that most buildings that are built today are not really monitored after they've been built to see how well they perform and so clients are not very well informed about the in-use performance and how that relates back to what they were targeting during the design stage.

Ben: Could that change though because we're entering the era of data and ever since the internet you can find out absolutely everything, talking about smart homes, but what about these actual, the things that we're talking about and putting sensors and monitoring equipment in permanently. Is it just wasteful to do that? On a large scale I'm talking about.

Helen: I don't think it would be wasteful if it was actually used. So if it had a purpose and someone was there to actually review the data and feed back to the occupants and feed back to the builders and the designers of those homes.

Ben: Is it quite expensive equipment?

Helen: At the moment it probably does seem quite expensive but I think, like you say, we're in the advent of big data and there are new technologies, new sensor technologies, that I'm sure that the costs will come down quite significantly again if there is a driver for it. If there's a reason for people to do it which kind of links back to our insurance product idea because that would, if we could create an insurance product which sets out to guarantee a home's energy performance that would necessarily require us to monitor the homes after they've been built in order to verify that the insurance is covered.

Ben: And I guess one of your big challenges with the product is to get consumers to want it as well. Because if they want it then I'm sure everyone else comes in on board, but some of the developers may not want to do this because they know their buildings aren't good enough!

Helen: Yeah, they may not want to so we'd have to try and cut straight to the consumers in some way to market the product and I think we see potential market for it being within the social housing sector where you have more informed clients, or developer clients, who have long term interest in the homes that they're building and also have a social responsibility.

Ben: Well tell me about some of the research then that goes into the performance gap and how we look at a building and discover well is it doing what we want it to do?

Helen: So a really easy way of looking at a building and seeing whether it's performing according to the design intentions is to have an airtightness test. Now not all homes are required to have an airtightness test. You can kind of use an assumed figure in your energy modelling but obviously this is not very accurate because it's just an estimate for the airtightness for the building.

Ben: But all buildings have an airtightness target that they want to achieve when they're built? Any building?

Helen: Yeah. All buildings would have an airtightness target but not all homes are required to be tested. So you might get a large development which they only have to test 10% or whatever.

So the airtightness test is a really simple way of verifying the airtightness performance, the air leakage of a building and verifying that you've met that target.

So that's one area that we look at and we've been looking at whether homes that are being built are meeting their targets or not.

Ben: Are you talking about building regulations would just be the target of a lot of houses or do they have more ambitious targets? I don't know in this area I guess.

Helen: Yeah. We've been looking at the data from the Building Performance Evaluation programme and this includes a number of houses that were built to Passivhaus standards, so this means very good levels of airtightness. And that was a subset of a larger group of homes that were all built to building regulations, probably a large majority of them were also built to Code 4, so probably beyond building regulations the majority of them in terms of their airtightness targets.

And indeed in order to meet building regulations these days you do have to set quite a stringent airtightness target, otherwise you're trying to overcompensate for it in other areas and that's not necessarily cost effective, so you do find more and more homes are now looking to achieve far better levels of airtightness.

Ben: Airtightness, nice and easy that you put the blower door in and you're away. Insulation, not quite so easy?

Helen: No, it is possible to look at insulation and to test whether the insulation has been installed well. And this is done through in situ U-value measurements where it's possible to measure the temperature gradient across a wall and doing so you can calculate the actual in use U-value.

So we've been looking at this data for these homes on the Building Performance Evaluation programme and there is a clear performance gap between the designed intent, the target U-value and the actual measured U-value in the homes is a lot higher, well not a lot higher but a bit higher than the what was designed U-value.

Ben: And I'm guessing as well that it's a complex picture that you're trying to get a snapshot of, aren't you, because some of it will be insulation, some of it will be airtightness, thermal bridging…?

Helen: That's right. That's right so there are guidelines for setting up in situ U-value measurements which mean that you sort of have to find the piece of wall that's away from a window, or a potential thermal bridge so that you get a homogenous section of the wall and try and get a section that's going to be performing well. Based on that

the measurement could vary across the building even, so it's not a complete failsafe method necessarily in itself, so like you say it is a rather complex picture and just looking at one wall within one home is not necessarily going to give you the full picture of the home and how it's performing as an entire unit, as a system in itself.

Ben: How does construction type play into this? I'm just trying to figure it out in my head here?

Helen: Well we've noticed some correlation between airtightness and construction type. So for example, in situ concrete is an inherently airtight construction method and seems to consistently meet or exceed its targets in terms of the airtightness, whereas masonry construction is much more likely to fail the airtightness targets that are being set. And we think this is just due to the method of construction and the ease of application of the airtightness barrier.

Ben: But this doesn't necessarily mean that we should have hundreds more concrete buildings?

Helen: No. I mean there are a number of reasons why you might want to choose a concrete building for your project but there a number of other equally viable construction methods and each should be considered for their own merit according to the project at hand really.

Ben: It's just saying it's the way that it's been put together, that's what you're really saying? That concrete is difficult to get wrong?

Helen: Concrete is difficult to get wrong from an airtightness perspective certainly.

Ben: What else are we not thinking about? Have we talked about energy consumption? That must be looked at too?

Helen: Yes, so we look at the total energy consumption from each of the homes and try and quantify the gap between the total energy consumed in use and what was predicted to be consumed during the design stage. That's where we notice the performance gap, the total performance gap if you like.

So what we've found actually is when we've tried to map airtightness with total energy consumption, we find no correlation which seems crazy at first because obviously in terms of the building physics there is a direct correlation between airtightness of a building and the predicted energy performance.

But what we've found is basically that there's no correlation between the airtightness and the total energy consumption and that's purely down to the building occupants. So it becomes very much a people thing that is driving this great variation from home to home in terms of energy use.

And if somehow we could normalise the data to eliminate the effects of occupancy, so if you imagine this situation where we've been able to profile all of the occupants and understand their behaviour and their energy consumption use from a personal perspective, we could then normalise the data. We could then eliminate the effects of the people factor and we would then I'm sure see a correlation between airtightness and total energy consumption.

Ben: Can you give us some examples then, is it someone with a massive TV screen that never gets switched off? What are we talking about in these variations?

Helen: Well I think one of the clear variations is with the elderly population who require warmer temperatures and also tend to have the heating on for longer periods of time because they may more typically be at home and inactive at home. So this kind of lifestyle demands a higher energy consumption than you would get from a typical family.

You can classify people even further than that. So I guess you might have a more frugal lifestyle classification and a more lavish one and there would be different behaviours that you could identify within those groups, and you could potentially quantify the effect of that lifestyle on energy consumption for a home and hopefully get some sense out of the performance gap in its entirety.

Ben: What conclusions came out of this then, if we haven't mentioned them already?

Helen: One of the main conclusions is that people are a big factor in this and we have to find some way of characterising an occupant's behaviour and using that to amend our predictions of energy performance for a particular home. That's how we potentially close the performance gap in that sense.

Ben: So are you saying that it really is a huge factor?

Helen: The people factor is huge, yes. The people factor is huge. And there are other factors which have a part to play and we should be able to account for those. But the people factor is the most complex

and more difficult to account for and it also seems to have the biggest influence on total energy consumption.

Ben: And I think finally I wanted to ask you about the Passivhaus standard, building to that we're always told that this bridges the performance gap. So how is that?

Helen: So we've seen this manifest itself in the Building Performance Evaluation programme where they collected a lot of data from a number of Passivhaus developments and also a number of non-Passivhaus developments. And what we found was that the performance gap within the Passivhaus subset is much smaller than the performance gap that measured across the wider dataset.

So the measured airtightness was much closer to the airtightness target in the Passivhaus dwellings. The measured U-values were much closer to the target U-values and total energy consumption as well was also much closer to the predicted energy consumption in the Passivhaus dwellings. And all of this hints at a higher quality in the construction of those dwellings.

Ben: And finally then, a wider question not based on research, more of your own opinion. How do you think this is going to play out? Are we going to get to a stage where we eliminate this performance gap?

Helen: I think only when we can link building users into the design process and link building contractors into the in-use phase. Only when we've managed to do that will we be able to eliminate the performance gap.

Ben: Helen, thank you very much.

Helen: Thank you.