HOUSE PLANNING HELP

Episode 64

Should You Expect Overheating in a Passivhaus?

The show notes: www.houseplanninghelp.com/64

Intro: Today's interview is on the topic of overheating. On the whole I think we all associate low energy buildings with having this great indoor environment, with very even heat, comfortable temperature, no cold surfaces. However on occasions it can get a little bit too much and it can overheat. This is not specifically tied to low energy buildings, it can happen to any building.

So we're going to have a chat with Ken Levenson from 475 High Performance Building Supply and I started by asking him for a bit of background about his career.

Ken: Yes, so I'm an architect by training, practising architecture for about 20 years with my own small practice in Brooklyn, New York, for about 10 years. At which point I had started digging around for low carbon building solutions, becoming more and more obsessed with climate change and stumbled upon Passivhaus on the internet and said "well here it is. Here is finally something that is speaking to the proportionate reductions in energy and carbon demand that we require". And so I quickly was very fortunate in being able to convert some clients and convince them to do Passivhauses and essentially the last few projects of my architectural practice were Passivhaus projects.

In doing the projects we found that we were really struggling with some of the materials and with the building supply industry in general. And out of that, working with my business partner Floris Keverling Buisman who is a Dutch trained architect, we realised that these materials existed in Europe and we knew of these companies and we could reach out to them and fill this hole in the marketplace as we saw it existing and growing. So we actually stopped taking architecture jobs and in the process of closing my office, which was essentially closed at this point, and we started 475 as a start-up: basically an e-commerce business, where we import most of our products from Europe and Germany in particular, and distribute them across the US. So we are very focussed on spreading knowledge, providing training, and on-site customer support so it was very exciting.

Ben: How would you describe the Passivhaus movement in America at the moment?

Ken: It's still very much in the nascent phase. It's very much just being born and informing. We see projects from coast to coast. We see growing interest but it is still such a tiny sliver of the market and of the general consciousness. At the same time we are very excited that professional firms, bigger firms and we see now real estate interests and governments, particularly local governments, taking notice so we are very encouraged.

Ben: We want to talk specifically about overheating today, so can we start with how do we define overheating?

Ken: Well Passivhaus is very specific in how it defines acceptable overheating in a technical manner, which is 10% of the hours of the day would be above 25 degrees Centigrade or 77 degrees Fahrenheit, and depending on what your comfort level is that may be overheating or it may not be. It may be overheating at a lower temperature threshold. From a non-technical and a more environmental point of view overheating is going to be where the internal temperature of the building is rising to a point where you have discomfort of the occupants.

Ben: And this has happened throughout history in different buildings?

Ken: Absolutely. It's nothing new or unique to Passivhaus. I think what's unique to Passivhaus is that they're identifying the problem and being sure that you address it successfully. Most of the buildings that I grew up in, in some form or another, or have worked in in the past, overheated in the summertime months, and it can be any combination of things that are causing the overheating to occur.

Ben: Before we get on to the reasons of why they occur, there's no reason why a Passivhaus building should overheat more than a traditionally built building, or would that be wrong?

Ken: In the general sense that is correct. There's absolutely no reason, all things being equal and assuming basic considerations of construction, there's nothing unique to Passivhaus about overheating per se.

Ben: So why do buildings overheat?

Ken: Well what happens could be a combination of a couple of things. One which we readily see is during the day, particularly in the afternoon if we're getting, if it's a hot, warm to hot summer day and you have solar heat gains, uncontrolled solar heat gains. Solar heat gains can warm up a space to extremely uncomfortable temperatures, particularly if you have western exposure and you have that long afternoon sun coming in. So that's one way.

Another way is just from the thermal envelope from an insulation point of view if you have a very hot temperature the heat transfer through the enclosure is going to occur coming into the structure just like it would be in the wintertime going in the other direction from the inside as the heat lost to the outside.

You also have internal heat gains. You know what people may be identifying, or mistaken identity if you will, is we use internal heat gains for the winter months for the heating time of the year to great benefit in a Passivhaus. Now in the summer time when we're worried about overheating the internal heat gains are a huge liability and so we want to be very careful. So by internal heat gains I mean everything from our lights, our electronics. In New York our TV cable boxes are particularly strong heaters. You can practically heat a Passivhaus with your TV cable box. The light fixtures, the cooking, the people, the pets. All of these are generating heat continuously in the enclosure and so you have a heating effect going on which can contribute significantly to overheating if the space is sort of at the borderline of conditions.

Ben: We will have thought about that upfront though, wouldn't we, considering all of those internal gains combined with the solar heat gains? So we wouldn't necessarily be expecting . . . What conditions might it, erm, if we have a party is that what we're thinking? If lots of people suddenly cram in and you've got all the insulation and the airtightness and the mechanical ventilation system or what other strategy you're using just can't cope?

Ken: Right. That's correct. I mean when you're designing a Passivhaus and putting the numbers together in the PHPP, you're accounting for the equipment, for the people, for the lights and with the design in proper balance you should be very much limiting the overheating to "a tolerable level", which again the Passive House Institute's definition for certification is under 10% of the time. Even if you've met that criteria when you do have a party, when you are baking or cooking significantly indoors beyond you know what might be typically be associated, or if you have not closed the blinds or done certain things you could experience overheating.

One of the issues is that built into the PHPP and the design of the Passivhaus to prevent overheating you have certain boxes that you can check where you are saying that you're going to do, you know, night-time cooling, with ventilation flushing the house so the building during the night when it's cooler out, or through opening the windows or by closing external window shades, and this requires typically the occupants to actively do these things. Now, that's all well and good in the PHPP and the design and you're getting the result that you want but in actuality if the occupants aren't behaving per the design and the PHPP they get to be experiencing much greater incidences of overheating. So this is something to consider as the occupants needs may change to be a little bit more robust. We can talk about this in terms of active cooling and how we deal with it to minimise this sort of unintentional overheating.

Ben: Let's take a couple of scenarios now. If you're in a Passivhaus and its overheating more than that 10%, what can you do?

Ken: Well, during the daytime if the temperature outside is hotter than it is indoors you can't really do anything short of turning on air conditioning and actively cooling the space.

Ben: You could somehow shade it externally? That could be a strategy or not are you saying?

Ken: Yeah, well once you're overheating.

Ben: Yeah of course.

Ken: You can't get it back. So certainly to prevent the overheating some basic things that we want to do passively is external shading, whether architectural elements, awnings or trees, landscaping or things like shutters that you could actively close or open. So you really want to block the light and the solar gains on the outside of the building.

Less preferable, but it can have definitely some beneficial effect, is to have window blinds within the building, but it is much less effective than external shading.

You know really important, and this is one of the things we talked about in terms of passive solar strategies in general, although Passivhauses are not passive solar houses per se, it's much easier to control solar heat gain on the southern exposure. You can much

more precisely prevent these direct solar heat gains in the summer time. As we add windows to the east and west facades it becomes much more difficult to control, so it's not to say that you can't have glazing on the east and west, certainly you can, but you'd need to be much more careful about it in terms of external shading.

I definitely had examples of buildings where it's otherwise functioning perfectly well and I know of one example where the family room is facing west. We had these big windows and the trees outside were providing good shading but then the trees got either trimmed or cut down and we had much too great western solar exposure, and that room would overheat in the afternoon and requires the addition of external shading.

Ben: I know that having visited a lot of Passivhauses, occasionally I will hear someone say that the brise soleils that they have there are very effective, obviously in the summer, and in the winter obviously lets all the solar gains in. But there's a period in between where it's not so effective. Now is that what you're saying about if perhaps you're slightly off south, or if you're in the other hemisphere the other way round?

Ken: Yeah, no absolutely. Certainly at different times of year with the orientation you need to be very careful with the sun. Especially if you're being relatively aggressive in using it for your energy balance and solar heat gains to make sure that you are considering the sort of shoulder months between the summer and the winter when it could be particularly unique angles where you're going to get the gains.

In the shoulder months though we can start to look pretty reliably, even in a place like New York, for night-time flushing and what's called free ventilation where you're running an exhaust ventilation without, or you're running the ventilation system without heat exchange and you're bringing in the fresh air at the cooler night-time temperature you're lowering the temperature of the interior environment overnight so that the next day it can take on some heat gains without overheating.

What we find in the summertime in our environment, New York, is that it's often too hot at night. We have times in New York where we can have a week of 38 degrees Celsius, 100 degrees Fahrenheit, and at night-time it's going down to 30 degrees Celsius. There's no relief overnight and you have to have air conditioning to provide relief from the heat.

Ben: Are there any other strategies as an occupant that we should be aware of or have we covered those before we move on?

Ken: Yeah well, no I think we mentioned them indirectly. I think that we really want to be cognisant of the internal heat gains is the big one, so to the extent that we have good indirect daylighting we are keeping the direct solar gains out, but we have nice daylighting and we can keep internal light fixtures off is great. I try to encourage clients to not bake or cook extensively indoors and go use the barbecue in the yard if they have one, and certainly any electronic devices that are running all the time and creating heat. It's much more important to have them shut off in the summertime for comfort reasons than it is in the wintertime when they're actually part of your heating system. So that, you really do need to be more cognisant of that, and if there are these passive systems for providing relief such as exterior shutters or ventilation that has been built into the design of the building you really need to take note of it, and practice per the design or you're going to be uncomfortable.

Ben: And we can never blame the insulation and airtightness for this, can we, because in many ways it should give us that thermal envelope that should be able to shield us from that hot exterior?

Ken: Right. That is true. So it is very much the opposite of what we can blame it on, the lack of insulation or airtightness where you have the heat coming in. It's definitely that is a case of mistaken identity where people feel that this greater insulation level has caused this overheating to occur, where certainly the insulation is. If you have an airtight environment that's well insulated, a Passivhaus, you're going to hold the cooler temperature indoors in short-term extreme heat events, weather events, longer than a typical building. There's just no doubt about that.

There's been many, many examples cited in the United States. One case that comes to mind; a house in Virginia where there was a blackout in the summertime a couple of years ago and the houses around them were all unoccupiable quite quickly after the blackout. And the house, the Passivhaus, in the neighbourhood in Virginia, not only habitable but comfortable for many days. So eventually the temperature is going to rise. Unlike in the wintertime where the passive heat gains are working for you inside and you can achieve an equilibrium without power indefinitely, if not in a very comfortable state, in a safe and usable temperature range. In the summertime it will eventually become quite uncomfortable, if not unliveable, [Ken laughs] depending on how hot it is.

Ben: I've got just a couple more questions and one of them is again down to experience. The places that I have seen overheat generally have been small buildings, so is that just coincidence or if you have a smaller Passivhaus it'll be more likely to overheat?

Ken: I don't know to be honest with you. I have a feeling that it may be . . .

Ben: Because the incidental gains at that point will become more significant, won't they, in a smaller . . .

Ken: Yeah, I mean that certainly intuitively makes sense. I don't know, I don't have any deep reading or learning regarding that difference but it intuitively makes sense.

Ben: Well one more question then. What about climate change? We know that it's starting to make our climate warmer but could we be in for a shock if let's say, not 2 degrees but we end up going 4 degrees more? What will that mean for all these buildings that have almost been programmed to operate at lower temperatures?

Ken: Yeah, well I would say that it was one of the more interesting things from the [International] Passive House Conference in Aachen this spring and at the beginning of the plenary session the IPCC scientist from Budapest, Diana Ürge-Vorsatz, who subsequently gave the opening talk at our New York Passive House Conference because she was so fantastic, made the key observation.

She really drove this home more in New York even than I think she did in Aachen, that our problem at the end of the day is not going to be heating, it's cooling. It's all cooling. [Ben laughs]. And particularly in cities because what they're showing with the research, that's really interesting, is that we all talk about the heat island effect because of the concrete, the materials and such in our urban environments, but a huge factor, and a growing factor, is going to be the effect that we have to air condition to such extreme amounts all of these buildings. As we're air conditioning of course we're removing the heat from the inside and throwing it into the outdoor city environment [Ben laughs].

So all the buildings are heating the cities and I don't know the exact implications but it's certainly the case that at the end of the day it's going to be a huge cooling problem.

And they were saying that the latest IPCC scientific research, was saying that by the middle of this century you know wide swathes of

the United States and Europe you actually won't be able to work outside during the day in the summertime. We're going to have to move to night-time work and then wintertime work and so the overheating is really going to be driving.

It's going to be interesting to see how this evolves. Passivhaus really started from a cold climate heating genesis, beginning, but really what I think will drive the conversation, science, and how we're approaching it is going to be cooling dominated.

In New York we're fortunate the Passivhauses are generally where we're driving down the loads. The Passivhauses are being heated by air-cooled heat pump systems that provide the air conditioning that can also provide the heating, so very simple technology now and can be used in very, quite cold climates. And we see I think, there's a growing realisation, even not just here but globally, that these systems are kind of ideally suited in their ability to provide both heating and cooling and will be flexible going forward to balance this out, so we're excited about that.

Ben: Well Ken, it's been absolutely fantastic to have a chat with you. We always enjoy connecting with different parts of the world and I think you're our first from New York so thank you very much for your time.

Ken: It's been a pleasure.