The Fine Homebuilding Interview

Chris Magwood

This Ontario builder and designer inspires us to see that our homes don't have to be at the expense of the planet

BY AARON FAGAN

Chris Magwood began his building career by constructing his own home, the first permitted straw-bale house in Ontario, in 1996. In 1998, he cofounded Camel's Back Construction, and over eight years helped to design and build more than 30 homes and buildings utilizing sustainable design. Chris recently completed his master's at Trent University, studying carbon-storage potential of the built environment, and his thesis, "Opportunities for Carbon Capture and Storage in Building Materials," was published in April 2019.

An active speaker and workshop instructor in Canada and internationally, Chris is a founder of the Endeavour Centre, a sustainable-building school in Ontario. He has authored numerous books, including *Essential Sustainable Home Design*, *Essential Hempcrete Construction*, and *Making Better Buildings*. Co-editor of the Sustainable Building Essentials series from New Society Publishers, Chris is currently at work on a new book, *Building Beyond Zero: New Ideas for Carbon-Smart Architecture* to be published by Island Press. He is also in the beta-testing phase for a carbon calculator app he developed called BEAM (Building Emissions Accounting for Materials). By inputting the main dimensions of a building, it provides a comprehensive list of possible materials along with the carbon footprint of each option.

AF: I've been told you are the low-carbon rock star.

CM: It's a bit of an oxymoron. I'm not sure those two things go together.

AF: I want to start with some terms that get thrown around. The home-building industry uses "sustainability" the way the food industry uses "organic." By what standard are we saying these things? What is a clear and responsible definition of "sustainability"?

CM: It's hard to pin down. In my practice and what we do at Endeavour, a word like that sits up at the top. We say it, and we use it—but it means so many different things in practice. So, we have developed this 10-point criteria matrix system that we use with our clients that has things like energy efficiency, ecosystem impacts, indoor-environment quality, embodied carbon, and so on. Within each point, we have measurements we can use, but two of those might be high priorities for some clients and not so high for others. Another client may want to knock it out of the park on all of them. In practical terms, how do we measure our results in these given categories? And sustainability—or "green building" or whatever—sits over the top of it.

That gets the conversation started, but then we start getting specific about what it means to the client. If we are talking indoor-environment quality, do you mean no chemicals of concern? Great ventilation? Are you going all the way? In which case, are we meeting the Living Building Challenge and following their Red List? Are we doing what LEED Gold would tell us to do? Or do we not care about that one and we're going to focus our attention and resources in other places?

I think that's how I got into the measurement of embodied carbon. Ten years ago, the climate-change conversation was a loud wake-up call for me. How do we literally measure this? How do I assure a client we are doing the best we possibly can with the project in terms of having the least impact on the climate? It's followed the same pattern as energy-efficiency metrics. Twenty years ago, the thinking was to put a bunch of insulation in the walls, and that will be great. Then more precise measurements and code followed. You could define what the minimum was and determine whether or not you wanted to be 50% better than code or not. We are obsessed with measurement and that is how we define sustainability: How are we doing by measure in many or all of these categories that touch on sustainability.

AF: The measure of embodied carbon is often perceived as a nascent or squishy science or it's entirely ignored. Is there

Drawing: Joe Ciardiello

a standardized system that has been deployed for people to understand what it is and how to measure it?

CM: I think the measurement has become well standardized. There is an ISO standard for environmental product declarations (EPDs) that lays out the criteria and scope for all the materials in a certain category. So, if you are talking about building insulation, the EPD rules are: You measure these things in this way, you total them all together, and you express a carbon footprint per meter squared of insulation at RSI (R-value System International) thermal value of 1—and now this is comparable across different material types. Of all the things we do in this field, embodied carbon has become the most measurable. And that came about in recent years. When I first started looking nearly a decade ago, there were vague little bits of data around, but it's quickly evolved into something that's highly data driven. More and more manufacturers are putting these declarations out. They are third-party verified. It's come very far from just taking someone at their word that something is green. The numbers speak clearly, and there isn't any substantiated debate against the validity of those numbers.

AF: The status quo regarding energy efficiency is that those measures are a poor return on investment. Buying a home is often the single greatest burden of financial risk a person will ever take on. How do we talk about the incentives without it coming across as a luxury belief system?

CM: First of all, we need to stop talking about energy efficiency and start talking about carbon use. Yes, those two things are kind of related, but they don't speak for each other. I can use 100kwh of energy in a house via burning fuel or I can use the same amount of energy coming from my solar panels. It's the same energy, but the carbon footprint is very different. It would be helpful to disassociate those things and talk about carbon-use intensity rather than energy intensity. Then that lends itself to wrapping the material carbon footprint into the same metric. Buildings should just have a carbon budget, which can be set locally or whatever way: Over the next 30 or 50 years, your building can emit this much carbon. We don't care if you address that by using renewables, being energy efficient, or using carbon-storing materials—you figure that part out, but here's the bar. This is the carbon budget you have to spend, go nuts!

AF: What is carbon storage?

CM: Carbon storage is when materials have more carbon in them than was emitted in making them—in the building material itself there's more carbon stored that came out of the atmosphere than was released into the atmosphere when making the material in the first place. What's available now are plant-based materials that accomplish the process by photosynthesis. But there's also lots of work going on with mineralized materials, for example, where people are growing bricks using bacteria or putting waste CO_2 in recycled concrete aggregate (RCA).

> *"The climate should be in better shape when I am done with this building than when I started."*

AF: The embodied carbon of a high-performance home generally exceeds that of a code-built home. It seems like a lot of high-performance materials manufacturers who are heavily reliant on petrochemicals use sustainability as a false flag to keep doing things the way they always have, if not worse.

CM: It's representative of our tendency to fixate on one variable and then go nuts trying to solve that thing and ignore everything else. If energy efficiency is the thing you're pursuing—governments are encouraging you to pursue it, everybody is after that number—then you're ignoring that you bring all sorts of toxic chemicals into the house or are creating this waste or carbon problem. If you just put the blinders on you can make a Passive House, but if we go back to thinking about what "sustainable" means, we need to pay attention to more than one thing. Yes, we want energy-efficient buildings, but we also want healthy buildings, affordable buildings, and carbon-responsible buildings. An approach needs to think about all those things.

I have this concern now that embodied carbon is on people's map that the same thing is going to happen. Somebody will figure out some loophole like if I put 50% wheat straw in my spray foam it's carbon-neutral. But we don't want those chemicals and the weird composite waste at the end. It's important to think about these things holistically. I have spent 20 years trying to build in a way that takes all of these holistic considerations into account, and what I've observed is that the carbon footprint of a material tracks closely to the health and waste impacts of the material. Most of the great carbon-storing materials are very low waste and don't have any toxic chemicals in them. And a lot of them are insulation materials, so you can use them to make your building more energy efficient. I'm concerned that, as the world gets focused on the climate, we will start wreaking all sorts of other havoc. Will we just turn our blinkered attention from one thing to another thing? We need to look at all of these things in a comprehensive way.

AF: Water management is central to modern building science. How do you allay concerns about the health and performance of natural building materials? For example, mold in a straw-bale home.

CM: The field of natural building was started by people trying to address those issues. How do I make a healthy, energy-efficient, airtight building that doesn't adversely affect the health of the people in it? The thing about a lot of the carbon-storing building approaches that gets missed is that from a building science point of view, these materials are great. Joe Lstiburek rethought his "Perfect Wall" a while ago and started to muse that maybe a completely vapor-open wall assembly is actually the perfect wall. That's exactly what we're building. If it's a straw-bale house, it's vapor-permeable because you've got plaster on both sides and this straw in the middle that can take on vast amounts of moisture without turning it into liquid water, but

you can also have a double-stud wall with dense-pack cellulose, a smart vapor barrier, wood fiberboard on the outside, and a breathable WRB— it's the same thing.

Natural building materials are way less likely to mold, because when there is water or humidity in them, the material has a huge capacity to absorb, distribute, and then release moisture to the inside, the outside, or both—depending on the conditions—and dry itself out. That's way better than a bunch of water stuck behind 2 in. of XPS, OSB, a 6-mil. poly vapor barrier, and mineral insulation, which has no moisture-storage capacity whatsoever.

AF: Drainage is a feature, not a flaw.

CM: Exactly. These aren't the drawbacks of this way of building, these are the *benefits*. These materials are demonstrably resilient against the things that everybody thinks are their Achilles heel. I think that's true not just of straw-bale building, but of things like hempcrete. If you are building in that vapor-open, airtight way, that to me is just the best thing you could be doing. Whether or not you care about the carbon, chemical loading, or any of those others things, it just makes good sense to approach it that way.

Builders still tend to think, "I am capable of putting up these barriers and the water won't get in." Won't? The water *will* get in. So why don't we design systems that don't invite it in, but when it gets in, they have some potential to handle it and let it go. You don't even have to call it natural building. Just let building science do the talking. That's the way that we should be approaching these assemblies.

AF: It's amazing how many engineered materials do not appear to prioritize how buildings truly behave in nature.

CM: I think it's that blinders thing. You have so many assemblies and so many components within those assemblies, all designed by engineers concerned with the task at hand. For example, we test insulation for its fire resistance and its R-value as a piece of insulation in a box by itself.

AF: And now you've tested insulation in a box, not insulation in a house.

CM: Exactly. We don't know what the actual, effective R-value of a wall assembly is. We know what the insulation does when there is no moving air around, when the temperature is one degree different on one side than the other for a static 24-hour period. Great! That means nothing.

We see things in these very blinkered pieces, and it's rare when we stand back and ask how it works as a whole. It's taken us a long time to realize that there are a lot of consequences to putting all those different pieces together. It's only in the last ten years that we have started to think about

> *"We need to stop talking about energy efficiency and start talking about carbon use."*

it, and even then it's broken into categories. There are people who focus just on indoor-air quality. Others focus just on airtightness and energy efficiency. How about looking at how all those things relate to and impact each other? We're getting there, but it has been a very disassociated process.

AF: Systems thinking is complex. Even if you think through every detail forward and backward, it still would be dealing in concepts of averages, and not tailored to each individual homeowner.

CM: People are in these buildings, and people are weird and have all kinds of random things that they do. They turn the heat up really high and open the windows. They hose down their floor instead of mopping. We don't even have good methodologies for considering the range of human behavior. We base these things all on averages. Not a single human being actually does what the average thing is in their building.

AF: What are your basic priorities when you first think of a building and what branches off of that?

CM: Honestly, even though I've told you how metrics-driven I am, the first thing that comes to mind as a designer is the feel of the space. I want whoever is going to be in that space to say, "Yes!" And that means it is doing everything they hoped it would do. It's meeting all the very human concerns that are so hard to quantify.

Baked into that, the climate is my top priority—that doesn't trump those human concerns, but I have to build that human space in a climate-responsible way. And for me, that's not a "do less harm" way, that's an "actually do good" way. The climate should be in better shape when I am done with this building than when I started. I think a whole bunch of things fall out from that. Part of making that space great for the people in it is that it's not hurting them.

AF: There is not a lot that people have to do differently to build in a low-carbon way. It is about making better choices.

CM: I enjoy talking to builders and developers, and data really helps. There is a large developer in the Toronto area, and I did a carbon analysis of their current building and showed them the four hot spots where their carbon footprint was really high. I said, here are the things you could replace this with to make a huge difference in your carbon footprint, and they looked around the table and said, "Yeah. OK." I think as people see the data and see where those easy moves are, it tends to speak for itself. Seeing that uptake with people is exciting because it is straightforward.

AF: Any last thoughts?

CM: I'm a longtime reader of *Fine Homebuilding*, so I'm the audience. For so long it has been about the craft of doing this work. It celebrates the doer of these things as much as the end product. As a builder, I want to have that level of craftsmanship and pride in my work. Part of the craft now is doing that work without wrecking the climate or creating uncomfortable and unhealthy spaces to live in. That is the pinnacle we should be reaching for. What could be better than combining that lofty goals of combating climate change with a physical trade where you leave your mark on the world with what you've built? □

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