

“We need a disruptive change in the building industry within the next ten years”

STEPHAN BIRK, ARCHITECT, TU MUNICH



Stephan Birk at his architectural office in Stuttgart

From dwellings to airports, from offices to bridges—the world is building more and more every year. How can we find a way to improve people’s lives by erecting more sustainable structures? Materials scientist and concrete advocate Karen Scrivener joins architect and timber expert Stephan Birk to discuss possible paths towards climate friendly solutions.

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As we speak, the world of architecture is convening in Venice for the Biennale. One theme in many of this year’s exhibits and presentations is the question of how to reduce the environmental footprint of buildings. Today, construction accounts for 38 percent of man-made CO₂ emissions. Professor Scrivener, do we need to build less?

SCRIVENER I’m afraid that is a discussion people have in their comfortable little bubble here in Europe or in North America. And it’s not helpful at all. There are plenty of issues in the industrial world that we should address. For example, the living area per person, which is going up exponentially. We are selfishly devouring resources. But we can’t then just turn around and say the world needs to build less. That doesn’t account for millions and millions of people in Africa and elsewhere who don’t yet have a decent place to live. They need to build to better their lives. And they have a right to do so.



Karen Scrivener at the Ecole Polytechnique Fédérale in Lausanne

“A disruptive change may be desirable. I just think we have to be realistic”

KAREN SCRIVENER, MATERIALS SCIENTIST, EPF LAUSANNE

Should we then at least ditch concrete, which alone is responsible for eight percent of humanity’s carbon footprint?

SCRIVENER No, of course not. For one thing, concrete is a low CO₂ material. The intrinsic CO₂ content per ton for concrete is ten times lower than that of steel or bricks and one hundred times lower than that of plastic. Yes, cement is carbon-intensive. But cement is just a small component in the final concrete mix. The reason it comes to these eight percent is because concrete makes up such an enormous amount of what we consume. And that’s, indirectly, a result of population growth. People need housing. That is why 90 percent of concrete consumption happens outside of the rich OECD countries, in places where cities are exploding.

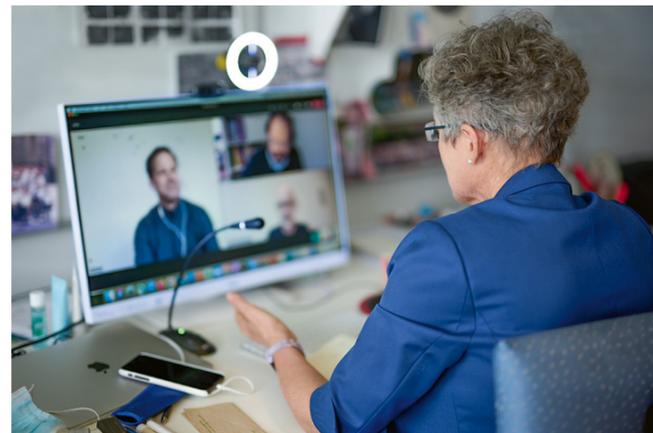
So are we doomed to destroy the planet with what we build, Professor Birk?

BIRK I agree with Karen that in a global context the question can’t be whether we need to build less. But we do need a discussion about how we can optimize the use of resources in the world. The building sector accounts for 30 to 60 percent of energy consumption, material consumption, and greenhouse gas emissions. We have to change that drastically. And that requires a turnaround as soon as possible. That’s where I have to fundamentally disagree with my colleague: We do need a disruptive change in the building industry within the next ten years because otherwise it’s too late.

SCRIVENER We surely need to optimize resources and minimize CO₂. This is what I’m working on. A disruptive change may be desirable. I just think we have to be realistic. It all comes down to a matter of physics and of the resources we have available on Earth. →



Karen Scrivener, 62, is the head of the Laboratory of Construction Materials and a full Professor at the Ecole Polytechnique Fédérale de Lausanne (EPFL) in Switzerland. She graduated from the Cambridge University in Material Sciences and earned her PhD in Materials Science from the Imperial College London, where she worked until 1995 as a post-doctoral research assistant and lecturer. From 1995 till 2001 she worked at Lafarge, the French manufacturer of cement, aggregates, and concrete. In collaboration with other universities, institutions, and companies she developed Limestone Calcined Clay Cement (LC3), a new type of low-carbon cement



98 percent of the Earth's crust is made up of just eight elements. Cement uses four of them—in a way that can't be beaten.

Why has concrete or cement become so popular?

SCRIVENER It's an incredibly useful material: You can transport cement anywhere in the world as a powder and then mix it with sand, rocks, and water to produce a block of concrete that sets and hardens. Anybody can do it. And because it's so cheap the use of cement and concrete has grown rapidly worldwide. It has been a major contributor to lifting many millions of people out of poverty. And we need to continue this because people need a chance to lead a dignified life. Otherwise, they will migrate.

Could the use of more wood instead of concrete be part of the solution?

SCRIVENER We need all the materials we have on Earth. As far as timber is concerned, it is absolutely fine if we can grow that sustainably. But the timber we're using today is mostly not sustainable. If we wanted to replace just one quarter of concrete with timber we would have to plant new forests one and a half times the size of India.

BIRK Let's grow more forests sustainably and let's increase the number of buildings made of natural materials such as timber. But after all, it is not a question of using just one or the other. It is only important to use them in the most efficient way possible. For example, we do a lot of timber construction combined

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with concrete in ceilings. Just looking at Switzerland, Austria, Germany, and Scandinavia for a moment, we see that timber can be good for one third to even half of all buildings. We have to increase that share wherever we can. The more concrete we substitute for timber, the better. We also have to bring knowledge about sustainable forestry to other parts of the world in order to change the building industry there as well—at least to a certain degree.

SCRIVENER That's incredibly naive! I've worked a lot in India, where they actually set up a building institute to look for substitutes for wood because they don't have the land area. Using local wood may work in Sweden, which has a tiny population of less than ten million people but an awful lot of land area that can be forested.

BIRK Using timber is not naive. It can be a part of the solution to lower the carbon emissions of the building sector. And by the way, there is potential for sustainable forestry in other parts of the world, surely, if you look at China, Russia, Brazil, and East Africa.

SCRIVENER Then let's use all the timber we can grow sustainably. It has many virtues, no doubt. And as you said, let's stop spending time saying that we should use one or the other. We really have to look at what's the most efficient building material available. And the fact of the matter is that concrete makes up more than all of the other materials put together. If you want to tackle the problem of CO₂ emissions from construction, you need to address the situation of concrete.

What, then, can we do to lower concrete's carbon footprint?

SCRIVENER We don't have to come up with some magical ideas. Most of the emissions from concrete come from the breakdown of limestone into calcium oxide and CO₂. Many people suggest using something else

instead of limestone. But there is nothing that can replace it altogether—at least nothing that is available in the quantities we need. But we can substitute parts of the limestone with calcined clay. That's something we developed in our laboratories here in Lausanne: Our LC3 cement can reduce CO₂ emissions by 40 percent.

That's impressive, but far from climate-neutral, which is what the cement industry is aiming for by 2050.

SCRIVENER LC3 is not the end of the story. We need to look along the value chain. The share of cement in concrete can easily be lowered by at least 20 percent. Then you need to look at the concrete in the buildings, which again can easily be reduced by 20 percent and probably more. Some buildings are using two to three times as much concrete as others for the same floor area. So clearly, work needs to be done in just minimizing the amount of material used. It will take a combination of efforts to reach net zero by 2050.

BIRK That's too little too late. The cement industry is responsible for coming up with a solution more quickly. What we're seeing is simply not good enough.

SCRIVENER We surely need to go faster. That's why I'm trying to convince the industry to use our new cement, which, by the way, is even cheaper to make.

Why is that such a hard sell?

SCRIVENER Well, it takes time. There's the huge question of norms and standards put in place for buildings to ensure safety. And of course this makes it really difficult to bring these innovations to the field. All the major cement producers are convinced. But we have to realize that the top ten companies only make up about 30 percent of the world market. So we have to get out there and address the smaller manufacturers in Africa and Asia to achieve the impact we need to have. →

“Timber can be part of the solution to lower the carbon emissions of the building sector”

STEPHAN BIRK

Many of those large companies have plans to capture and store CO₂ from their plants. Can this so-called CCS technology help on a larger scale?

BIRK I think we have to look at various options to fight the climate crisis. Capturing CO₂ can be part of the solution. Otherwise, it will hardly be possible to get to net zero. But CCS is still a contentious issue.

SCRIVENER Capturing CO₂ and putting it underground is far from easy. I think it has to be a last resort. With substitutions and other measures we can achieve reductions of over 70 or 80 percent overall. Technologies aren't the problem, it's their implementation.

We're talking a lot about building materials. Shouldn't we also rethink how we design and use buildings—and what happens to them afterwards?

BIRK Exactly. We need to ask how long we can keep buildings in use regardless of whether they are built from timber, concrete, clay or bricks. We as architects and engineers have to come up with better ways to design and to construct buildings in the age of the climate crisis. New digital tools are helping a lot with what we've talked about—optimizing the use of materials etc. In the building sector we need to follow the principals of the circular economy. Today, we're tearing down buildings from the 1980s or 1990s because they don't meet our standards anymore. The ceilings are too low, or the technical equipment doesn't fit anymore. We have to think about what we do with the buildings after their first cycle of use in order to prevent them from being demolished.

Does concrete fit in with a circular economy?

SCRIVENER It's perfectly recyclable: You can crush it up and the aggregates can then be reused in new concrete. In fact, you can even take the fine material back to a cement factory and turn it into new cement. Many countries in Europe already recycle concrete to a high extent. However, we have to be aware that in many parts of the world there's still a lot of first-time construction going on. Furthermore, because concrete is so cheap, you end up spending more on transporting and recycling it than you would producing it afresh.

How can governments set the right incentives to improve sustainability in construction?

BIRK Several countries in Europe, for example, require an energy efficiency rating for most buildings. Today, these certificates mainly focus on the energy consumption during the use period. You could give any building a CO₂ budget that is good for the construction phase, including all used materials, for the time you're using it and beyond that, when it comes to demolishing the building. The use of secondary recycled resources could be made tax-exempt. Again, at the moment that may only work in Europe and North America, but I think it's a good start.

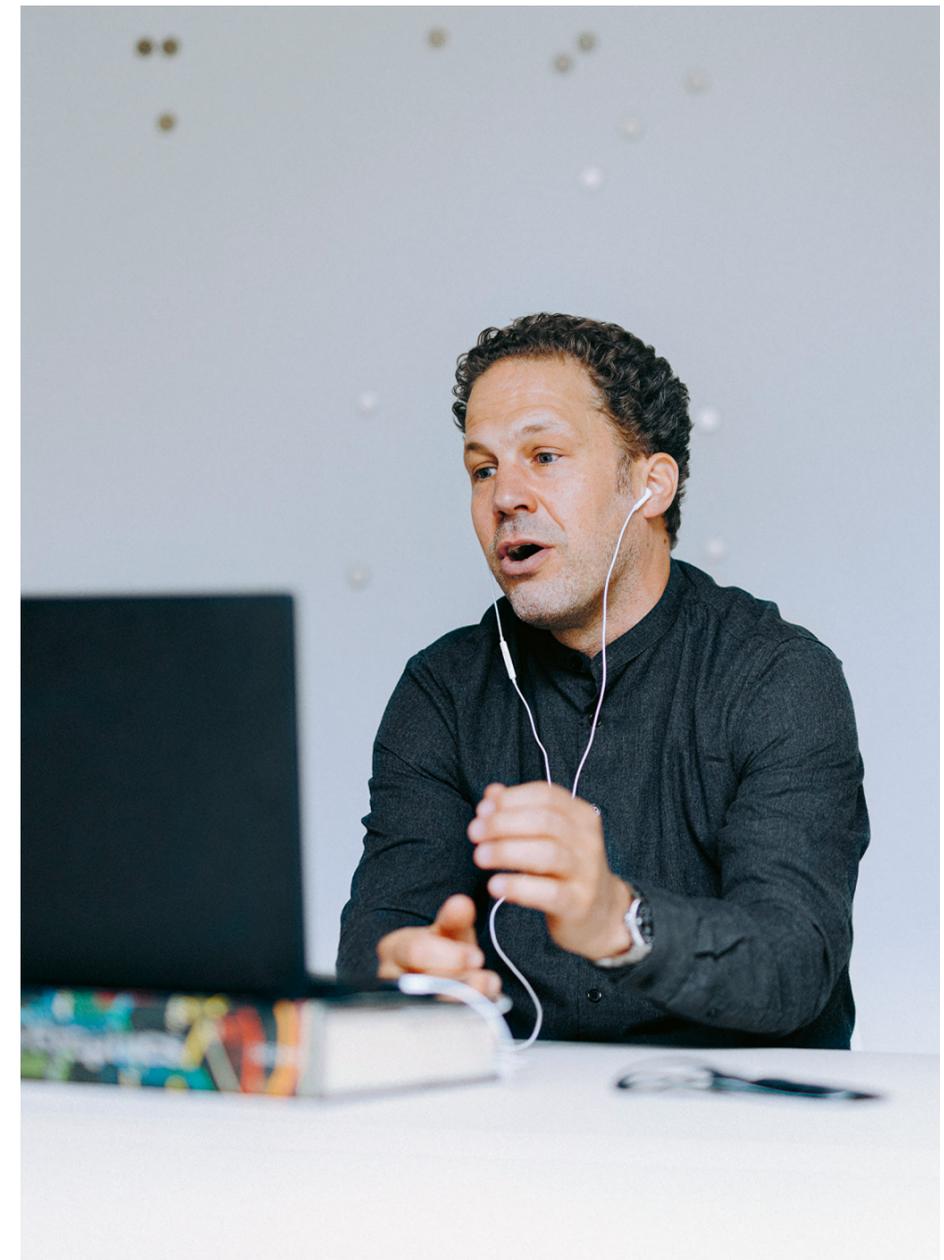
China currently uses more concrete than the rest of the world combined. What can we do to get the Chinese on board?

SCRIVENER My impression is that the government there is just as committed as the European Union. It's been a long time coming, but the country is now moving ahead of pace. But China has already done most of its construction; its consumption of cement is actually going down. We have to anticipate the next China. In India, per capita consumption of cement is four or five times lower than in China. That is where we've got to focus. And we need to get in there before people start building on a large scale. We also have to look at Africa. But because Africa is not one but fifty-five countries it makes it even more time-consuming to engage with all of them.

How can rich countries, whose share of global construction is shrinking, still have a positive impact and be better allies of those countries?

BIRK We have to share our knowledge so others don't make the same mistakes that we did. I see lots of buildings in parts of the world which don't suit their environment at all. Think of glass office buildings in the middle of a desert with an extremely high energy need for air conditioning. There's also a lot of knowledge in Europe about how to build a sustainable forest industry that can be useful elsewhere. And we have to share innovations in the area of more climate-friendly cement with these countries as well.

Stephan Birk, 46, was appointed Professor of Architecture and Timber Construction at the Technical University of Munich (TUM) in April 2021, where he is part of the research group Tum.wood. He is a founding partner of the Stuttgart-based architectural office Birk Heilmeyer und Frenzel Architekten. Birk has been engaged in teaching and research since 2007. In the last six years, he has led the Department of Building Construction and Design at the Technical University of Kaiserslautern and jointly established the research area T-Lab Timber Architecture and Wood Materials with Professor Jürgen Graf



SCRIVENER What is equally important is the use of local resources. You don't have that much limestone in Africa. Clinker often has to be imported. You also have issues with low-quality construction. We have seen some very sad cases of buildings collapsing because people are replacing cement with stuff that doesn't react at all. We need to bring in materials that can be produced locally at a reasonable price—and that are sustainable at the same time.

In Venice, the discussion about the future of architecture will continue until November. What's your vision for how we'll build and live tomorrow?

BIRK We need to be more in balance with the environ-

ment on every level, not only in the building industry. It may be a European view, but we have distanced ourselves from what's important and we have to find a more balanced approach towards consumption.

SCRIVENER It's great to have visions. But how do we realize them? We spend too much time talking in our nice offices in Europe. Instead, we need to spend more time thinking about how we can really do something in those places where cities are exploding.

BIRK That's true. But we also serve as role models. Whether that's good or bad, people still look at what we're doing in Europe. Fixing the mistakes we've made and helping others not repeat them is a good start. If we make a change, others will follow. —