Interview with Dr Rob Wolfs, 2024 RILEM Colonnetti medallist

Dr Rob Wolfs is Assistant Professor in the Built Environment Department of the Eindhoven University of Technology (TU/e), the Netherlands. He was member of the RILEM Technical Committee (TC) 276-DFC "Digital fabrication with cement-based materials", and co-author of the STAR produced by this TC. He is currently a TC member of 303-PFC "Performance requirements and testing of fresh printable cement-based materials", 304-ADC "Assessment of Additively Manufactured Concrete Materials and Structures" and DCS "Data-driven concrete science". Dr Wolfs received this medal for his high-level scientific research achievements in the field of novel digital technologies to design structures with higher efficiency and lower environmental impact. Dr Wolfs will be a key-note speaker at the 2024 RILEM Spring Convention, in Milan, Italy, presenting "The status quo of 3D concrete printing: are we there yet?".

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Daniela Ciancio, RILEM Implementation Manager (RIM): Congratulations for this medal, Rob! I would like to start with the same question that I have posed to all the medallists I interviewed so far: when and how you joined RILEM?

Dr Rob Wolfs (Rob): I joined RILEM in 2019, by the end of my PhD, but I had been involved in RILEM before that. The first time I really got in touch with RILEM, I think it was around 2017. There was an international workshop at ETH Zürich (*editor's note: International RILEM Workshop "Digital Fabrication with Concrete", on 13 Jan 2017*), on digital fabrication; digital fabrication is an umbrella term to encompass many robotic technologies for construction, like 3D concrete printing, which was the topic of my PhD research at that time. When we visited that workshop, we realized that "we really have to start joining the technical committee meetings that are affiliated to this group of people that organised the workshop!" (*editor's note: RILEM TC 276-DFC : Digital fabrication with cement-based materials*). So, I think I was involved from that moment onwards. When we were reaching the finalisation of the Technical Committee and when the state-of-the-art report was supposed to be written, I think also for a matter of authorship, it was important that we were members, so we could also be listed as authors (*editor's note: please see "RILEM TC membership and authorship" here*); from that moment on, I became formally a member and I kept it up to today; there was also a shift from finishing my PhD to my current position, so I felt that I wanted to be a member.

RIM: 2015 was the end of your master's degree in 3D printing concrete; we are in 2024 and you're still working on this topic. What was this topic nine years ago and where do you think it is going?

Rob: I think this is exactly the question that I will try to answer, or at least elaborate on, during my key-lecture in Milan. It's been nine years - or actually even 10 - because in 2015 I completed my

master's degree, that means that for almost one year I had been performing a first research on this topic. I was trained as a structural engineer and I was looking for an innovative topic with some new technologies and then, sort of accidentally, 3D printing came to my path. It was through some brainstorm meetings with my supervisor at that time, Professor Theo Salet; we were certainly not the first, but there were only quite a few people, some pioneers actually, across the globe who had been working on 3D concrete printing, but the technology hadn't really taken off yet. It received relatively little attention both in industry and in academia, until, I think, about 10 years ago when some first large scale applications started to appear. This attracted global press attention, with news headlines like: "you can print your house in one day and it only costs €1000!"; and obviously that gave 3D concrete printing much more exposure. At the same time, well, if you look a bit deeper into these statements, you see that there are a lot of things not yet clear or maybe not as strong as these headlines might imply. Realising that 3D concrete printing had a great potential in terms of increased productivity or reduced environmental impact we started to focus on this technology, targeting the barriers or challenges which were limiting its full potential for our construction industry.

RIM: Compared to other technologies that aim to reduce the carbon footprint of the built environment, this one seems to be a technique that is quickly moving from the research phase into the commercialization status.

Rob: That's absolutely true! But at the same time, I think we should be critical that while we are on an exponential growth curve, we are not moving in the wrong direction, that we're not making decisions or investments that might make sense now or can be used to attract attention, maybe to attract funding, but on the long run might harm us. Many of the printable material compositions, for instance, have a relatively high cement content; we make the claim that we can reduce the amount of material by 3D printing which is true, we don't need any formwork, we can make optimised structures, but at the same time the materials that we use have a higher impact and that is something that should be addressed. We also see these very large houses or structures being printed with very big printers, which look very fascinating, but at the same time, this means we are making monolithic structures and in an era of circularity, reusability, this seems to be contradicting. I think we have passed the phase where the novelty has worn off. We are now able to explain the basic principles of 3D printing, but the technology really has to mature, and that means we have to be in full control of *what* and *how* we print. This will require a lot of attention in the next years, from academia, industry and governments.

RIM: Where do you see yourself in 10 or 20 years?

Rob: It's a question I sometimes think about as well, and I find it very difficult to answer. What I do like and what I have been doing in the past ten years is looking for innovative, new technologies that I can apply in my field, which have a high potential for the built environment. I think that is something that sparks my enthusiasm, like the way I can collaborate with other people from different fields. It wouldn't surprise me if 10 years from now I'm still involved in research - but maybe not on 3D concrete printing only, maybe on some different technology or even a completely different material.

RIM: Your background is in structural engineering; you built a large-scale 3D printer, so you have skills in robotics too. I assume also that you know about concrete rheology and chemistry too. Do you find the time to sleep at night?

Rob: Sometimes (laughs)! Well, the nice thing about this topic is that it's very interdisciplinary. I'm not saying that I'm the expert on all the things that you just mentioned, but indeed you have to understand these different topics to be able to make something meaningful out of it. I had to dive into many topics that were not taught to me in my education, but it was a very interesting journey. I learned a lot from it, and that also means I can communicate with many different people from many fields and collaborate with them, which is a part of my career which I appreciate a lot.

RIM: You teach a course in "3D printing and digital design and manufacturing" at TU/e, and students really like that! Is it common to have such a course in a university nowadays?

Rob: I think it's relatively new, but I see more and more universities shaping new type of master tracks or educational programmes around the topic of digitalization for construction. I designed this course thinking "what can new digital technologies mean for their future field of employment?".

RIM: Do you think it is a skill for the future generation of engineers? Employers will ask graduates to have this in their curriculum?

Rob: This is a question that is also often raised at conferences or at industry events: is the future engineer going to be a programmer, a data scientist, or somebody that knows structural mechanics? I think in the end the core knowledge will still be needed, because even though there are many promising digital technologies, spanning from parametric modelling to machine learning and AI, if you don't understand the domain knowledge behind it, then you cannot use these tools in the right way, you cannot interpret their outputs and make sure that what you design and produce is actually safe. I think it's a set of skills that students can use to their benefits, but it shouldn't be the only thing or their main focus. It should really be an additional skill.

RIM: Just one last question that I always ask: was this your first time to apply for the medal?

Rob: No, it actually wasn't. I realised that when I applied for the first time I was quite young; it was quite shortly after my PhD project. I think my track record was still quite limited. I just kept building upon my record over the past few years and in parallel I kept applying, and now eventually it was successful, so I think that's appreciation. And maybe also a sort of a signal that even though initially it doesn't work out, which also sometimes happens when you apply for research grants, just keep improving and give it another shot!

RIM: Very wise words, Rob! Thank you for this interview. I look forward to meeting you in Milan in a couple of weeks for the award ceremony and your lecture!

Rob: Thanks!