

WE ARE ETH – Episode 36

With Mariana Popescu, Architect and Assistant Professor at the Technical University in Delft

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[00:00:00] Mariana Popescu: It's a structure that we built in Mexico city back in 2018 and it was meant to demonstrate how we could use a fabric formwork as a solution for concrete technology, so to cast concrete into, and it's of course then

[00:00:18] Susan Kish: Wait, wait, wait, wait. Let me just make sure I understand this. You wanted to make sure if you could use fabric to cast concrete?

[00:00:27] Mariana Popescu: Correct as a mold for concrete.

[00:00:29] Susan Kish: That's wild. In this episode, I'm talking with Mariana Popescu, ETH alumni in architecture who does computational design and fabrication as an assistant professor at the Technical University in Delft. This is the We Are ETH podcast, and I'm Susan Kish, your host. Mariana, every time I looked you up on

Google, I read about the Knit Candela project. Can you tell us about this project, because it sounds just fascinating, in addition to being beautiful.

[00:01:07] **Mariana Popescu:** Thank you, Susan, for having me. It's really a pleasure to be here. So the Knit Candela project was, let's say, the final demonstrator for my PhD that I did with the Block Research Group at ETH. It's a structure that we built in Mexico City back in 2018, and it was meant to demonstrate how we could use fabric formwork as a solution for concrete technology, so to cast concrete into, and it's of

[00:01:32] **Susan Kish:** Wait, wait, wait, wait, wait, wait. Let me just make sure I understand this. You wanted to make sure if you could use fabric to cast concrete?

[00:01:41] **Mariana Popescu:** Correct as a mold for concrete.

[00:01:44] **Susan Kish:** That's wild. Because usually it's wood or something, right? Or what do they traditionally use for casts?

[00:01:50] **Mariana Popescu:** Traditionally, you'd have timber or milled foam, especially when it comes to, to complex geometries. So the idea there was to look at complex geometries.

[00:02:00] **Susan Kish:** I see and fabric being very flexible would be a really interesting mold.

[00:02:05] **Mariana Popescu:** Exactly. (Susan: Fascinating)

[00:02:06] **Susan Kish:** Okay, I can see that, I think. All right. Sorry, please go ahead.

[00:02:11] **Mariana Popescu:** All good that's actually what my PhD was a little bit about, how we could use knitted textiles for this and the idea behind it is that usually when we do use timber or milled foam for complex geometries, that creates a lot of waste, we also use that mold only a single time, it happens to be heavy, difficult to put up.

Fabric is a possible alternative. I've not been the only one to do anything with a textile in that sense, right? There is a history of it happening for the better part of a hundred years, where different people have actually tried this out, but mostly with woven fabrics. And the idea was to go towards knitted fabrics because they can be manufactured with very specific local properties.

So you can control the manufacturing process to create 3D geometry instead of cutting it and sewing it and putting it together like you would any other piece of textile into geometry.

[00:03:06] **Susan Kish:** (Things you knit) can have shapes like a hat or a scarf or, oh, that's cool. All right so you've built three dimensions into it as opposed to fabric, which is flat by inherently. (Mariana: Yeah.) Okay, neat. So the line I kept reading was that you brought it to Mexico from Switzerland in a suitcase.

[00:03:24] **Mariana Popescu:** Two suitcases to be exact, but that is correct. Two suitcases because we couldn't exceed the 23 kilo limit and we had 25 kilos of textile and that was also a little bit of a way to show how lightweight you can do this, right? You can take it wherever you want quite easy to transport and lightweight in that sense.

[00:03:44] **Susan Kish:** And it was actually constructed, right? This wasn't just a thesis in a book, this was built.

[00:03:50] **Mariana Popescu:** This was built in the courtyard of a museum, the Muang. Which is the university museum, actually, in Mexico city and in one of its courtyards, we built the structure which was roughly four meters by four meters in plan and six in height or the other way around six and six and four, now I have to look for it in my head, but yes, roughly a bounding box of four by four by six.

[00:04:13] **Susan Kish:** That's big. So how many tons of concrete were poured around these 25 kilograms of knitted fabric?

[00:04:23] **Mariana Popescu:** In the end it carried about five tons, but it wasn't just the fabric that carried this. The fabric needed some cable nets to hold it up and those cable nets also weighed about 30 kilos, so I'd say 55 carried five tons.

[00:04:37] **Susan Kish:** That feels like there was a lot of computation behind it and modeling.

[00:04:41] **Mariana Popescu:** Well there's a lot in terms of structural design, which of course I don't do on my own, right? I was part of a group and there were other people who have a lot of, a lot of expertise in this that could also, that could also help but my focus, let's say, on the design side was on how to get that textile into the right shape and how to translate a given geometry into instructions for a machine to produce the textile in the right geometry that would stretch to the right size and would, and would have the features that we wanted to have so that it would carry the concrete.

[00:05:12] **Susan Kish:** Now, is this a specially designed knitting machine, or did you already, were you able to buy one off the shelf, so to speak?

[00:05:18] **Mariana Popescu:** Half and half, for all intents and purposes, it's off the shelf, so these machines exist. Knitting machines exist and manufacturers exist. We got a machine from Steiger, which is a Swiss company with a few modifications. So we, we tweaked maybe which types of needles we have, what gauge of a machine,

what the spacing between the beds are, things like this, getting an additional mechanism to carry something down, but for all intents and purposes off the shelf.

[00:05:47] **Susan Kish:** I have to say, this sounds in many ways like the ultimate Swiss project, because you were at the ETH, right? Switzerland has a history of being a world leader in knitting and sewing machines and embroidery machines since the 15th century and there are big guys like Holcim who are a global player in cement, also based in Switzerland.

[00:06:11] **Mariana Popescu:** I would agree. It is in very many ways, uniquely Swiss in other ways, I would also say it is something that can be, that can be applied elsewhere as well. So I think that's the, I think that's the, maybe the power of, maybe of Itaha, maybe of Switzerland, or of being able to produce very good solutions in different areas, but that are not short sighted to only being applicable to the Swiss environment.

[00:06:37] **Susan Kish:** Was being at the Antija a sort of part of the secret sauce of making this all come together?

[00:06:42] **Mariana Popescu:** Absolutely, there's no doubt about that. I think ETH is a wonderful place to be.

[00:06:47] **Susan Kish:** I read about a project you did in Rome in 22, so it sounds like you've been able to apply this unique combination of fabric as a three dimensional complicated frame for concrete. Do you see this being repeated many times? Do you see it as coming to scale and really Changing the way that we build things.

[00:07:09] **Mariana Popescu:** That's a very good question. Actually, one that I wrestle with more often so this is also for myself because I would like it to come to scale but of course, you always need to go through several stages of development before that happens. So the project we did in Rome, we did in 2022 and it was, let's say a similar setup that we took inspiration from a master builder.

This time from Pierluigi Nervi. The ambition was to bring it a little bit closer to what is recognizable to the industry. In the sense that it had, I would say, a geometry that is maybe more recognizable to the, to the construction industry maybe also one that has, let's say more, let's say controlled profiles, because it, it had this triangular profile, so very clean edges and, and so on.

If you think of a prism, it has Again, these kind of very clear rigid edges, which the knit candela didn't have, for example. So if in knit candela we needed some frames on the outside to hang those cables into before you could cast the concrete, uh, and then those frames could be taken away, uh, what we tried to do is also eliminate those kinds of frames so that it would be completely reusable parts.

So you have essentially no waste at all. That was the ambition with the project.

[00:08:23] **Susan Kish:** It is fascinating because it sounds like to do this effectively, you know, thank heavens your background is as an architect. So you think in three dimensions, you have to deal with material science, because you have to think through different kinds of concrete and different kinds of fabric and tensile, whatever you call it, strength and you have to be comfortable with modeling, right?

Even if you don't do it all yourself, you have to be pretty comfortable with it. You have to have a, aesthetic, because both structures, when I saw the pictures of them are, they're beautiful, they're breathtaking, right? They're really unique. So it sounds like you, you studied architecture at Delft for undergraduate and master's, and then you came to the ETH.

Why did you pick the ETH to go to, to continue your studies?

[00:09:14] **Mariana Popescu:** That's a funny one. Sometimes the easy answer is life takes you that way, but I'd say I could go through all of the steps of why, but I worked for a company actually first so I worked in Amsterdam. So it wasn't a sort of, I've been at this university and I want to change and go to a different university to continue.

It was more of a, I took a break, I went to industry and I decided I wanted to do a PhD. ETH.

[00:09:37] **Susan Kish:** and Jansma, the (architecture firm)

[00:09:39] **Mariana Popescu:** Yeah, that's correct. Yes, and at the time they were actually collaborating with BRG, I

[00:09:44] **Susan Kish:** And BRG stands for the Block Research Group?

[00:09:47] **Mariana Popescu:** Yes, that's correct.

[00:09:49] **Susan Kish:** What is the Block Research Group?

[00:09:50] **Mariana Popescu:** Oh, so the Block Research Group is a group in ITA, in the Institute of Technology and Architecture (at ETH)

[00:09:55] **Susan Kish:** Mm hmm.

[00:09:57] **Mariana Popescu:** And the architecture department, and it's the group led by Philip Block.

It, it focuses quite a lot on on structural design in a smart way so how we could use inspirations, getting inspired by the past to create a better future, I would say, and I'm paraphrasing this to really use a good structural principles to have good structural

form and that good structural form uses less material, um, and is a little bit more efficient and effective in general.

And those forms happen to be complex and they happen to be difficult to make and let's say that's where I found my niche.

[00:10:31] **Susan Kish:** Very, very cool. Once you're at the ETH, how did you decide upon this topic of your thesis? What was the other work that you did, and what was the atmosphere like in the architecture school, and at BRG? I should be more specific.

[00:10:44] **Mariana Popescu:** I think coming up with the topic was not something that happened, oh, I arrived and here it is and this is what it is, it kind of was a process probably of about three months. But I think I think it's highly, let's say, inspired by a few things. First, by the background, or the things that I found interesting, but second also by what was happening at the BRG at the time, right?

The BRG was busy with building complex structures and was also working on a fabric formwork. These things were somehow happening there, so you see them, you draw inspiration from that, so it's a little bit of a back and forth between what you find interesting or what I've personally found interesting, what my background or skills allowed me to do, and this kind of conversation with and seeing what's going on in within a particular group.

So I think I don't think this would have happened on its own without being in that group. Then the fact that people were like, yeah, sure, try it with knitting. Let's do this. I think that's great, because very often maybe others would have been like, look, I think that's a silly idea, also, we don't have a knitting machine and third, I don't knit and I think that this kind of environment of being quite inquisitive and asking rather, let's say tough questions about relevance, but at the same time having an openness to, okay, let's try the different idea is how I would, how I would describe it.

[00:12:11] **Susan Kish:** And now, of course, you know what my next question is going to be, which is, do you knit?

[00:12:16] **Mariana Popescu:** That depends with a machine I always do, by hand, never. I didn't knit before this, so I had never knit by hand, not never, I'm sure I gave it a try every now and then, but no, I would, as in I've never made myself anything, not even a hat or a scarf, by hand but I gladly knit with a machine. I'll get the machine to do whatever, very happily.

[00:12:38] **Susan Kish:** The other related question then is, do you know how to program? Did you have to learn how to code?

[00:12:43] **Mariana Popescu:** Uh, no, I knew how to code and this was part of both my education in Delft and, and then just all of the projects, also where I worked in Amsterdam, I was hired as a parametric design specialist. So my job was to, to try to

do computational design for them to solve geometrical problems actually for their more complex project.

[00:13:03] **Susan Kish:** Parametric design? What is that? Other than two complicated words that I wouldn't usually put together.

[00:13:10] **Mariana Popescu:** Uh, it's actually not all that complicated or that special parametric, and I prefer to call it computational design, but that was the title of my position so let's that's why I call it. But it just refers to being designing algorithms taking into account parameters rather than top down. So if I'll give you an example and say a square, I'd like to draw a square and that's my design, you could draw a square and say, okay, I'm going to draw now something that is five by five or you could say my square is defined by the fact that it has four edges of equal size, and I can change that size variably, so those are the variables or the parameters. So it just means setting up your design in a way that is a level of abstraction higher than, than a very fixed design.

[00:14:03] **Susan Kish:** Can you tell me in what you do today as an assistant professor at Delft? And I'm sure doing lots of research.

[00:14:10] **Mariana Popescu:** What I do now is I'm, I'm trying to set up a group that's mostly focused on fabrication, right? Um, we have a knitting machine here now as well, so we keep doing knitting projects. Um, so it's a lot of fun, but it's also difficult at times and I think ETH did prepare me for that. First, because of the let's say the program I was in. So this meant that we did need to collaborate and we did need to, um, let's say juggle more than just your little bubble of I'm working on this and I don't need to bother with anything. You did need to place yourself within a broader context you did need to understand how to work with other disciplines, that managing and curating of different aspects and seeing how that works did prepare me for this.

But other than that, you're never prepared. You're always thrown in at the deep end and you learn.

[00:15:02] **Susan Kish:** And do you still stay in touch with folks from the ETH? And do you still work with them?

[00:15:07] **Mariana Popescu:** The, the structure in Rome, the Nitnervi, is something that, uh, we did together, so it started out as a block research group project, then I moved to Delft, and then it became a block research group plus Delft project.

[00:15:19] **Susan Kish:** Understood. And congratulations. What great projects, really fun and interesting, and feel like they have the potential to really impact architecture, construction, fabrication, in ways we, we can't foresee quite yet. So I'd like to, Mariana, to close by asking a few questions that we always ask our guests, if that's okay.

When you were a little girl, what did you want to be when you grow up?

[00:15:45] **Mariana Popescu:** Somewhere around 16, I said I wanted to study physics, and then I had a conversation with my dad, and I don't remember exactly along which lines that went, but I came out thinking, yeah, maybe architecture. So this is, I think this is the, um, I don't know.

[00:16:00] **Susan Kish:** That's a pivot.

[00:16:01] **Mariana Popescu:** That's a pivot, but, but I, I returned, so my family is a family of engineers.

So I'm the black sheep because I went to architecture. I'm not the black sheep, but now I'm back in the civil engineering department, so I'm allowed back into the family.

[00:16:13] **Susan Kish:** What sparked your curiosity? What are you learning about today? Because there is a lot changing in fabrication and materials and architecture and construction. What captures your curiosity?

[00:16:25] **Mariana Popescu:** Well, um, this is a little bit zoomed in, but what kept, and maybe, uh, a little bit easy to say because it's the, it's, It's what everybody talks about today, but it's quite difficult to understand for us to really understand how all of these materials work. Yes, we can create very complex materials and we can have quite a lot of control of over how we make them, but we also want to create that link to how they perform and the more complicated they are, the more difficult they are to understand on how they perform and specifically how AI might help us do that actually.

But that's from a professional point of view and a very zoomed in one at that. I would say otherwise I prefer to, to read a lot, a little bit more on the social sciences side of things and how our society is shaped and how different people have a place in it. I read a lot of feminist books to, to say so.

[00:17:16] **Susan Kish:** And Mariana, you've set it up perfectly, because my next question is, what books are you reading?

[00:17:22] **Mariana Popescu:** Oh really

[00:17:22] **Susan Kish:** Yep, absolutely.

[00:17:24] **Mariana Popescu:** I have a funny, um, uh, habit now to read, uh, several books at the same time because they're nonfiction, so to keep me, um, um, going, I was in the process of reading, um, Hyperfocus and the other book is called Bitch, but maybe it's not the one to mention for this even though I really, which is, I love the book so I don't, and I'm not ashamed of the title. I'm just saying. So those are the two books that I'm reading in parallel right now.

[00:17:57] **Susan Kish:** Mariana, thank you so much. That was a great conversation, and I will not look at knitting in quite the same way or construction in quite the same way.

[00:18:05] **Mariana Popescu:** It was really fun talking to you.

[00:18:07] **Susan Kish:** I'm Susan Kish, host of the We Are ETH series, telling the stories of the alumni and friends of the ETH Zurich, the Swiss Federal Institute of Technology.

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