

The Hidden Geometry of the
Architecture of Herzog & de Meuron
Digital Tools and Design Practice

Alexandra Castro

D
2023



The Hidden Geometry of the
Architecture of Herzog & de Meuron
Digital Tools and Design Practice

Alexandra Castro



***The Hidden Geometry of the
Architecture of Herzog & de Meuron***
Digital Tools and Design Practice

Presented by

Alexandra Castro

Supervised by

Prof. Dr João Pedro Xavier

Prof. Dr José Miguel Rodrigues

Dr Kai Strehlke

Faculdade de Arquitectura da Universidade do Porto (FAUP)

Programa de Doutoramento em Arquitectura (PDA)

November 2023

C.2
Kai Strehlke



A.02

Kai Strehlke.

Head of the Digital Technologies Group at HdM from 2005 to 2015.

“I would choose Tate Modern.”

Conversation with Kai Strehlke

Zurich HB train station, Zurich, August 7, 2019.

Alexandra Castro (AC): I showed Steffen Riegas the diagram in which you related the drawing methods used in the office and the projects' geometric complexity.

In the opinion of Steffen, this curve is going down. He thinks that there was a time when the geometric complexity of the buildings was higher, but around 2012–2013 it started decreasing, maybe due to the crisis.

Kai Strehlke (KS): I think there's a difference between the office and the world.

You have a different kind of architect who is looking for their own style, and I think that HdM never really wanted to have their own style. However, in some moments they investigated ornamentation more, and in others they went away from it. I have the idea that in this later period ornamentation is not so present in their architecture any more.

AC: I agree with you. I also think it has more to do with HdM's research interest in ornament, which is very clear between 2000 and 2010. However, it began much earlier. In the first years of their career this is visible, for instance, in the imprints on the glass, concrete or polycarbonate.

When you joined the office in 2005, HdM were investigating this topic from a three-dimensional approach. Digital tools allowed them to go further.

KS: Yes, Ciudad del Flamenco is a good example for this. Their research interest was the study of Arabic calligraphy as well as tags from street art and their implementation in architecture.

AC: Afterwards, I think that there's a turning point in their research, because from 2010 the buildings' overall shape became simpler and more essential.

KS: I agree with you. Maybe it also has to do with the kind of projects they have. Like Roche, for example, when they worked on the double helix. The double helix project was very beautiful because you had, in one direction, a very steep helix, and in the other a very shallow one. The intersection

between the two helices always occurred at 90 degrees in different positions. This allowed there to be a meeting point, like a cafeteria, that was looking at the landscape at different heights. There was a lot of thinking in this building, and I suppose they were also quite happy with it, but in this case, it did not fit the client. The client, Roche, has a completely different mind. They are very structured.

AC: Swiss!

KS: Yes, it's also that! When you look at Roche and compare it to Novartis, Novartis filled the campus with many different architectures. They have Gehry doing this egg inside the campus. The mentality of Novartis is completely different from Roche.

AC: Roche has had its architectural style since the fifties, with these black and white stripes.

KS: This particular architecture is very much driven by the client.

AC: Do you think that HdM would have been happy if the first Roche building had been built?

KS: Yes. At that moment, it was a surprise that the client rejected the project. We had to stop, and start with a completely new project.

AC: The "Digital Technology" group is now called "Design Technologies". HdM consider that nowadays everything is digital, so they wanted to focus on the design issues rather than the digital. They have three main areas of expertise: 1- Project delivery, which includes CAD and BIM management, scripting and geometric support; 2- Digital workshop and fabrication; and 3- Visualisation and VR.

KS: A little bit different from my time. We had five departments, and for me, geometric support, scripting and parametric design were quite important, because, at that time, the projects had some relevant geometrical issues. It was important to understand the geometry, the design and how you can do things more simply.

In Messe Basel, for example, this wall is a hyperbolic paraboloid. You have a ruled surface, but when you offset it you get to a double-curved surface. It's strange, but it's like this. So, for a long time, the construction behind was a double-curved surface. Then I came and said, "Listen, this does not make sense at all. We should make this as simple as possible. We'll make a ruled surface on one side, and then a second ruled surface on the other one." The geometric consequence is that the horizontal distance between the two surfaces varies. This distance is bridged with steel elements which are laser cut. So we put the geometric complexity into these elements and scripted them. In all these projects, there were always issues related to geometry in which it was essential to understand what is important for the design and what are the simplest rules you can follow to produce them. For me, this was the most important task in the department.

AC: Steffen told me that Revit was used for the first time in the office in around 2004, in the Roche Building 97.

KS: Revit was used a lot of times while I was there. We did sixteen projects with Revit, but they all had some particularities. Leonard Street, for example, was a project done in Revit. There they worked mainly on the outer facade with Revit. There were buildings where it was very successful, but I think it was because of the team and how they were using it.

It was different in Roche Building 97. In this project, there was a young architect who had never worked with Revit. He didn't come from the scripting side, and the office asked him to do this building with Revit. In the end, he was the only one who was working, and, for him, it wasn't easy.

AC: I suppose that now, in the office, the majority of the projects are done with Revit. Steffen showed me this diagram which also shows the relationship between hand-drawing, CAD and BIM, but scripting is not mentioned. I believe that for Steffen, scripting does not have the same importance as for you. It is a tool used as a complement to Rhino, to draw in a faster way. On the contrary, for him, BIM is quite important.

KS: I was always very sceptical about BIM. Nowadays I'm working in a timber construction company, so I'm happy when we have good models. We work with CadWork, a software for wooden structures, in which we have everything. It's a kind of BIM model. You have all the parts, with the additional information about the materials, numbering, textures associated to every part of the building; how these are assembled, the groups, the sub-groups, the order of construction. Everything is in this model. What we have is exactly a BIM model. We use this a lot, but when we work with Revit models, we still get extremely creepy information. So, my point is that people often believe that a BIM model is precise per se, and that you get all the data by just clicking a button. In my time, there were many projects, for example, where you had a very complicated staircase that you just implemented as a 3D model. After, when you tried to take the data out of it, like how much concrete you need, the weights, you didn't have it because the staircase was not modelled with the BIM software.

For the Kinderspital and these buildings, we had BIM teams. However, I didn't have this impression that BIM was the most efficient way of doing things. Models became extremely big, extremely heavy, and I wonder if all this complexity needs always to be there all the time.

At the New North Zealand Hospital, in the very first stage, they had to deliver a Revit plan, but there was also a lot of scripting to find and foster the main design idea. The beautiful thing about this building is the spirit that is inside. You have a first level which is super complex, with all the surgery rooms, and then you have one roof on top of it, which is a beautiful garden. All the patients who are at the border of the building, they can look out on one side into the landscape and on the other side into a park. People don't have the impression of being in a hospital. These are beautiful design ideas. For this, you don't need a Revit model. It's not the Revit model that helps you with this. We were supporting that design process with small scripting tools.

AC: *I would like to talk with you about the case study for my PhD. I would like to take only one building as the main case study, even if, when I analyse it, I will certainly relate it to other buildings. However, I should choose just one building.*

In my opinion, it should be from 2005 onwards. It should be a building that stands out as an exceptional architectural example in which digital tools were fundamental in solving geometric problems, but also in which we may find those most trivial questions of architecture. For example, a building that is iconic but also contextual, and at the same time, paradigmatic of the possibilities opened up by technology. I also think that it should be built.

Do you want to suggest any? Looking at this map, I can tell you which buildings I find more interesting: the Elbphilharmonie, Jinhua Structure, Tate Modern 2, Actelion, Blavatnik School, Stadium of Bordeaux, Stamford Bridge.

KS: What is going to be the title of your PhD? You should know. I was in a conference with John Fraser, and he said that when someone is doing a PhD, he should have the title in mind and be able to describe it in two sentences.

AC: *I have my question, "What changed in the architecture of Herzog & de Meuron from the moment they introduced digital tools into their design process?" My keywords are geometry, architecture and digital tools.*

KS: I know what I would take! I would choose Tate Modern.

I would take this one for several reasons. It's a building in which they became very famous. There's a relationship in their work between something they have purely done by hand and something they have done with the computer's support. Tate Modern 2 is very much scripted, and from a geometrical point of view it is something where they really played with the geometry. When you look at the bricks, there's a lot of investigation of how to use them. There's always this relation between the old and the new, and from a material point of view, it is interesting how they used brick. It's also very decorative because there's a concrete building behind, so it's a very visual facade. You have points in which the bricks intersect that look very strange. Some people find it interesting, some people find it amazing, some people ugly, but it has a position, and, at the same time, you have a very architectural material. You also have other similar situations where they used brick, cutting out the windows directly in the traditional brick wall. I think this is an amazing building.

Elbphilharmonie is an exceptional building, but it's unique. Tate, instead, is a building that is giving much more food to relate to, to investigate. And it is an interesting case for the use of digital technology—not BIM, not other stuff, but the use of scripting and geometry tools. For example, Stamford Bridge is a building where they also tried to use this kind of brick appearance, but it's so far away. For me, this is a very strange building. When I was in the office, I complained a lot, saying the columns look like laminate. They are so thin.

AC: *Something, I suppose, that is complex in this building is the stairs.*

KS: Yes, the complete circulation system.

Tate Modern 2 is also a contextual building. It sits in an area where another building is located made of the same material but with a completely different system. I think it will give you a lot of food.

AC: *Okay, it's done! I accept your suggestion. With my supervisors, for a while, we thought it could be interesting to choose a building with the two phases, analogue and digital, and Tate Modern came to my mind. Tate Modern 1 comes from hand drawing and 2D CAD, and its architectonic language is clearly related to their initial projects. In the same complex, on the south, there's Tate Modern 2, which has been developed with digital tools.*

KS: I didn't look at it before, but when you explained the kind of building that interested you, I immediately thought about this one. You can also relate it to Ricola because of how things appear on the facade, this kind of layering. I think that when you consider some parts of it, you can connect it to other buildings.

AC: *If I asked you, "would it have been possible to design and construct this building if you didn't have the digital technologies?" what would you answer?*

KS: I was in Mannheim seeing the Multihalle by Frei Otto. If you constructed this building today, you would say that you can only do it digitally. I think everything is possible in different ways. For me, the digital tools we have are just tools. They help you to be faster, to interact with a design team and to support a design process, to test things, and understand geometrical issues. Yes, you could have also done it without, but these tools existed, they were used, and they were part of the design and part of the story. But I believe a lot of things are possible, even with no digital tools.

AC: *And what about the Elbphilharmonie?*

KS: Maybe there are some parts of the building, like the frit pattern, that you could not do without them. For that, you definitely needed digital tools. When you look at the roof cladding which has been used, you need to script it. This is too complex. But if you don't script them, what would you do then? You would do bigger circles and smaller circles. Then you would randomly place the bigger circles, and the smaller ones, you would have placed them in-between. So there's always a manual answer to achieve similar results. It might not look exactly like this, but I'm sure you would be able to find easier ways to think about things differently.

In Tate 2, we worked on geometry, but we also worked on the colour of the bricks, which was a very interesting task. When you burn a brick, you can add air or take the air away during the cooling process. When you put more air into the fire, you burn the brick, and it becomes darker. You have the possibility with the same clay to get a variety of shades and colours. In the beginning, when I scripted it, they wanted to have a smooth gradient of colours on the facade. Each stone had its own colour. But then we realised that we could not construct a building and say the stone there should be a little lighter than the other one. We went to the company that produced the bricks and looked at the different colours they could provide. When they burn bricks, they take them out of the oven and burn another bunch of bricks. They take them again out of the oven, and

they don't have exactly the same colour, so they mix them. From a production point of view, we did not change anything. We took a horizontal band of the building in which we decided to have the bricks burnt very high in five bunches, two not so dark, and we mixed them. I mixed them also in the script, and you saw how it would look afterwards. It was not important to define the exact colour of each brick. We just wanted to define the mix. Then, higher on the building, we changed the colour of it again. So it was understanding the production system, understanding the construction, understanding the design possibilities of it, and then using scripts to test it, design it, define it, and so on. For me, that was a beautiful task. In total we have fifty-four different kinds of bricks. We have straight bricks, inclined bricks. We have the anti-climbing system, which is a kind of gradient where the bricks start to be placed a little bit inside and then they are taken off. There are a lot of geometrical issues happening in the facade, which were included in the script. I was super happy working on this, and when you stand in front of the building, you see everything. You see all these kinds of geometrical solutions. Because of the twisting it became quite complicated.

There's also another interesting aspect. The building is very ornamental. The facade's texture is something you can compare to other buildings from the office.

In the Schaulager, for example, you have a windowsill, which looks very strange. It is very ornamental, and they designed it using a can. They squeezed a can, took clay, and rolled the can into the clay. This was the design method for the windowsill. At the Schaulager it was a very manual design method producing an ornament. In contradiction to the Schaulager, the ornamentation of the Tate results from the application of digital computer scripts.

AC: In a monograph of HdM, the detail of these windows is described as "digital landscape, calculated forms produced with digitally controlled tools", and there's a picture of this surface designed by the computer.

KS: But this was drawn manually, and the original idea behind it is the can. I think the can is also in the archive. The initial idea came from manual work.

It's the same for the Elbphilharmonie. In the beginning, for the sala, they made a lot of foam models, some of which you can see in the archive. When you look at these models, they are not sophisticated. They are just catching the idea. It's not about making a beautiful model, it's about capturing the design idea and finding a translation in the world using models, drawings, sketches to understand it, and this is extremely manual.

AC: Before you joined the office, were they working with digital modelling?

KS: Yes. I had a student when I was at the ETHZ, Volker Helm. He went to HdM, and I think he was the one who was doing a lot of 3D modelling at the beginning. With him, Rhino was introduced into the office.

AC: When did this happen? Do you remember?

KS: I would say 2003–2004.

AC: *I found out that around 2000, in these projects for Prada, HdM worked with Urs Roth, a geometric engineer from Zurich. They asked him to develop an aperiodic pattern for the facade of one of these buildings. Maybe their idea was to have a random composition that was geometrically controlled. If, at that time, they already had the scripting, they would probably have used it instead.*

KS: Yes! I think an interesting point about Jacques and Pierre is that they never neglect anything. There are architects, like Peter Zumthor, who often neglects technology and doesn't want to have anything to do with it. And I think this is a fascinating point about Herzog & de Meuron. They are always interested in good architecture, and they don't care how, why and who. They are incredibly open to working with artists, biologists, scientists. They are not chasing the hype, and they are not trying to jump behind important things that other people are doing. They try to do their signature and their architecture. Still, they are incredibly willing to create connections with other people in different fields of knowledge, like in the Kunsthau at Aarau, where they worked with biologists. They were working on the stone, and tried to generate the green colour of the building only with moss. They did a lot of tests in the office where they had stones with water. They tried to understand how the stone should be in order to grow the moss, but in the end, the building was too much in the sun, and it didn't work.

AC: *In the archive, do you suggest that I look at anything in particular about Tate Modern 2?*

KS: I don't know exactly what is in the archive about this building. We did many brick models, very big brick models, but I'm sure that they did not archive all of them because they were too big. You know that you archive what you can archive!

The best thing to do is to follow the buildings along the path. If possible, you don't stop and walk once in the whole archive. One thing that strikes me is when you look at the first years, where you see that there are like two, three, four, five models. Then, when you come to these buildings after 2005, there are massive amounts of models. When you continue, you see fewer models again. This happens because we had the digital machines, the CNC technology, which pushed the models incredibly. Around 2006–2007 there's a lot of models. So, when you walk along these shelves, in the beginning, you can see one year, two years, per shelf, then you continue, and you see, oh, it's not a year, it's like one week, another week, another week. This is an interesting point.

Then, I think it is interesting to look at how they catch architectural ideas with these models. These models are not beautiful, but they are about catching the design idea.

If you work on Tate 2, I would try to look at the models of this building and then, of course, at all the brick buildings, especially the Tate Modern 1, to compare how many models they have done. The Tate Modern extension is interesting because of the context, and it is interesting because of the material, because of how the brick is used. And I think there are lots of different levels of analysing it and looking at it.

END